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# Completion Report for the Underground Storage Tanks Source Removal Project


September 23, 1996
Volume 1

**COMPLETION REPORT for the UNDERGROUND STORAGE TANK (UST) SOURCE REMOVAL PROJECT**

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## LIST OF ACRONYMS

| | |
|---|---|
| AAP | Accelerated Action Plan |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| CDPHE | Colorado Department of Health and Environment |
| CLP | Contract Laboratory Program |
| DOE | Department of Energy |
| DQOs | Data Quality Objectives |
| EPA | Environmental Protection Agency |
| IAG | Inter-Agency Agreement |
| ICPES | Inductively Coupled Plasma Emission Spectroscopy |
| OPWL | Original Process Waste Lines |
| OU | Operable Unit |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RFI/RI | RCRA Facility Investigation/Remedial Investigation |
| TAL | Target Analyte List |
| UST | Underground Storage Tank |
| VOCs | Volatile Organic Compounds |

# 1.0 INTRODUCTION

This report presents results of the Inter-Agency Agreement (IAG) Underground Storage Tank (UST) Source Removal Project at the Department of Energy (DOE) Rocky Flats Environmental Technology Site (RFETS). The IAG UST Source Removal Project consisted of accelerated remedial actions to remove residual liquids and sludge from six underground storage tanks. These six tanks are Tanks T-2, T-3, T-10, T-14, T-16, and T-40. Locations of these tanks are illustrated on Figure 1-1.

The IAG USTs were selected for accelerated remedial actions based upon potential risk to human health and the environment. The risk analysis for the six tanks was performed using results from samples collected in support of *Technical Memorandum No. 1, Addendum to Phase I RFI/RI Work plan, Operable Unit 9, Original Process Waste Lines* (DOE, 1994).

The IAG UST Source Removal Project remedial actions were completed by September 30, 1996. This report documents the completion of the remedial actions and presents results of the sampling activities required to verify completion of the remedial actions.

## 1.1 SUMMARY OF ACCELERATED ACTIONS

The scope of the accelerated activities is derived from the *Accelerated Action Plan for the Inter-Agency Agreement Underground Storage Tanks Containing RCRA-Regulated Materials* (AAP) (DOE, 1995a). The AAP was approved by the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE) (Appendix A), and describes the general accelerated actions intended to reduce potential risks posed by the tanks. As outlined in the AAP, the actions performed on all six tanks included the following:

- Removal of existing tank contents (i.e., liquid and sludge);
- Rinsing of the tanks to remove any gross contamination;
- Sampling and laboratory analysis of the rinsate to document the extent of any contamination remaining in the tanks;
- Managing and treating liquid contents and rinsates on-site at RFETS facilities, and managing sludges on-site pending appropriate offsite disposition;

- Filling the tanks with an inert closed-cell foam (polyurethane) to stabilize potential residual contamination, prevent groundwater and surface water infiltration, and preserve tank integrity. This action was conducted in compliance with the *Proposed Action Memorandum for the Contaminant Stabilization of Underground Storage Tanks* (DOE, 1996).

## 1.2 DESCRIPTION OF IAG TANKS

The six IAG USTs are located within what was formerly known as Operable Unit (OU) 9, Original Process Waste Lines (OPWL). The IAG USTs were part of the OPWL network of tanks and underground pipelines utilized at RFETS to transport and temporarily store process wastes. The six IAG underground storage tanks are described in detail in the AAP (DOE, 1995a). A brief description of each IAG tank installation is presented below.

### 1.2.1 Tank Group T-2 and T-3

The T-2/T-3 tank installation adjacent to the south wall of Building 441 consists of an underlying holding tank and overhead chambers, a limestone bed, and wet well. These tanks were formerly used to receive waste streams from Building 122 (Medical Facility), Building 123 (Health Physics Laboratory), and Building 441 (Analytical Laboratory). Waste streams received by the tanks included acids, bases, solvents, radionuclides, metals, thiocyanate, ethylene glycol, polychlorinated biphenyls (PCBs), bleach, soap, and hydrogen peroxide.

The northern-most extent of the system contains the wet well and limestone bed (neutralization tank). The internal dimensions are 12 feet by 6 feet by 6 feet deep. In 1966, a south wing was added onto Building 441 for additional office space (DOE, 1992), covering the northern-most tank location. Because the northern-most tank is now located beneath Building 441 and is inaccessible, it was not included as part of the IAG UST Source Removal Project scope.

The remaining T-2/T-3 system consists of a 6,000-gallon holding tank with internal dimensions of 12 feet by 13 feet 4 inches by 7.5 feet deep. The holding tank is located outside of the Building 441 foundation and is overlain by three enclosed concrete chambers. The southern-most chamber contains the holding tank discharge control valve and a manway for accessing the holding tank. The northern-most chamber previously housed two material transfer pumps, which lifted neutralized liquid contained in the holding tank to the center head chamber. Each of the three concrete chambers has access manways with steel cover plates.

### 1.2.3 Tank Group T-14 and T-16

The T-14 and T-16 tanks are located adjacent to the east side of Building 774 - Process Waste Treatment Facility. Tank T-14, which is designated by RFETS as Tank 68, consists of one 30,000-gallon concrete underground holding tank. T-16 consists of two 14,000-gallon underground concrete holding tanks. The northern-most T-16 tank, which will be referred to as T-16 (north), is designated by RFETS as Tank 66. The southern-most tank, T-16 (south), is designated by RFETS as Tank 67.

Tank T-14 is 16 feet wide, 28 feet 10 inches long, and 10 feet 3 inches deep on the inside. Inner dimensions of T-16 (north) and T-16 (south) are as follows: 20 feet long, 10 feet wide, and 10 feet 2 inches deep. Both T-16 tanks and Tank T-14 are overlain by a concrete slab and accessed through 24-inch diameter manways. Tank T-14 and Tanks T-16 (north) and T-16 (south) received treated transuranic aqueous mixed waste streams from the Process Waste Treatment Facility (Building 774) (Rockwell, 1989). These wastes included acids, bases, radionuclides, metals, and other wastes from RFETS processes.

### 1.2.4 Tank T-10

Tank T-10 consists of two 4,500-gallon concrete underground tanks with the dimensions of 15 feet by 5 feet by 10 feet deep. The T-10 tanks are located inside Building 730 adjacent to Tank T-9 (two, 22,500-gallon underground concrete tanks). The T-9 tanks are currently active and are not part of the IAG UST Source Removal Project scope. The central portions of the T-10 tanks are overlain by a concrete vault which contains the discharge pumps and valve manifold, and four manways for each of the T-9 and T-10 tanks. The vault dimensions are 15 feet by 20 feet by 8 feet deep. The four manways are fitted with 4-foot by 4-foot steel covers.

Tanks T-10 and T-9 received on-site laundry waste from Building 778 (DOE, 1994). Tank T-9 was converted to plenum deluge tanks for Building 776 (Process Waste Pit) in 1984.

## 2.0 TANK INVENTORY REMOVAL

This section presents a summary of the quantity of residual liquid and sludge removed from the IAG tanks. Volumes of rinse water used in cleaning each tank is also provided. Table 2-1 summarizes this information.

### 2.1 TANK GROUP T-2 AND T-3

Approximately 15,000 gallons of beginning liquid inventory was removed from the T-2/T-3 underground holding tank and three concrete chambers. Approximately 750 gallons of water was added during liquid removal. In addition, an influx of groundwater was detected during liquid removal from the underground tank in February, March, and April 1996 (totaling approximately 1,043 gallons) which was also removed. The liquid encountered inside the overlying chambers likely originated from groundwater infiltration and precipitation/surface water runoff into the three chamber manways. Approximately 500 gallons of sludge was removed from the holding tank.

Based on water level measurements taken prior to liquid removal (in February 1996) and engineering drawings of the T-2/T-3 tank system, the total liquid volume inside the T-2/T-3 tank system (estimated 15,000 gallons), including the neutralization tank, wet well, and holding tank as described in Subsection 1.2.1, exceeded the total tank system capacity (estimated to be 12,000 gallons). This difference in volume indicates the tank system was receiving groundwater.

### 2.2 TANK T-40

Approximately 2,600 gallons of liquid were initially pumped from the Tank T-40. This total volume includes the volume of liquid contained in the valve vault (estimated 35 gallons) as well as approximately 30 gallons of rinse water added to the tank during the rinsing operations. Prior to content removal, both T-40 tanks were filled with liquid, and approximately 1-inch of liquid covered the overlying vault floor. The liquid encountered inside the two underground storage tanks and inside the valve vault likely originated from groundwater infiltration into the tanks and/or vault. Prior to filing the T-40 tanks with foam in July 1996, an additional 500 gallons of liquid was pumped from the north T-40 tank. This liquid most probably originated from groundwater influx into the tank.

Approximately 115 gallons of sludge was removed from the north T-40 tank. Approximately 85 gallons of sludge was removed from the south tank. Including an estimated 100 gallons of rinse water used to mobilize the sludges, 300 gallons of residual sludge and rinse water were removed from the T-40 tanks.

## Table 2-1
## IAG Tank Inventories
(Gallons)

| Tank | Beginning Inventory | | Intitial Rinse Water | Groundwater Influx | Total Initial Liquid | Sludge Mobilization- | Total Sludge | Total Volume |
|---|---|---|---|---|---|---|---|---|
| | Liquid | Sludge | Added (Estimated) | (Estimated) | Removed (Estimated) | Water Added | Removed | Removed(1) |
| T-2/T-3 | 15,000 | 500 | 750 | 1,043 | 16,793 | 250 | 750 | 17,543 |
| T-40 | 2,570 | 200 | 30 | 500 | 3,100 | 100 | 300 | 3,400 |
| T-14 | 1,150 | 2,300 | 0 | 0 | 1,150 | 2,830 | 5,130 | 6,280 |
| T-16 (north) | 1,000 | 1,000 | 200 | 0 | 1,200 | 1,800 | 2,800 | 4,000 |
| T-16 (south) | 1,745 | 1,000 | 150 | 0 | 1,895 | 1,275 | 2,275 | 5,670(2) |
| T-10 (east) | 0 | 75 | 0 | 0 | 0 | 1,000 | 1,075 | 1,075 |
| T-10 (west) | 1,100 | 25 | 0 | 0 | 1,100 | 1,300 | 1,325 | 2,425 |

1 Total Volume Removed = (Total Initial Liquid Removed + Total Sudge Removed)
2 Includes additional 1,500 gallons of water added to remove Tank T-10 contents

## 2.3 TANK GROUP T-14 AND T-16

Approximately 1,150 gallons of liquid was pumped from Tank T-14. An estimated 2,300 gallons of sludge was removed from Tank T-14 using approximately 2,830 gallons of rinse water. No influx of groundwater was detected during content removal from Tank T-14.

Tank T-16 (north) and Tank T-16 (south) contained approximately 1,000 gallons and 1,745 gallons of liquid, respectively. Approximately 1,000 gallons of sludge was measured in both T-16 (north) and T-16 (south). In Tank T-16 (north) an estimated 200 gallons of water was added during liquid removal, and approximately 1,800 gallons of water was added to remove sludge.

An estimated 150 gallons of water was added during initial liquid removal in Tank T-16 (south). Approximately 1,275 gallons of water was added to aid in removing sludge from T-16 (south). Following the content removal from T-16 (south), liquids and sludges removed from Tank T-10 were transferred via pipeline to T-16 (south). The T-10 liquids/sludges were then pumped from T-16 (south) into Building 774, as discussed in Subsection 4.1. Subsequently, an additional 1,500 gallons of water was added to Tank T-16 (south) to remove rinse water and sludge from Tank T-10 and perform the final tank rinsing. No influx of groundwater was detected in Tank T-16 (north) or T-16 (south).

## 2.4 TANK T-10

No liquid was observed inside the east T-10 tank. An estimated 75 gallons of dry sediment was removed from the east T-10 tank. The west T-10 tank contained approximately 1,100 gallons of liquid and approximately 25 gallons of sludge. Liquids and sludges removed from the T-10 tanks were pumped into Tank T-16 (south) for handling as mentioned above. No influx of groundwater was observed in the T-10 tanks.

## 3.0 TANK RINSING AND SAMPLING

All residual liquids and sludges were removed from each of the IAG USTs. Following removal of the liquids and sludges from each tank, the tank interior was rinsed three times, in compliance with the AAP, to remove any gross contamination remaining in the tank. A sample of the rinse water was collected from the tank for analytical screening purposes after each rinse. These screening rinsate samples were submitted for quick turnaround to an on-site laboratory for analysis of gross alpha and gross beta activities, (Inductively Coupled Plasma Emission Spectroscopy) ICPES metals including mercury, volatile organic compounds (VOCs), and water quality parameters (pH and conductivity). Table 3-1 summarizes the analyses performed on the rinsate screening samples and the analytical methods used.

An additional sample from the third rinsate water was collected for comprehensive analysis to determine the quality of the final rinsate in each tank, and to document the extent of contamination remaining in the tank. The results of this final rinsate sample may be useful when considering final tank closure alternatives. A sample of discharge water from the pressure washer was collected prior to rinsing to establish a baseline of the potable water used during the tank rinsing process. Table 3-1 summarizes the analyses performed on the final rinsate samples and the rinse water baseline samples (noted as the Rinse Water Blank in Table 3-1). The rinsate screening sample analytical results are summarized below in Tables 3-2 through 3-6. Only those parameters measured above the analytical detection limits are reported in these tables. Appendix B contains summary tables of the analyses of final rinsate samples. Appendix D is a copy of the laboratory reports for each sample collected in support of the project.

To determine the effectiveness of rinsing in each IAG tank as specified in the AAP, analytical results for the rinsate screening samples were compared by plotting the measured concentrations of total volatile organic compounds and total ICPES metals (Figures 3-1 through 3-5). In general, the concentrations of total volatile organic compounds and total ICPES metals measured in rinse water generated from the second and third rinsing effort were significantly less than those detected in rinse water generated from the first rinse. As illustrated by the rinsate comparison plots, this decreasing trend in contaminant concentrations indicates that the bulk contamination was removed from each tank during the first and second rinse.

Because this effort was performed as an accelerated action for the protection of human health and the environment and not for the purpose of achieving clean closure, no performance goals to serve as indicators for clean closure of the six IAG tanks were negotiated with CDPHE nor was a closure plan submitted. Therefore the final rinsate samples were not compared to clean closure standards.

## Table 3-1
## Rinsate Sample Analyses

| Analysis | Analytical Method | Screening Rinsate Samples | Rinse Water Blank | Final Rinsate Sample |
|---|---|---|---|---|
| Radioanalytical Screen; Gross Alpha and Gross Beta | Gas Proportional Counting | X | | X |
| Gross Alpha and Gross Beta | Gas Proportional Counting | | X | X |
| Plutonium-239/240<br>Americium 241<br>Uranium Isotopes | Alpha Spectrometry | | X | X |
| Volatile Organic Compounds (VOCs) | EPA Method 8240 | | X | X |
| Semi-VOCs | EPA Method 8270 | | X | X |
| Total Metals[1] | SW-846 Methods | | X | X |
| Metals Sweep (ICPES analytes and Mercury) | ICPES-Method 200.7 CLP-M<br>CVAA-Method 245.1 or Method 245.2 CLP-M (Modified)[2] | X | | |
| VOC Sweep | EPA Method 8240 (Modified)[3] | X | | |
| PCBs[4] | EPA Method 8081/505 | | | X |
| Field Parameters; pH, Conductivity, Temperature | Ion Specific Probe | X | X | X |

[1] Contract Laboratory Program (CLP)-Target Analyte List (TAL) analytes and CLP-TAL detection limits.
[2] Modified to meet data quality objectives (DQOs) of screening samples. Required quality control samples are limited to instrument calibration, preparation blank, independent calibration verification, and continuing calibration checks. Instrument detection limits for arsenic, lead, and selenium were those achieved by ICPES.
[3] Modified to meet DQOs of screening samples. Matrix spikes and matrix spike duplicates were not required.
[4] Tank T-2/T-3 only.

## Table 3-2
## Tank T-2/T-3 Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (1.2 +/- 0.1)E5 | (5.2 +/- 0.8)E4 | (4.7 +/- 1.3)E3 |
| Gross Beta | pCi/l | (1.4 +/- 0.1)E5 | (6.6 +/- 0.6)E4 | (5.9 +/- 1.1)E3 |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Bromomethane | µg/l | ND | 12 | ND |
| Acetone | µg/l | 14(B) | 10(B) | ND |
| Chloroform | µg/l | 3(J) | ND | ND |
| Tetrachloroethene | µg/l | 67 | 14 | 3(J) |
| **Total** | µg/l | 84 | 36 | 3 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | 29,700 | 9,550 | 1,720 |
| Cadmium | µg/l | 575 | 301 | 51.6 |
| Chromium | µg/l | 58,000 | 12,200 | 2,030 |
| Lead | µg/l | 86,300 | 24,100 | 4,310 |
| Mercury | µg/l | 18,200 | 9,310 | 1,530 |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 9,390 | 5,600 | 994 |
| **Total** | µg/l | 202,165 | 61,061 | 10,635.6 |

µg/l = micrograms per liter
pCi/l = picocuries per liter
ND = Not Detected
B = Laboratory qualifier indicating analyte detected in blank sample
J = Estimated value which is less than the detection limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-3a
## Tank T-40 (North) Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (3.43 +/- 1.26)E3 | (3.59 +/- 1.38)E3 | (2.45 +/- 1.08)E3 |
| Gross Beta | pCi/l | (0.00 +/- 8.21)E2 | (1.99 +/- 7.44)E2 | (0.00 +/- 9.02)E2 |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Acetone | µg/l | 51(B) | 32(B, J) | 59(B) |
| 2-Butanone | µg/l | 17(B, J) | 14(B, J) | 21(B, J) |
| 1,2-Dichloropropane | µg/l | 16(J) | ND | ND |
| Trichloroethene | µg/l | 460 | 51 | 44 |
| 4-Methyl-2-Pentanone | µg/l | 9(J) | ND | ND |
| Tetrachloroethene | µg/l | 14,000(E) | 2,700 | 2,400 |
| Xylene (m,p) | µg/l | 13(J) | ND | ND |
| Trich-triflethane | µg/l | 210 | 36 | 27 |
| **Total** | µg/l | 14,776 | 2,833 | 2,551 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | 1,930 | 535 | 298 |
| Cadmium | µg/l | 309 | 124 | 69.7 |
| Chromium | µg/l | 2,770 | 601 | 430 |
| Lead | µg/l | 4,320 | 753 | 583 |
| Mercury | µg/l | 212 | 76.2 | 66.3 |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 169 | 56.9 | 22.6 |
| **Total** | µg/l | 9,710 | 2,146.1 | 1,469.6 |

µg/l = micrograms per liter
pCi/l = picocuries per liter
ND = Not Detected
B = Laboratory qualifier indicating analyte detected in blank sample
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
E = Laboratory qualifier indicating that the concentration exceeds the instrument calibration limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-3b
## Tank T-40 (South) Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (5.90 +/- 1.48)E3 | (3.52 +/- 1.26)E3 | (1.24 +/- 0.79)E3 |
| Gross Beta | pCi/l | (1.96 +/- 7.60)E2 | (7.65 +/- 8.47)E2 | (6.55 +/- 9.26)E2 |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Acetone | µg/l | 60(B) | 42(B, J) | 40(B, J) |
| 2-Butanone | µg/l | 17(B, J) | 16(B, J) | 15(B, J) |
| Trichloroethene | µg/l | 92 | 12(J) | 7(J) |
| 4-Methyl-2-Pentanone | µg/l | 11(J) | ND | ND |
| Tetrachloroethene | µg/l | 5,700 | 3,600 | 610 |
| Xylene (m,p) | µg/l | 7(J) | ND | ND |
| Trich-triflethane | µg/l | 21(J) | 6(J) | ND |
| **Total** | µg/l | 5908 | 3,676 | 672 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | 1,900 | 682 | 525 |
| Cadmium | µg/l | 352 | 500 | 88.9 |
| Chromium | µg/l | 1,980 | 619 | 422 |
| Lead | µg/l | 2,580 | 755 | 508 |
| Mercury | µg/l | 187 | 89.4 | 36.3 |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 94.2 | 55.5 | 16.5 |
| **Total** | µg/l | 7,093.2 | 2,700.9 | 1,596.7 |

µg/l = micrograms per liter
pCi/l = picocuries per liter
ND = Not Detected
B = Laboratory qualifier indicating analyte detected in blank sample
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-4a
## Tank T-16 (North) Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (2.12 +/- 0.03)E6 | (2.79 +/- 0.10)E5 | (1.75 +/- 0.33)E4 |
| Gross Beta | pCi/l | (0.00 +/- 7.36)E3 | (0.00 +/- 2.35)E3 | (0.00 +/- 7.89)E2 |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse(1) |
| Acetone | µg/l | 14(B) | 11(B) | 8.9(J,B) |
| 2-Butanone | µg/l | 1.8(J) | 2.9(J) | 1.8(J) |
| Chloroform | µg/l | 1.5(J) | ND | ND |
| 4-Methyl-2-Pentanone | µg/l | 11 | ND | ND |
| Toluene | µg/l | ND | ND | 12 |
| Tetrachloroethene | µg/l | 2.6(J) | 1.2(J) | ND |
| **Total** | µg/l | 30.9 | 15.1 | 22.7 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | ND | ND | ND |
| Cadmium | µg/l | ND | ND | ND |
| Chromium | µg/l | 149(B) | ND | ND |
| Lead | µg/l | 334(B) | 170(B) | 56(B) |
| Mercury | µg/l | ND | ND | ND |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 206(B) | 172(B) | ND |
| **Total** | µg/l | 689 | 342 | 56 |

µg/l = micrograms per liter
pCi/l = picocuries per liter
ND = Not Detected
1 Final rinse values used since not sufficient 3rd rinse sample volume for organic analysis
B = Laboratory qualifier indicating analyte detected in blank sample (ORGANIC)
B = Laboratory qualifier indicating analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
E = Laboratory qualifier indicating that the concentration exceeds the instrument calibration limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-4b
## Tank T-16 (South) Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS(1) | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (1.88+E5) | (4.12+E4) | (2.16+E4) |
| Gross Beta | pCi/l | (-1.73+E4) | (2.28+E3) | (8.73+E3) |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Chloromethane | µg/l | 2(J) | 2(J) | 3(J) |
| Chloroform | µg/l | 55 | 49 | 39 |
| 2-Butanone | µg/l | 2(J) | 2(J) | 3(J) |
| Bromodichloromethane | µg/l | 2(J) | 2(J) | 2(J) |
| 1,2-Dichloropropane | µg/l | 190 | 180 | 320(E) |
| 4-Methyl-2-Pentanone | µg/l | ND | ND | 2(J) |
| Tetrachloroethene | µg/l | ND | 3(J) | ND |
| **Total** | µg/l | 251 | 238 | 369 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | 19.9(B) | 15.3(B) | 14.4(B) |
| Cadmium | µg/l | ND | ND | ND |
| Chromium | µg/l | 53 | 25 | 15 |
| Lead | µg/l | 61.1(B) | ND | ND |
| Mercury | µg/l | 0.22 | ND | ND |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 46. | 26 | 13 |
| **Total** | µg/l | 180.22 | 66.3 | 42.4 |

µg/l = micrograms per liter
pCi/l = picocuries per liter

1 Negative value due to crosstalk correction factor
ND = Not Detected

B = Laboratory qualifier indicating analyte detected in blank sample (ORGANIC ANALYSIS)
B = Laboratory qualifier indicating analyte concentration < method detection limit but >= instrument detection limit (INORGANIC ANALYSIS)
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
E = Laboratory qualifier indicating that the concentration exceeds the instrument calibration limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-5
## Tank T-14 Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (2.74 +/- 0.16)E5 | (8.47 +/- 2.35)E3 | (2.36 +/- 0.38)E4 |
| Gross Beta | pCi/l | (5.19 +/- 14.0)E2 | (1.74 +/- 7.51)E2 | (0.00 +/- 8.71)E2 |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Acetone | µg/l | 30(B) | 22(B) | 10(B) |
| Carbon Disulfide | µg/l | ND | 130 | 1.8(J) |
| Methylene Chloride | µg/l | 3.4(J) | 8.3(J) | ND |
| 2-Butanone | µg/l | 3(J) | 2.8(J) | ND |
| Chloroform | µg/l | 1.7(J) | ND | ND |
| Tetrachloroethene | µg/l | ND | ND | 1.8(J) |
| 4-Methyl-2-Pentanone | µg/l | 30 | 2(J) | ND |
| **Total** | µg/l | 68.1 | 165.1 | 13.6 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | ND | ND | ND |
| Cadmium | µg/l | ND | ND | ND |
| Chromium | µg/l | 1,761(B) | 280(B) | 100(B) |
| Lead | µg/l | 68(B) | ND | 82(B) |
| Mercury | µg/l | ND | ND | ND |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | ND | ND | ND |
| **Total** | µg/l | 1,829 | 280 | 182 |

µg/l = micrograms per liter
pCi/l = picocuries per liter
ND = Not Detected

B = Laboratory qualifier indicating analyte detected in blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
E = Laboratory qualifier indicating that the concentration exceeds the instrument calibration limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-6a
## Tank T-10 (East) Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS(1) | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (5.55+E4) | (4.46+E4) | (1.95+E3) |
| Gross Beta | pCi/l | (-8.62+E3) | (-5.40+E3) | (-3.31+E2) |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Acetone | µg/l | 6(J) | 5(J) | 7(J) |
| Chloroform | µg/l | 67 | 67 | 62 |
| Bromodichloromethan | µg/l | 2(J) | 2(J) | 2(J) |
| Tetrachloroethene | µg/l | 1(J) | ND | 4(J) |
| **Total** | µg/l | 76.0 | 74.0 | 75.0 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | 14.4(B) | 13.3(B) | 13.2(B) |
| Cadmium | µg/l | ND | ND | ND |
| Chromium | µg/l | 14.5 | 7.3(B) | ND |
| Lead | µg/l | ND | ND | ND |
| Mercury | µg/l | ND | ND | ND |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 15 | 9.1(B) | ND |
| **Total** | µg/l | 43.9 | 29.7 | 13.2 |

µg/l = micrograms per liter
pCi/l = picocuries per liter

1 Negative values due to crosstalk correction factor
ND = Not Detected
B = Laboratory qualifier indicating analyte detected in blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
E = Laboratory qualifier indicating that the concentration exceeds the instrument calibration limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

## Table 3-6b
## Tank T-10 (West) Analytical Results Rinsate Screening Samples

| RADIOLOGICAL SCREEN ANALYSIS(1) | | | | |
|---|---|---|---|---|
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Gross Alpha | pCi/l | (4.07+E6) | (3.01+E4) | (6.13+E3) |
| Gross Beta | pCi/l | (-6.61+E5) | (-5.07+E3) | (-9.93+E2) |
| VOLATILE ORGANIC ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Acetone | µg/l | 6(J) | 9(J) | 7(J) |
| Chloroform | µg/l | 55 | 73 | 52 |
| 2-Butanone | µg/l | 1(J) | ND | ND |
| 1,1,1-Trichloroethane | µg/l | 1(J) | ND | ND |
| Carbon Tetrachloride | µg/l | 1(J) | ND | ND |
| Bromodichloromethane | µg/l | ND | 2(J) | 2(J) |
| Trichloroethene | µg/l | 280 | 5(J) | 9 |
| Tetrachloroethene | µg/l | 650 | 17 | 12 |
| Toluene | µg/l | 38 | ND | ND |
| Ethylbenzene | µg/l | 6 | ND | ND |
| Xylene (total) | µg/l | 24 | ND | ND |
| **Total** | µg/l | 1,062 | 106.0 | 82.0 |
| ICPES METALS ANALYSIS | | | | |
| Analyte | Units | 1st Rinse | 2nd Rinse | 3rd Rinse |
| Arsenic | µg/l | ND | ND | ND |
| Barium | µg/l | 92(B) | 16.3(B) | 12.9(B) |
| Cadmium | µg/l | 12.5 | ND | ND |
| Chromium | µg/l | 364.3 | 17.2 | ND |
| Lead | µg/l | 936.1 | ND | ND |
| Mercury | µg/l | 2.1 | ND | ND |
| Selenium | µg/l | ND | ND | ND |
| Silver | µg/l | 707.4 | 14.5 | 7.2(B) |
| **Total** | µg/l | 2,114.4 | 48.0 | 20.1 |

µg/l = micrograms per liter
pCi/l = picocuries per liter

1 Negative values due to crosstalk error
ND = Not Detected
B = Laboratory qualifier indicating analyte detected in blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
E = Laboratory qualifier indicating that the concentration exceeds the instrument calibration limit
ICPES = Inductively Coupled Plasma Emission Spectroscopy

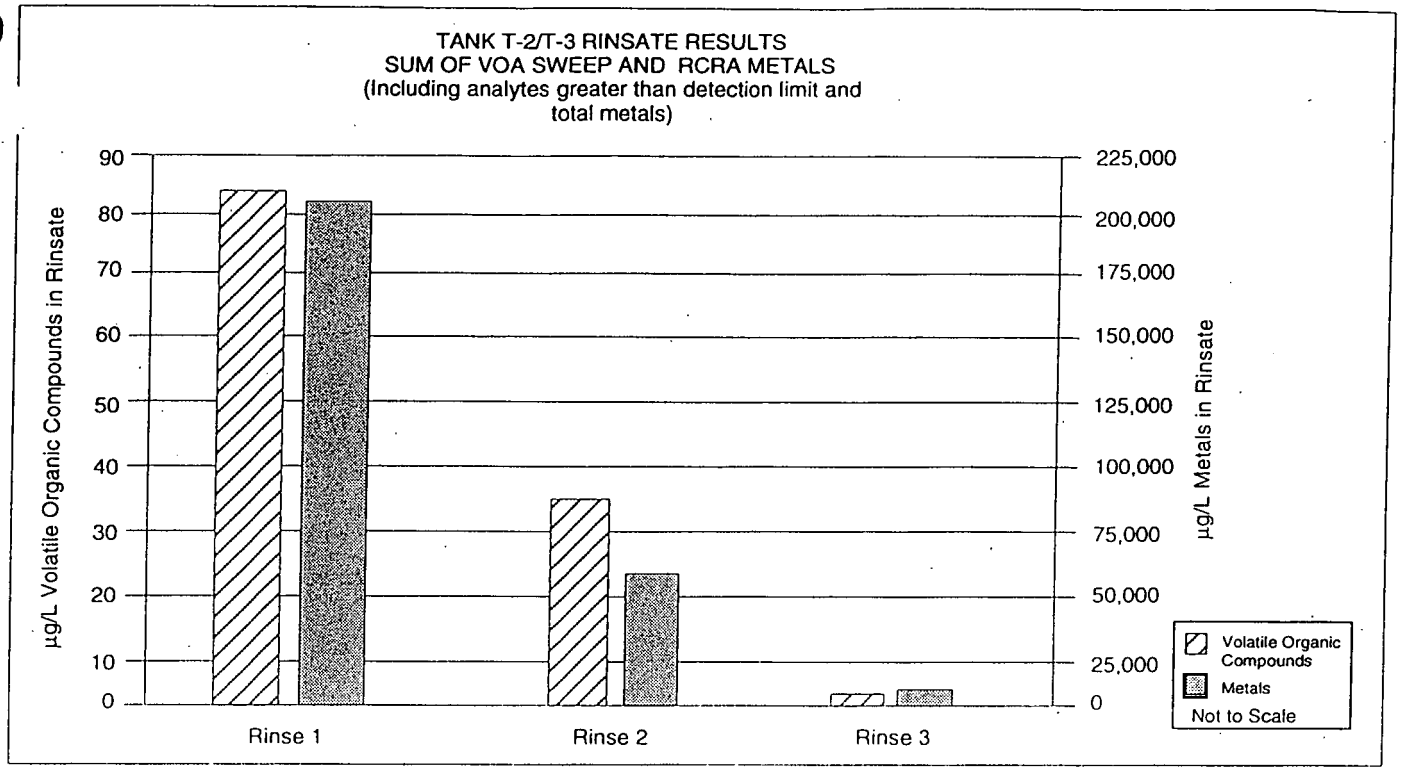


Figure 3-1 Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-2/T-3

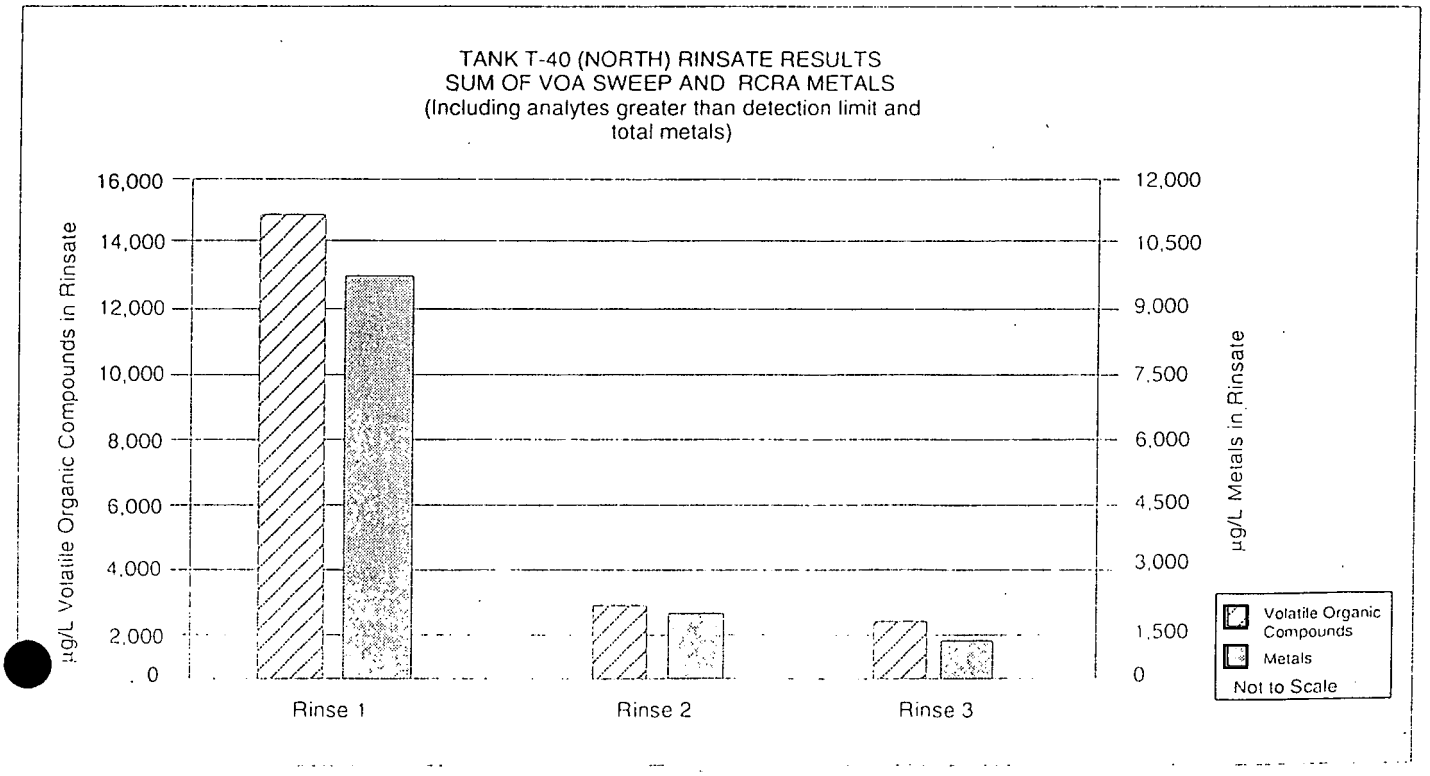


Figure 3-2a Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-40 (North)

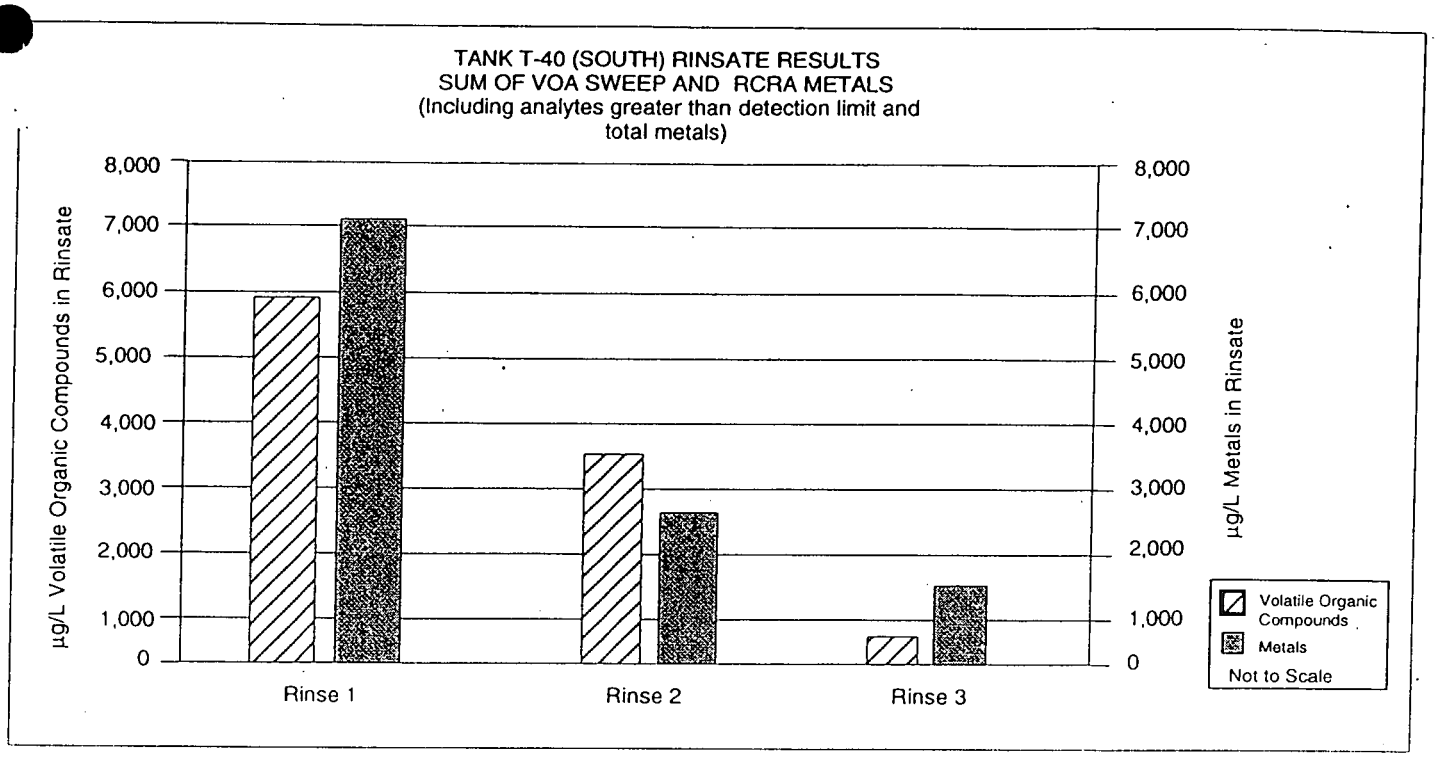


Figure 3-2b Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-40 (South)

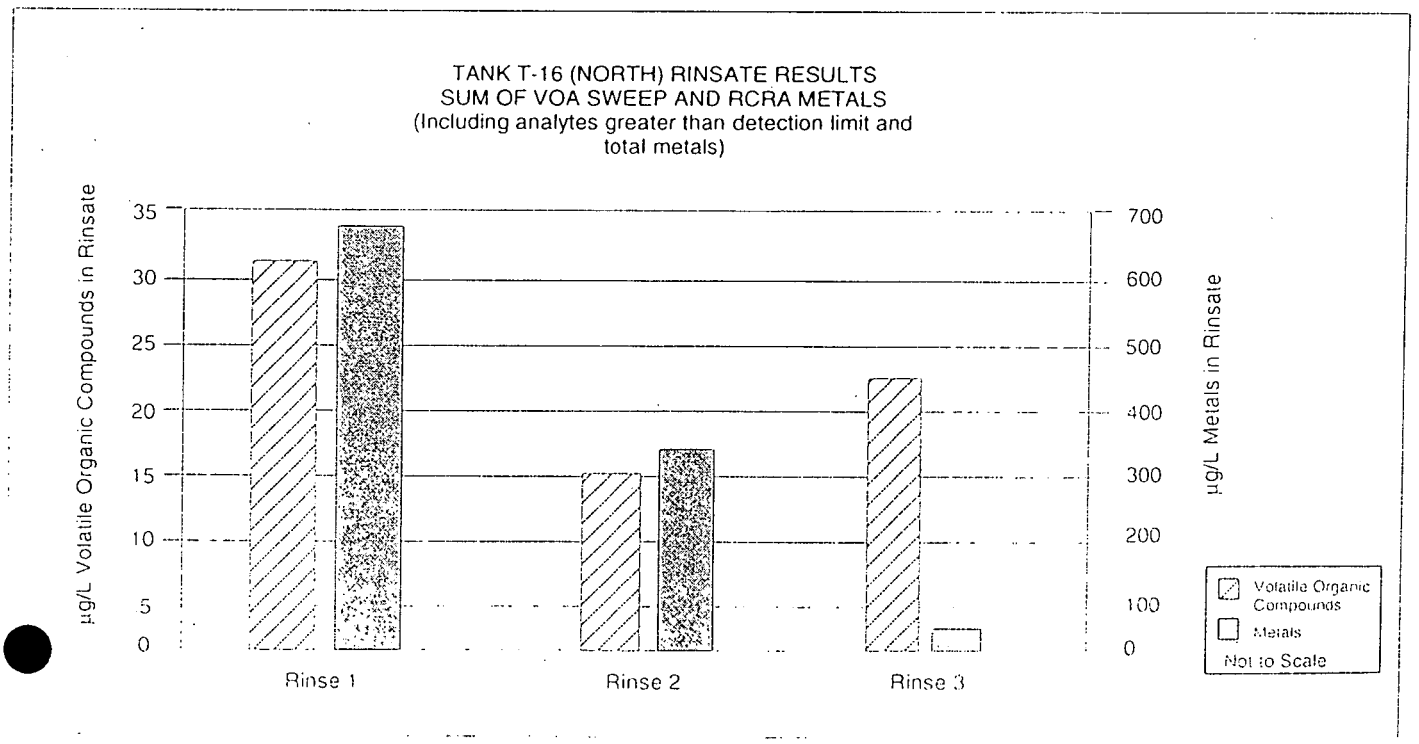


Figure 3-3a Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-16 (North)

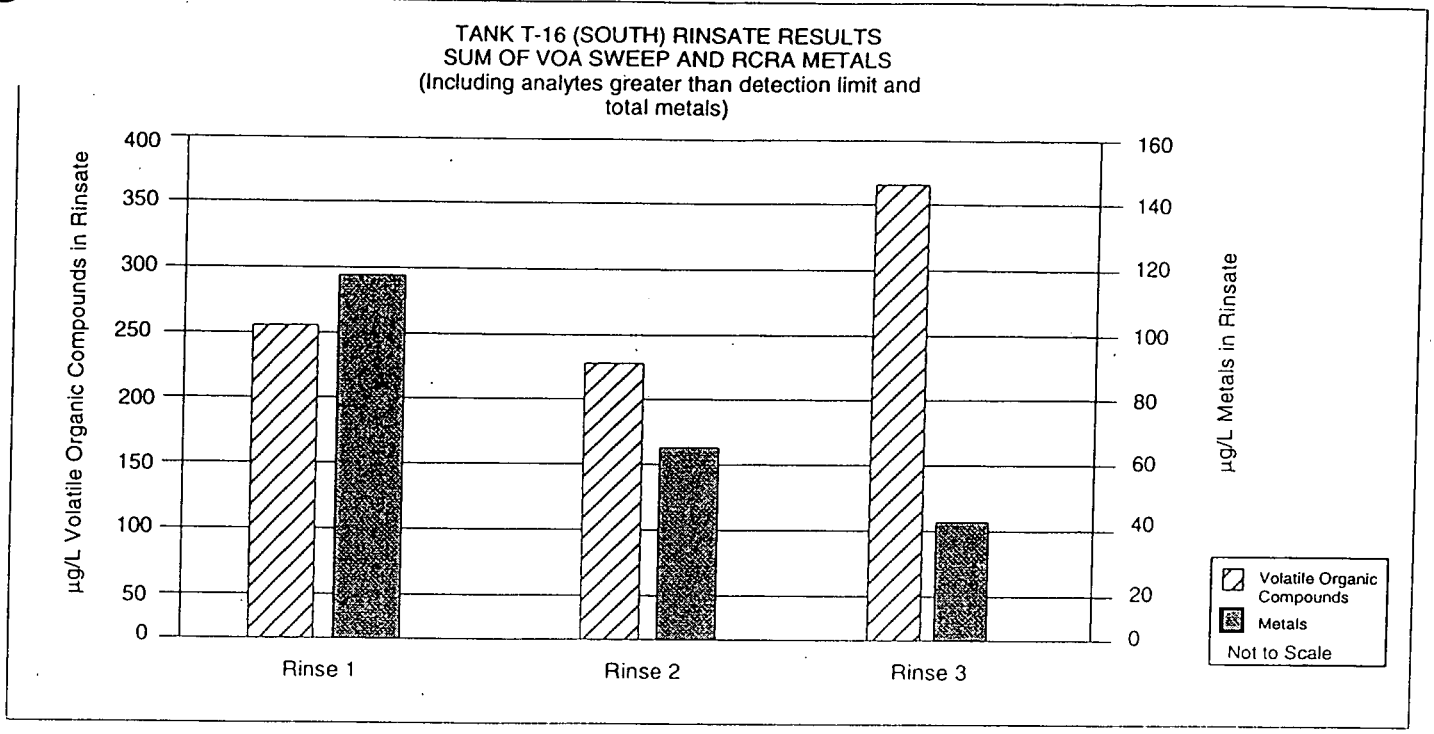


Figure 3-3b Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-16 (South)

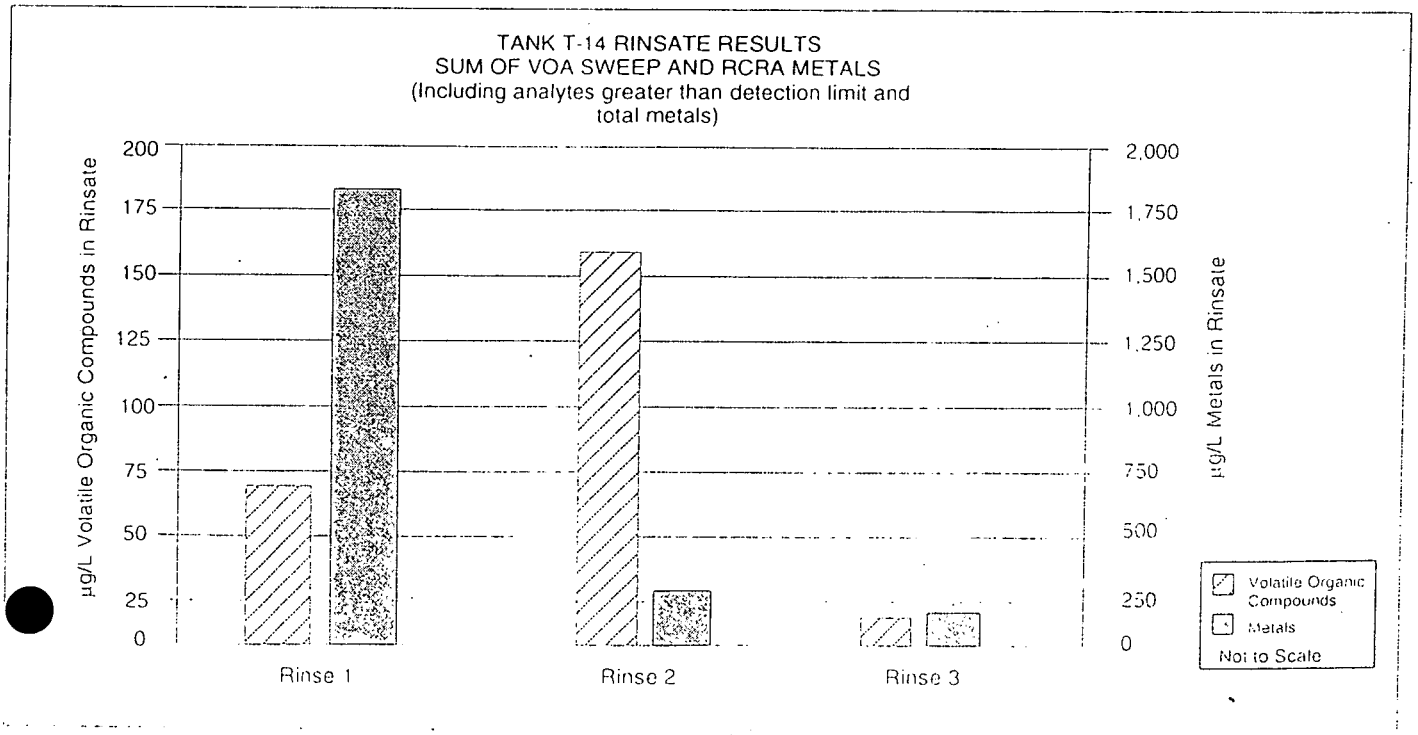


Figure 3-4 Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-14

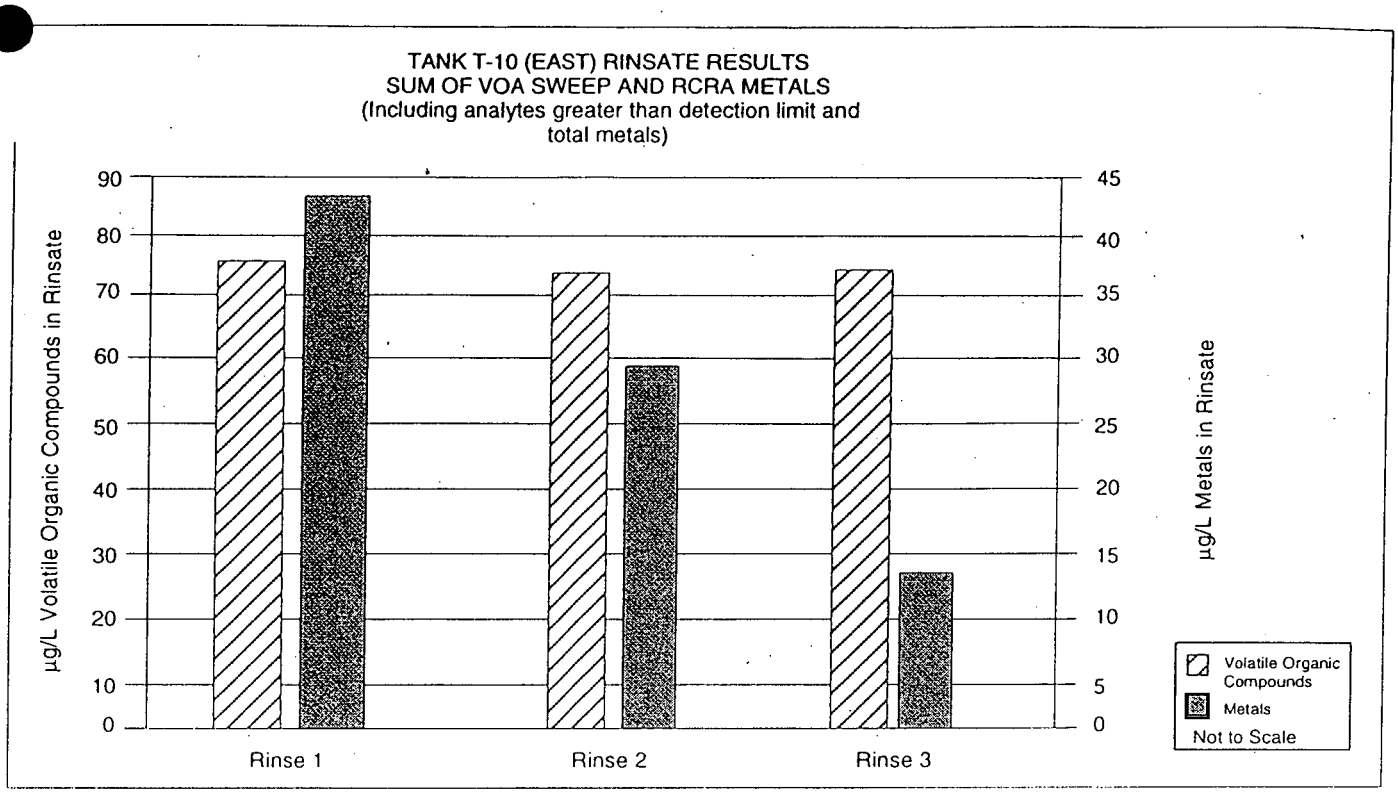


Figure 3-5a Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-10 (East)

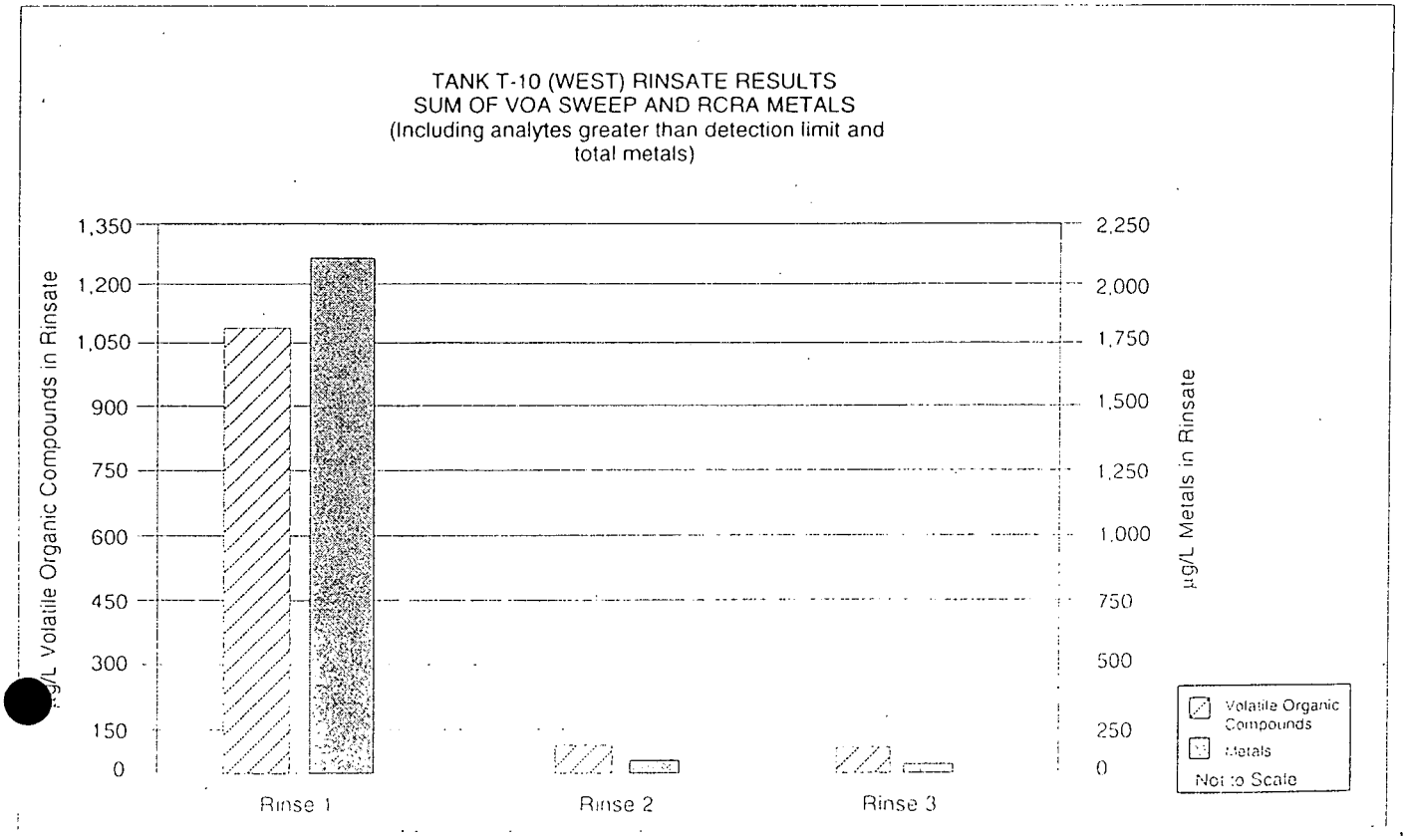


Figure 3-5b Concentration of Volatile Organic Compounds and Metals in Rinsate After Three Consecutive Rinses of Tank T-10 (West)

# 4.0 TANK WASTE TREATMENT AND DISPOSITION

## 4.1 LIQUIDS

All liquids, including groundwater, pumped from Tank T-2/T-3 and Tank T-40 were transferred into a RCRA-permitted, radiologically controlled tank truck. The liquids were transferred to the on-site Water Treatment Facility (Building 891) for treatment of metals and radionuclides (chemical precipitation treatment), volatile organic compounds (ultraviolet/peroxide and activated carbon treatment), and other water quality parameters (ion exchange treatment). The treated water was sampled for analyses to confirm applicable or relevant and appropriate requirements (ARARs) compliance.

Liquids removed from Tank T-14, Tank T-16 (north), and Tank T-16 (south) were pumped directly into the Building 774 sampling tank (Tank 201). The liquids were treated to remove solids in Building 774, based on the Tank 201 sampling results, and transferred to Building 374 for evaporation. Liquids from Tank T-10 were pumped via pipeline to Tank T-16 (south) for transfer to Building 774. The T-10 liquids were then pumped from T-16 (south) into Building 774 for sampling and liquid/solid separation, and finally transferred to Building 374 for evaporation.

## 4.2 SLUDGES

The IAG tanks are known to have been historically utilized for transporting and temporarily storing process wastes containing high levels of radionuclides, inorganic, and organic contaminants. Samples of sludge remaining in Tank T-2/T-3 and Tank T-40 were collected for contaminant characterization and subsequent treatment and disposition. Although not required, samples of sludge contained in Tank T-14, Tank T-16 (north), and Tank T-16 (south) were collected for chemical characterization to aid in content removal operations. Table 4-1 summarizes the analytical constituents and methods used for the sludge samples. Analytical results are summarized in Tables 4-2 through 4-5. The characterization data for Tank T-10 sludge may be referenced in the *Data Summary Report No. 2, Operable Unit No. 9, Outside Tanks, Volume 1* (DOE, 1995b).

Sludges removed from Tank T-2/T-3 and Tank T-40 were characterized as radioactive mixed waste, and containerized in 15 plastic-lined 55-gallon drums. The drums were transported to the on-site RCRA Unit No. 1 where the sludge and rinse water mixture contained in each drum will be solidified. The drums will be managed and shipped offsite for disposal with existing plant inventory.

Sludges removed from Tank T-10, Tank T-14, and Tanks T-16 (north) and T-16 (south) were characterized as radioactive mixed waste. Sludges from these tanks were mobilized with water and transferred to Building 774 for treatment. The liquid/sludge solutions were sampled and treated in Building 774 to remove solids. The resultant tank bottom sludges were gravity dropped into a holding tank for interim storage until installation of the Sludge Modification Unit, adjacent to Building 774, is completed circa 1998. The tank bottom sludges will then undergo a cementation process in the temporary Sludge Modification Unit for transport and final disposition offsite. The liquid effluent was handled as described above for the T-10, T-14, and T-16 tank liquids.

**Table 4-1**
**Sludge Sample Analyses**

| Analysis | Analytical Method |
|---|---|
| Radioanalytical Screen; Gross Alpha and Gross Beta | Gas Proportional Counting |
| Gross Alpha and Gross Beta | Gas Proportional Counting |
| Plutonium-239/240, Americium 241, Uranium Isotopes | Alpha Spectrometry |
| Volatile Organic Compounds (VOCs) | EPA Method 8240 |
| Semi-VOCs | EPA Method 8270 |
| Total Metals[1] | SW-846 Methods |
| Metals Sweep (ICPES analytes and Mercury) | ICPES-Method 200.7 CLP-M CVAA-Method 245.1 or Method 245.2 CLP-M (Modified)[2] |
| VOC Sweep | EPA Method 8240 (Modified)[3] |
| PCBs[4] | EPA Method 8081/505 |
| Field Parameters; pH, Conductivity, Temperature | Ion Specific Probe |

[1] Contract Laboratory Program (CLP)-Target Analyte List (TAL) analytes and CLP-TAL detection limits.
[2] Modified to meet data quality objectives (DQOs) of screening samples. Required quality control samples are limited to instrument calibration, preparation blank, independent calibration verification, and continuing calibration checks. Instrument detection limits for arsenic, lead, and selenium were those achieved by ICPES.
[3] Modified to meet DQOs of screening samples. Matrix spikes and matrix spike duplicates were not required.
[4] Tank T-2/T-3 only.

## Table 4-2
## Tank T-2/T-3 Analytical Results Sludge Sample

(Sample No. TN00117RM)

| GROSS ALPHA/GROSS BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (10.0 +/- 0.4)E3 | pCi/g |
| Gross Beta | (11.6 +/- 0.3)E3 | pCi/g |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 7,424 +/- 443 | pCi/g |
| Uranium-235 | 209 +/- 18 | pCi/g |
| Uranium-233/234 | 2,045 +/- 127 | pCi/g |
| Plutonium-239/240 | 66 +/- 2 | pCi/g |
| Americium-241 | 26 +/- 1 | pCi/g |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Bromomethane | 360 (J) | µg/kg |
| Acetone | 590 (B, J) | µg/kg |
| 2-Butanone | 540 (B, J) | µg/kg |
| Tetrachloroethene | 1,700 | µg/kg |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Naphthalene | 1,300 (J) | µg/kg |
| Naphthalene 2-methyl- | 570 (J) | µg/kg |
| 2-Chloronaphthalene | 750 (J) | µg/kg |
| Acenaphthene | 2,600 (J) | µg/kg |
| Dibenzofuran | 1,500 (J) | µg/kg |
| Fluorene | 2,800 (J) | µg/kg |
| Phenanthrene | 17,000 | µg/kg |
| Anthracene | 3,400 | µg/kg |
| Di-n-butylphthalate | 830 (B, J) | µg/kg |
| Fluoranthene | 11,000 | µg/kg |
| Pyrene | 16,000 | µg/kg |
| Butylbenzylphthalate | 630 (J) | µg/kg |
| Benzo [a] anthracene | 4,400 | µg/kg |
| Chrysene | 4,800 | µg/kg |
| 2-Ethylhexylphthalate bis- | 17,000 | µg/kg |
| Di-n-octylphthalate | 5,900 | µg/kg |
| Benzo [b] fluoranthene | 2,400 (J) | µg/kg |
| Benzo [k] fluoranthene | 3,400 | µg/kg |
| Benzo [a] pyrene | 3,600 | µg/kg |
| Indeno [1,2,3-cd] pyrene | 2,600 (J) | µg/kg |
| Benzo [g,h,i] perylene | 2,300 (J) | µg/kg |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | 4.5 | mg/kg |
| Barium | 268 | mg/kg |
| Cadmium | 6.3 | mg/kg |
| Chromium | 446 | mg/kg |
| Lead | 494 | mg/kg |
| Mercury | 931.2 | mg/kg |
| Selenium | 1.6 | mg/kg |
| Silver | 317 | mg/kg |

pCi/g = picocuries per gram
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
B = Laboratory qualifier indicating the analyte was detected in the blank sample

## Table 4-3a
## Tank T-40 (North) Analytical Results Sludge Sample

(Sample No. TN00102RM)

| GROSS ALPHA/GROSS BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | 417 +/- 44 | pCi/g |
| Gross Beta | 413 +/- 43 | pCi/g |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 198 +/- 40 | pCi/g |
| Uranium-235 | 46 +/- 22 | pCi/g |
| Uranium-233/234 | 154 +/- 31 | pCi/g |
| Plutonium-239/240 | 21 +/- 18 | pCi/g |
| Americium-241 | 1.2 +/- 1.4 | pCi/g |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 58,930(J, B) | µg/kg |
| Methylene Chloride | 2,480(J, B) | µg/kg |
| Benzene | 990(J) | µg/kg |
| Trichloroethene | 530,000(B) | µg/kg |
| 1,2-Dichloropropane | 29,000(J) | µg/kg |
| Toluene | 5,030(J) | µg/kg |
| Tetrachloroethene | 3E+07(E) | µg/kg |
| Ethylbenzene | 4,100(J, B) | µg/kg |
| Xylene-(m,p) | 18,900(J, B) | µg/kg |
| Xylene-(o) | 5,000(J, B) | µg/kg |
| 1,4-Dichlorobenzene | 2,800(J, B) | µg/kg |
| 1,2-Dichlorobenzene | 15,600(J, B) | µg/kg |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| 1,4-Dichlorobenzene | 2,300(J) | µg/kg |
| 1,2-Dichlorobenzene | 18,000 | µg/kg |
| 1,2,4-Trichlorobenzene | 1,400(J) | µg/kg |
| Naphthalene | 5,700 (J) | µg/kg |
| 2-Methylnaphthalene | 28,000 | µg/kg |
| Diethyl phthalate | 1,000(J) | µg/kg |
| Phenanthrene | 2,000(J) | µg/kg |
| Di-n-butyl phthalate | 13,000(B) | µg/kg |
| bis(2-Ethylhexyl) phthalate | 290,000(E, B) | µg/kg |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | mg/kg |
| Barium | 159(B) | mg/kg |
| Cadmium | 15.8(B) | mg/kg |
| Chromium | 527 | mg/kg |
| Lead | 362 | mg/kg |
| Mercury | 1.8 | mg/kg |
| Selenium | ND | mg/kg |
| Silver | ND | mg/kg |

pCi/g = picocuries per gram
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
ND = Laboratory qualifier indicating analyte was analyzed for but not detected
E = Laboratory qualifier indicating the concentration exceeds the instrument calibration limit

## Table 4-3b
## Tank T-40 (South) Analytical Results Sludge Sample

(Sample No. TN00109RM)

| GROSS ALPHA/GROSS BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | 39 +/- 10 | pCi/g |
| Gross Beta | 12 +/- 9 | pCi/g |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 19 +/- 2 | pCi/g |
| Uranium-235 | 4.3 +/- 1.4 | pCi/g |
| Uranium-233/234 | 1.6 +/- 0.2 | pCi/g |
| Plutonium-239/240 | 0.8 +/- 0.8 | pCi/g |
| Americium-241 | 0.1 +/- 0.2 | pCi/g |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Methylene Chloride | 46(J, B) | µg/kg |
| cis-1,2-Dichloroethene | 25(J) | µg/kg |
| Benzene | 28(J) | µg/kg |
| Trichloroethene | 13,000(J) | µg/kg |
| 1,2-Dichloropropane | 560 | µg/kg |
| 4-Methyl-2-pentanone | 99(J, B) | µg/kg |
| Toluene | 260(J) | µg/kg |
| Tetrachloroethene | 700,000 | µg/kg |
| Chlorobenzene | 17(J) | µg/kg |
| Ethylbenzene | 720(B) | µg/kg |
| Xylene-(m,p) | 2,600(B) | µg/kg |
| Xylene-(o) | 690(B) | µg/kg |
| 1,3-Dichlorobenzene | 31(J) | µg/kg |
| 1,4-Dichlorobenzene | 320 | µg/kg |
| 1,2-Dichlorobenzene | 2,400 | µg/kg |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| 1,2-Dichlorobenzene | 2,100(J) | µg/kg |
| 2-Methylnaphthalene | 2,800(J) | µg/kg |
| Phenanthrene | 2,600(J) | µg/kg |
| Di-n-butyl phthalate | 3,100(J, B) | µg/kg |
| Pyrene | 1,700(J) | µg/kg |
| bis(2-Ethylhexyl) phthalate | 200,000(B) | µg/kg |
| Di-n-octyl phthalate | 11,000 | µg/kg |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | mg/kg |
| Barium | 488(B) | mg/kg |
| Cadmium | 27.6 | mg/kg |
| Chromium | 377 | mg/kg |
| Lead | 318 | mg/kg |
| Mercury | 5.21 | mg/kg |
| Selenium | ND | mg/kg |
| Silver | 3(B) | mg/kg |

pCi/g = picocuries per gram
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
ND = Laboratory qualifier indicating analyte was analyzed for but not detected

## Table 4-4a
## Tank T-16 (North) Analytical Results Sludge Sample

(Sample No. TN00130RM)

| GROSS ALPHA/GROSS BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | NA | pCi/g |
| Gross Beta | NA | pCi/g |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS(1)** | | |
| Analyte | Activity | Units |
| Uranium-238 | </=7.7E4(2) | pCi/g |
| Uranium-235 | </=1.1E5(2) | pCi/g |
| Uranium-234 | </=2.0E5(2) | pCi/g |
| Plutonium-239/240 | (1.00 +/- 0.14)E6 | pCi/g |
| Plutonium-238/Americium-241 | (6.10 +/- 0.85)E5 | pCi/g |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 57(J, B) | µg/kg |
| Methylene Chloride | 550 | µg/kg |
| Toluene | 12(J) | µg/kg |
| Tetrachloroethene | 67 | µg/kg |
| **SEMIVOLATILE ORGANIC ANALYSIS(3)** | | |
| Analyte | Concentration | Units |
| Diethyl phthalate | 2,000(J) | µg/kg |
| Di-n-butyl phthalate | 37,000(B) | µg/kg |
| bis(2-Ethylhexyl) phthalate | 8,100(J, B) | µg/kg |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | mg/kg |
| Barium | 17.57(B) | mg/kg |
| Cadmium | 3.55(B) | mg/kg |
| Chromium | 87.91(B) | mg/kg |
| Lead | 66.14(B) | mg/kg |
| Mercury | 0.139(B) | mg/kg |
| Selenium | 11.85(B) | mg/kg |
| Silver | 169.45 | mg/kg |

pCi/g = picocuries per gram

µg/kg = micrograms per kilogram

mg/kg = milligrams per kilogram

1 The sample located and used for this analysis had been handled multiple times in plutonium contaminated gloveboxes

2 Value is non-detect due to the plutonium level in the sample

3 Sample holding time was exceeded.

NA = Gross Alpha/Beta analyses were not performed due to high radioactivities in the sample

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)

ND = Laboratory qualifier indicating analyte was analyzed for but not detected

## Table 4-4b
## Tank T-16 (South) Analytical Results Sludge Sample

(Sample No. TN00141RM)

| GROSS ALPHA/GROSS BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | NA | pCi/g |
| Gross Beta | NA | pCi/g |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS(1)** | | |
| Analyte | Activity | Units |
| Uranium-238 | </= 8.5E3(2) | pCi/g |
| Uranium-235 | </= 2.2E4(2) | pCi/g |
| Uranium-234 | </= 5.4E4(2) | pCi/g |
| Plutonium-239/240 | (5.89 +/- 0.82)E5 | pCi/g |
| Plutonium-238/Americium-241 | (3.16 +/- 0.44)E5 | pCi/g |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 36(J, B) | µg/kg |
| Methylene Chloride | 45(J) | µg/kg |
| **SEMIVOLATILE ORGANIC ANALYSIS(3)** | | |
| Analyte | Concentration | Units |
| Diethyl phthalate | 1,400(J) | µg/kg |
| Di-n-butyl phthalate | 150,000(B) | µg/kg |
| Fluoranthene | 1,600(J) | µg/kg |
| bis(2-Ethylhexyl) phthalate | 16,000(B) | µg/kg |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | mg/kg |
| Barium | 11.82(B) | mg/kg |
| Cadmium | 3.35(B) | mg/kg |
| Chromium | 121.77 | mg/kg |
| Lead | 44.19(B) | mg/kg |
| Mercury | 1.17 | mg/kg |
| Selenium | ND | mg/kg |
| Silver | 126.21 | mg/kg |

pCi/g = picocuries per gram

µg/kg = micrograms per kilogram

mg/kg = milligrams per kilogram

1 The sample located and used for this analysis had been handled multiple times in plutonium contaminated gloveboxes

2 Value is non-detect due to the plutonium level in the sample

3 Sample holding time was exceeded.

NA = Gross Alpha/Beta analyses were not performed due to high radioactivities in the sample

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)

ND = Laboratory qualifier indicating analyte was analyzed for but not detected

# Table 4-5
# Tank T-14 Analytical Results Sludge Sample

(Sample No. TN00169RM)

| GROSS ALPHA/GROSS BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (2.22 +/- 0.04)E5 | pCi/g |
| Gross Beta | (1.64 +/- 5.09)E2 | pCi/g |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | (6.44 +/- 3.22)E3 | pCi/g |
| Uranium-235 | </= 2.6E3(1) | pCi/g |
| Uranium-234 | </= 6.4E3(1) | pCi/g |
| Plutonium-239/240 | (4.94 +/- 0.69)E4 | pCi/g |
| Plutonium-238/Americium-241 | (4.73 +/- 0.66)E4 | pCi/g |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 68(J, B) | µg/kg |
| 2-Butanone | 24(J, B) | µg/kg |
| 1,1,1-Trichloroethane | 44(J) | µg/kg |
| Benzene | 10(J) | µg/kg |
| Toluene | 68 | µg/kg |
| Tetrachloroethene | 11(J) | µg/kg |
| Chlorobenzene | 7.2(J) | µg/kg |
| Ethylbenzene | 310 | µg/kg |
| m,p-Xylene | 1,100 | µg/kg |
| o-Xylene | 570 | µg/kg |
| **SEMIVOLATILE ORGANIC ANALYSIS(2)** | | |
| Analyte | Concentration | Units |
| 4-Chloro-3-methylphenol | 1,300(J) | µg/kg |
| 4-Nitrophenol | 2,100(J) | µg/kg |
| Diethyl phthalate | 1,600(J) | µg/kg |
| Di-n-butyl phthalate | 63,000(B) | µg/kg |
| bis(2-Ethylhexyl) phthalate | 27,000(B) | µg/kg |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | mg/kg |
| Barium | 29.36(B) | mg/kg |
| Cadmium | 4.62(B) | mg/kg |
| Chromium | 4,269 | mg/kg |
| Lead | 71.62(B) | mg/kg |
| Mercury | 1.85 | mg/kg |
| Selenium | 13.01(B) | mg/kg |
| Silver | 82.80(B) | mg/kg |

pCi/g = picocuries per gram
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
1 Value is non-detect due to the plutonium level in the sample
2 Sample holding time was exceeded.
J = Laboratory qualifier indicating an estimated value which is less than the detection limit
B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration was < method detection limit but >= instrument detection limit (INORGANIC)
ND = Laboratory qualifier indicating analyte was analyzed for but not detected

## 4.3 AUXILIARY EQUIPMENT AND DEBRIS

Waste materials and auxiliary equipment generated at each tank installation were monitored by radiological operations and placed in wooden crates for storage as low-level radioactive waste in Building 664 (Table 4-6). These crates will be managed and shipped offsite for disposal with existing plant inventory.

Waste materials included construction materials (wood, plastic, metal), sampling and monitoring equipment (glass, plastic), plastic buckets and plastic sheeting, and one metal/plastic-constructed radiological containment house. Waste equipment included such items as pumps, hoses, piping and ducting, filters, ladders, personnel hoisting equipment, and electrical lights and power cords.

## 4.4 PERSONNEL PROTECTIVE EQUIPMENT

Use of PPE was conducted as specified in the *Integrated Operable Units 8, 9, 10, 13, and 14 Phase I RFI/RI Final Health and Safety Plan* (DOE, 1993) and the project activity hazard analysis/preliminary hazard analysis. All used PPE was monitored by radiological operations for appropriate disposal. PPE which did not meet radiological operations release criteria was containerized for storage as low-level waste in Building 664 (Table 4-6). Uncontaminated PPE was placed into plastic bags for disposal at the RFETS solid waste landfill.

## Table 4-6
## Summary of Waste Material Handling

| Tank Location | Type of Waste | Approximate Volume | Waste Class | Container Type | Storage Location | Planned Disposal |
|---|---|---|---|---|---|---|
| T-40, T-2, T-3 | Various IDC's:<br>• PPE<br>• Metal<br>• Glass<br>• Plastic | 6 cubic yards | Low Level | 3 Half-Crates | Building 664 | Offsite |
| T-10, T-14, T-16 | Dry Combustibles:<br>• PPE<br>• Bottles<br>• Hoses<br>• Sampling Equipment<br>• Wood | 10 cubic yards | Low Level | 2 Full-Crates<br>1 Half-Crate | Building 664 | Offsite |
| T-10, T-14, T-16 | Plastics:<br>• Tent<br>• Coolers | 4 cubic yards | Low Level | 1 Full-Crate | Building 664 | Offsite |
| T-10, T-14, T-16 | Metal:<br>• Chair<br>• Pump<br>• Hose | 2 cubic yards | Low Level | 1 Half-Crate | Building 664 | Offsite |
| Total | | 22 cubic yards | | 3 Full-Crates<br>5 Half-Crates | | |

## 5.0 TANK STABILIZATION

Following the contaminant removal and tank rinsing, the IAG USTs were completely filled with polyurethane foam to stabilize any possible remaining contamination in the tanks until final disposition of the tanks is determined. The polyurethane foam is designed to stabilize the residual contamination in the tanks by preventing contaminant migration from the tanks to the surrounding groundwater, as well as preventing infiltration of groundwater, surface water, or pipe flow into the tanks.

The liquid polyurethane foam components (resin and activator) are mixed in a material dispensing line and injected through a low-pressure flexible tubing into the tanks. As the liquid mix is injected into the tank, it flows to the lowest surfaces allowing the tank to fill from the bottom up. The liquid mix is applied in stages to allow the foam to harden in intervals (normally two minutes). Once hardened, the foam qualifies as a solid, inert material with a density of approximately two pounds per cubic foot (2 lbs/ft$^3$). A copy of the Material Safety Data Sheet for the polyurethane foam is provided in Appendix C.

The weight of foam material applied to each tank system was calculated based on the foam density (2 lbs/ft$^3$) and measured pumping rate of foam into the tank. Table 5-1 summarizes the estimated weight and volume of foam contained in each IAG tank. This information may be useful when determining final disposition of the IAG tanks. It should be noted that the weight and volume of foam reported for Tank T-40 includes the quantity of foam applied to the overlying valve vault, as described in Subsection 1.2.2. Foam was applied to fill the vault opening, leaving no void space beneath the vault cover. The vault lid was closed and secured with a lock after the foaming operations were completed. The valve vault overlying Tanks T-9 and T-10 (Subsection 1.2.4) was not filled with foam since Tank T-9 is currently in use.

Due to groundwater infiltration, it was necessary to pump approximately 500 gallons of additional liquid from the north T-40 tank prior to application of foam. As specified in the AAP, this water was sampled and analyzed for Building 891 treatment acceptance criteria only (i.e., gross alpha and gross beta activities, and pH). The results for these analyses are as follows: 133 pCi/l gross alpha activity, 60 pCi/l gross beta activity, and pH 8.17. Prior to being foamed, approximately 17 gallons and 19 gallons of residual water was measured in the Tank T-2/T-3 holding tank sump and the overlying center concrete chamber, respectively. This water was absorbed with an absorbent just before foam was applied to the tank system. Actual foaming activities were completed at the six tank sites on the dates listed in Table 5-1.

## Table 5-1
## Weight and Volume of Foam in IAG Tanks

| FOAM | Tank T-2/T-3 | Tank T-40 | Tank T-14 | Tank T-16 (north) | Tank T-16 (south) | Tank T-10 (east)(1) | Tank T-10 (west)(1) |
|---|---|---|---|---|---|---|---|
| Weight (Pounds) | 2,340 | 1,660 | 10,487 | 3,699 | 3,950 | 1,433 | 1,433 |
| Volume (Cubic Feet) | 1,137 | 306 | 5,096 | 1,797 | 1,919 | 697 | 697 |
| Volume (Gallons) | 8,506 | 6,034 | 38,122 | 13,447 | 14,359 | 5,211 | 5,211 |
| Date Foamed | 07/23/96 | 07/25/96 | 09/23/96 | 09/17/96 | 09/19/96 | 09/16/96 | 09/16/96 |

(1) Calculated based on a measured total volume of 10,423 gallons of foam to fill Tank T-10 (east) and Tank T-10 (west)

## 6.0 CONCLUSIONS

1) All liquids and sludges were removed from the six IAG underground storage tanks.

2) Following removal of liquids and sludges, each tank was triple-rinsed to remove bulk contamination. In each tank a sample of the final rinsate water was collected for comprehensive analysis to document the extent of contamination remaining.

3) All materials and wastes generated by the above activities were characterized and dispositioned. The liquids removed from the IAG tanks were treated at on-site facilities (Buildings 891, 774, and 374). Sludges removed from Tank T-2/T-3 and Tank T-40 were containerized in 55-gallon drums for storage as radioactive mixed waste in RCRA Unit No. 1 until appropriate offsite disposal is authorized. Sludges removed from Tanks T-10, T-14, and T-16 were transferred to Building 774 for interim storage as radioactive mixed waste. This waste is planned for treatment on-site circa 1998 following the installation of a temporary Sludge Modification Unit adjacent to Building 774. The treated sludge will then be scheduled for appropriate offsite disposal.

   Auxiliary equipment, debris, and contaminated personnel protective equipment was containerized and stored as low-level waste in Building 664. These materials are planned for offsite disposal.

4) All six IAG USTs were filled with an inert closed-cell foam (polyurethane) to stabilize residual contamination and prevent influx of groundwater and/or surface water. Influx of groundwater was observed in Tank T-2/T-3 and Tank T-40 during liquid removal.

5) The above referenced tasks were completed by the scheduled end date, September 30, 1996.

## LIST OF REFERENCES


**DOE, 1992** - U.S. Department of Energy, 1992, *Final Historical Release Report for the Rocky Flats Plant*, Environmental Restoration Program, June.

**DOE, 1993** - U.S. Department of Energy, 1993, *Integrated Operable Units 8, 9, 10, 13, and 14 Phase I RFI/RI Final Health and Safety Plan.*

**DOE, 1994** - U.S. Department of Energy, 1994, *Technical Memorandum No. 1, Addendum to Phase I RFI/RI Work Plan, Field Sampling Plan, Volume I, Part A - Outside Tanks*, May.

**DOE, 1995a** - U.S. Department of Energy, 1995a, *Accelerated Action Plan for the Inter-Agency Agreement Underground Storage Tanks Containing RCRA-Regulated Materials*, December.

**DOE, 1995b** - U.S. Department of Energy, 1995b, *Data Summary Report No.2, Operable Unit No. 9, Outside Tanks, Volume 1*, Environmental Restoration Program, October.

**DOE, 1995c** - U.S. Department of Energy, 1995c, *RCRA Closure Plan, Building 889 Process Waste System*, EPA ID No. CO7890010526, June.

**DOE, 1996** - U.S. Department of Energy, 1996, *Proposed Action Memorandum for the Contaminant Stabilization of Underground Storage Tanks.*

**Rockwell, 1989** - Rockwell International, 1989, *RCRA Closure Plan, Tanks T-40, T-66, T-67, T-68, Hazardous Waste Management Unit 55*, September.

# APPENDIX A

## AAP Approval Letter

# STATE OF COLORADO

Roy Romer, Governor
Patricia A. Nolan, MD, MPH, Executive Director

*Dedicated to protecting and improving the health and environment of the people of Colorado*

HAZARDOUS MATERIALS AND WASTE MANAGEMENT DIVISION

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Denver, Colorado 80222-1530
Phone (303) 692-3300
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Colorado Department
of Public Health
and Environment


January 30, 1996

Mr. Steve Slaten
IAG Coordinator
Department of Energy-RFFO
P.O. Box 928
Golden, CO 80402-0928

RE: Approval of Accelerated Action Plan for Six IAG USTs

Dear Mr. Slaten:

The Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division and the Environmental Protection Agency (the Agencies) have reviewed the Accelerated Action Plan for six Underground Storage Tanks (USTs) containing Resource Conservation and Recovery Act (RCRA) materials listed in the Inter-Agency Agreement (IAG). This plan details activities including inventory removal and rinsing and sampling the tanks in preparation of filling the tanks with foam to prevent ground/surface water infiltration as interim actions to remove these USTs as on-going sources of contamination.

The Agencies give their approval for the actions detailed in this plan. The actions detailed are all within the scope of normal operations with the exception of filling the tanks with foam. It has been stated by Kaiser-Hill personnel that the foaming activity will be addressed in a separate Proposed Action Memorandum (PAM) detailing that process.

The Agencies would like to emphasize that although this plan is not intended to be a closure plan it may be possible to document that clean closure standards pertaining to the tanks themselves have been met with the activities conducted in this plan. Therefore, all rinsate samples should be compared to the clean closure standards contained within the permit to determine if these standards have been met. Also, the last sample collected and analyzed should be done with all QA/QC protocols in place so these data can be used at a later date. If clean closure is desired a P.E. certification of the work conducted under this plan should also be obtained. It should be noted, however, that this is an interim action and does not fully address closure issues including ancillary equipment and any releases from the tank systems. These issues will need to be addressed at a later date.

If you have any questions or comments about the Agencies approval of these actions please contact Mark Agular, EPA, at 312-6013 or Cathy Alstatt, CDPHE, at 692-3349.

Sincerely,

Joe Schieffelin, CDPHE
Unit Leader, Permitting and Compliance
Federal Facilities Program

Tim Rehder, EPA
Manager, Rocky Flats Program

cc: Susan Chaki, CDPHE-HMWMD
Steve Tarlton, CDPHE-OE
Dan Miller, AGO
Dave Maxwell, DOE
Mike Ferrari, Kaiser-Hill
Jefferson County Health Department

# APPENDIX B

## Final Rinsate Sample Data Tables

# Tank T-2/T-3 Analytical Results Final Rinsate Sample

(Sample No. TN00124RM)

| GROSS ALPHA/BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (5.6 +/- 0.6)E3 | pCi/l |
| Gross Beta | (6.5 +/- 0.5)E3 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 4,306 +/- 230 | pCi/l |
| Uranium-235 | 87 +/- 7 | pCi/l |
| Uranium-233/234 | 1,234 +/- 68 | pCi/l |
| Plutonium-239/240 | 33 +/- 1 | pCi/l |
| Americium-241 | 12 +/- 1 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Chloromethane | 2(J) | µg/l |
| Bromomethane | 9(J) | µg/l |
| Acetone | 21 | µg/l |
| 2-Butanone | 5(J) | µg/l |
| Tetrachloroethene | 4(J) | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acenaphthene | 11(J) | µg/l |
| Dibenzofuran | 6(J) | µg/l |
| Fluorene | 7(J) | µg/l |
| Phenanthrene | 24(J) | µg/l |
| Fluoranthene | 19(J) | µg/l |
| Pyrene | 18(J) | µg/l |
| Butylbenzylphthalate | 11(J) | µg/l |
| Benzo [a] anthracene | 7(J) | µg/l |
| Chrysene | 7(J) | µg/l |
| 2-Ethylhexylphthalate bis- | 87(B, J) | µg/l |
| Benzo [b] fluoranthene | 4(J) | µg/l |
| Benzo [k] fluoranthene | 4(J) | µg/l |
| Benzo [a] pyrene | 4(J) | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | 44 | µg/l |
| Barium | 2,030 | µg/l |
| Cadmium | 55.2 | µg/l |
| Chromium | 2,320 | µg/l |
| Lead | 5,800 | µg/l |
| Mercury | 2,010 | µg/l |
| Selenium | 10 | µg/l |
| Silver | 1,070 | µg/l |

pCi/l = picocuries per liter

µg/l = micrograms per liter

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration < method detection limit but >= instrument detection limit (INORGANIC)

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

# Tank T-10 (East) Analytical Results Final Rinsate Sample

(Sample No. TN00155RM)

| GROSS ALPHA/BETA ANALYSIS(1) | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (1.9 +/- 0.2)E3 | pCi/l |
| Gross Beta | (-3.4 +/- 0.9)E2 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 0.625 +/- 0.137 | pCi/l |
| Uranium-235 | 0.000 +/- 0.042 | pCi/l |
| Uranium-233/234 | 0.298 +/- 0.103 | pCi/l |
| Plutonium-239/240 | 1,304 +/- 31 | pCi/l |
| Americium-241 | 403 +/- 6 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 7(J) | µg/l |
| Chloroform | 63 | µg/l |
| Bromodichloromethane | 2(J) | µg/l |
| Trichloroethene | 1(J) | µg/l |
| Tetrachloroethene | 1(J) | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| bis(2-Ethylhexyl) phthalate | 1(J) | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | µg/l |
| Barium | 8.7(B) | µg/l |
| Cadmium | ND | µg/l |
| Chromium | ND | µg/l |
| Lead | 4.5(B) | µg/l |
| Mercury | ND | µg/l |
| Selenium | ND | µg/l |
| Silver | ND | µg/l |

1 Negative value due to crosstalk correction factor

pCi/l = picocuries per liter

µg/l = micrograms per liter

ND = Not Detected

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration < method detection limit but >= instrument detection limit (INORGANIC)

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

## Tank T-10 (West) Analytical Results Final Rinsate Sample

(Sample No. TN00165RM)

| GROSS ALPHA/BETA ANALYSIS(1) | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (6.6 +/- 0.6)E3 | pCi/l |
| Gross Beta | (-1.0 +/- 0.2)E3 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 8.21 +/- 0.55 | pCi/l |
| Uranium-235 | 0.200 +/- 0.094 | pCi/l |
| Uranium-233/234 | 3.07 +/- 0.33 | pCi/l |
| Plutonium-239/240 | 5,419 +/- 126 | pCi/l |
| Americium-241 | 1,675 +/- 21 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 8(J) | µg/l |
| Chloroform | 51 | µg/l |
| Bromodichloromethane | 2(J) | µg/l |
| Trichloroethene | 9 | µg/l |
| Tetrachloroethene | 13 | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| bis(2-Ethylhexyl) phthalate | 4(J) | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | µg/l |
| Barium | 13.2(B) | µg/l |
| Cadmium | ND | µg/l |
| Chromium | 6.2(B) | µg/l |
| Lead | 8.2 | µg/l |
| Mercury | ND | µg/l |
| Selenium | ND | µg/l |
| Silver | 5.0(B) | µg/l |

1 Negative value due to crosstalk correction factor

pCi/l = picocuries per liter

µg/l = micrograms per liter

ND = Not Detected

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration < method detection limit but >= instrument detection limit (INORGANIC)

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

# Tank T-14 Analytical Results Final Rinsate Sample

(Sample No. TN00174RM)

| GROSS ALPHA/BETA ANALYSIS(1) | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (1.4 +/- 0.1)E4 | pCi/l |
| Gross Beta | (-5.7 +/- 3.0)E2 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 117 +/- 3 | pCi/l |
| Uranium-235 | 1.66 +/- 0.27 | pCi/l |
| Uranium-233/234 | 19.4 +/- 1.0 | pCi/l |
| Plutonium-239/240 | 2,047 +/- 50 | pCi/l |
| Americium-241 | 8,187 +/- 121 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 9.6(B, J) | µg/l |
| Carbon Disulfide | 1.8(J) | µg/l |
| 2-Butanone | 1.5(J) | µg/l |
| Tetrachloroethene | 1.7(J) | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Dimethylphthalate | 19 | µg/l |
| N-Nitrosodiphenylamine 1 | 14 | µg/l |
| bis (2-Ethylhexyl) phthalate | 23 | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | µg/l |
| Barium | 9.6(B) | µg/l |
| Cadmium | ND | µg/l |
| Chromium | ND | µg/l |
| Lead | 4.7(B) | µg/l |
| Mercury | ND | µg/l |
| Selenium | ND | µg/l |
| Silver | ND | µg/l |

1 Negative value due to crosstalk correction factor

pCi/l = picocuries per liter

µg/l = micrograms per liter

ND = Not Detected

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration < method detection limit but >= instrument detection limit (INORGANIC)

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

# Tank T-16 (South) Analytical Results Final Rinsate Sample

(Sample No. TN00146RM)

| GROSS ALPHA/BETA ANALYSIS(1) | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (2.5 +/- 0.1)E4 | pCi/l |
| Gross Beta | (-5.5 +/- 2.9) E2 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 56.3 +/- 1.9 | pCi/l |
| Uranium-235 | 1.16 +/- 0.22 | pCi/l |
| Uranium-233/234 | 36.8 +/- 1.4 | pCi/l |
| Plutonium-239/240 | 5,367 +/- 130 | pCi/l |
| Americium-241 | 13,954 +/- 201 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Methylene Chloride | 3(J) | µg/l |
| Acetone | 90(J,B) | µg/l |
| 1,1-Dichlorethene | 130 | µg/l |
| Chloroform | 40 | µg/l |
| 1,2-Dichloropropane | 270 | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| bis(2-Ethylhexyl) phthalate | 2(J) | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | ND | µg/l |
| Barium | 18.1(B) | µg/l |
| Cadmium | ND | µg/l |
| Chromium | 12.2 | µg/l |
| Lead | 20 | µg/l |
| Mercury | ND | µg/l |
| Selenium | 1.7(B) | µg/l |
| Silver | 10.5 | µg/l |

1 Negative value due to crosstalk correction factor

pCi/l = picocuries per liter

µg/l = micrograms per liter

ND = Not Detected

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the concentration is < method detection limit but >= instrument detection limit (INORGANIC)

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

# Tank T-40 (North) Analytical Results Final Rinsate Sample

(Sample No. TN00106RM)

| GROSS ALPHA/BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (4.2 +/- 0.4)E3 | pCi/l |
| Gross Beta | (1.1 +/- 0.2)E2 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 608 +/- 28 | pCi/l |
| Uranium-235 | 38.6 +/- 4.1 | pCi/l |
| Uranium-233/234 | 1,403 +/- 58 | pCi/l |
| Plutonium-239/240 | 265 +/- 11 | pCi/l |
| Americium-241 | 49.7 +/- 3.3 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 73(B) | µg/l |
| 2-Butanone | 19(B, J) | µg/l |
| Trichloroethene | 38 | µg/l |
| Benzene | 10(J) | µg/l |
| Tetrachloroethene | 2,800 | µg/l |
| Ethylbenzene | 6(J) | µg/l |
| Xylene (m,p) | 15(J) | µg/l |
| Trich-triflethane | 29 | µg/l |
| Xylene (o) | 7(J) | µg/l |
| 1,4-Dichlorobenzene | 9(J) | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| 1,2-Dichlorobenzene | 10(J) | µg/l |
| Acetophenone | 7(J) | µg/l |
| Naphthalene | 4(J) | µg/l |
| 2-Methylnaphthalene | 16(J) | µg/l |
| Dimethyl phthalate | 54 | µg/l |
| Diethyl phthalate | 4(J) | µg/l |
| Phenanthrene | 9(J) | µg/l |
| Di-n-butyl phthalate | 13(B, J) | µg/l |
| Pyrene | 7(J) | µg/l |
| bis(2-Ethylhexyl) phthalate | 520(E, B) | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | 2.9 | µg/l |
| Barium | 313 | µg/l |
| Cadmium | 64.2 | µg/l |
| Chromium | 462 | µg/l |
| Lead | 600 | µg/l |
| Mercury | 43.7 | µg/l |
| Selenium | ND | µg/l |
| Silver | 20.1 | µg/l |

pCi/l = picocuries per liter
µg/l = micrograms per liter
ND = Not Detected
B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)
B = Laboratory qualifier indicating the analyte concentration < method detection limit but >= instrument detection limit (INORGANIC)
J = Laboratory qualifier indicating an estimated value which is less than the detection limit

## Tank T-40 (South) Analytical Results Final Rinsate Sample

(Sample No. TN00113RM)

| GROSS ALPHA/BETA ANALYSIS | | |
|---|---|---|
| Analyte | Activity | Units |
| Gross Alpha | (2.6 +/- 0.3)E3 | pCi/l |
| Gross Beta | (5.0 +/- 1.4)E2 | pCi/l |
| **RADIOCHEMISTRY ISOTOPIC ANALYSIS** | | |
| Analyte | Activity | Units |
| Uranium-238 | 468 +/- 23 | pCi/l |
| Uranium-235 | 35.7 +/- 4.1 | pCi/l |
| Uranium-233/234 | 1,102 +/- 48 | pCi/l |
| Plutonium-239/240 | 179 +/- 8 | pCi/l |
| Americium-241 | 41.4 +/- 2.9 | pCi/l |
| **VOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| Acetone | 31(B, J) | µg/l |
| 2-Butanone | 8(B, J) | µg/l |
| Trichloroethene | 9(J) | µg/l |
| Tetrachloroethene | 710 | µg/l |
| Xylene (m,p) | 6(J) | µg/l |
| **SEMIVOLATILE ORGANIC ANALYSIS** | | |
| Analyte | Concentration | Units |
| 1,2-Dichlorobenzene | 3(J) | µg/l |
| Diethyl phthalate | 2(J) | µg/l |
| Di-n-butyl phthalate | 9(B, J) | µg/l |
| bis(2-Ethylhexyl) phthalate | 260(B) | µg/l |
| **TOTAL METAL ANALYSIS** | | |
| Analyte | Concentration | Units |
| Arsenic | 2.7 | µg/l |
| Barium | 230 | µg/l |
| Cadmium | 72 | µg/l |
| Chromium | 146 | µg/l |
| Lead | 332 | µg/l |
| Mercury | 48.9 | µg/l |
| Selenium | ND | µg/l |
| Silver | 8.4 | µg/l |

pCi/l = picocuries per liter

µg/l = micrograms per liter

ND = Not Detected

B = Laboratory qualifier indicating the analyte was detected in the blank sample (ORGANIC)

B = Laboratory qualifier indicating the analyte concentration < method detection limit but >= instrument detection limit (INORGANIC)

J = Laboratory qualifier indicating an estimated value which is less than the detection limit

# APPENDIX C

## MSDS for Polyurethane Foam

# Material Safety Data Sheet

NCFI

NORTH CAROLINA FOAM INDUSTRIES, INC.

P.O. BOX 1528
MOUNT AIRY, NORTH CAROLINA 27030
919-789-9161

## PRODUCT IDENTIFICATION

**TRADE NAME:** NCFI 810-91 R
**CHEMICAL FAMILY:** Polyol Resin System
**CHEMICAL NAME:** Mixture
**FORMULA:** N/A
**SYNONYMS:** Urethane Resin
**DATE PREPARED:** 6/25/91

## INGREDIENTS - HAZARD CLASSIFICATION

| NAME: | CAS NO. | % | TLV |
|---|---|---|---|
| 1,1-Dichloro-1-fluoroethane[1] ($CH_3CCl_2F$ or HCFC-141b) | 1717-00-6 | 14 | None Established. 500 ppm TWA and 800 ppm STEL recommended. |

[1]Not listed as a carcinogen (NTA, IARC, OSHA)

## SHIPPING INFORMATION

chlorofluoroethane is not regulated when shipped domestically by land or water. If shipped by (IATA): other regulated substances: Class 9; ID NO. 8027 (miscellaneous label).

## PHYSICAL DATA

BOILING POINT (°F): $CH_3CCl_2F$, 90°F
SPECIFIC GRAVITY: 1.16
SOLUBILITY IN WATER: Slight
% VOLATILE BY VOLUME: 13
APPEARANCE AND ODOR: Dark red-brown liquid; slight ethereal odor

## FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: After $CH_3CCl_2F$ evaporation, over 200°F (Pensky-Martens)
FLAMMABLE LIMITS (VAPOR)
EXTINGUISHING MEDIA: Water, dry chemicals, $CO_2$.
Lower: 7.4%; Upper: 15.5%

SPECIAL FIRE FIGHTING PROCEDURES: A self-contained breathing apparatus must be worn to protect against toxic and irritating vapors.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Overheated containers may rupture due to pressure produced by $CH_3CCl_2F$. $CH_3CCl_2F$ burns to form acids and noxious gases.

## REACTIVITY DATA

STABILITY: Stable
CONDITIONS TO AVOID: Temperatures over 85°F

YMERIZATION: Will not occur
CONDITIONS TO AVOID: N/A

OMPATABILITY: Isocyanates and other chemicals which react with hydroxyl groups.

ARDOUS DECOMPOSITION PRODUCTS: When burned; CO, $CO_2$, $NO_x$, aliphatic fragments, HF, HCl

# Material Safety Data Sheet

NCFI

NORTH CAROLINA FOAM INDUSTRIES, INC.

P.O. BOX 1528
MOUNT AIRY, NORTH CAROLINA 27030
919-789-9161

## PRODUCT IDENTIFICATION

**Trade Name:** NCFI 810-91 A

**Chemical Family:** Aromatic Isocyanate

**Chemical Name:** Polymethylenepolyphenylisocyanate

**Formula:** N/A

**Synonyms:** Polymeric MDI

**Date Prepared:** 6/25/91

## HAZARDOUS INGREDIENTS

| Name: | % | TLV |
|---|---|---|
| Diphenylmethane diisocyanate (MDI)[1] | Approximately 50 | 0.02 ppm ceiling |
| Higher polymers of similar structure[1] | Approximately 50 | Not established |

[1] Not listed as a carcinogen (NTA, IARC, OSHA)

## PHYSICAL DATA

**'ing Point:** 625°F

**Specific Gravity:** 1.24

**Solubility in Water:** Insoluble, reacts

**%Volatile by Volume:** None

**Appearance and Odor:** Brown liquid, slightly aromatic odor

## FIRE AND EXPLOSION HAZARD DATA

**Flash Point (test method):** 390°F Pensky-Martens)

**Extinguishing Media:** Water, dry chemicals, $CO_2$

**Special Fire Fighting Procedures:** A self-contained breathing apparatus should be worn to protect against toxic and irritating vapors.

**Unusual Fire and Explosion Hazards:** At temperatures above 400°F, MDI can polymerize/decompose causing pressure build-up in closed containers and possibly rupture. Avoid water contamination in closed containers which may cause rupture ($CO_2$ is evolved).

## REACTIVITY DATA

**Stability:** Stable

**Conditions to Avoid:** Contamination with water.

**Polymerization:** May occur if in contact with water or other isocyanate reactive materials.

**ompatability:** Water, alcohols, amines, strong bases.

**ardous Decomposition Products:** By high heat or fire; CO, $CO_2$, $NO_x$, benzene, toluene, aliphatic fragments, traces of HCN.

# Material Safety Data Sheet

NCFI

NORTH CAROLINA FOAM INDUSTRIES, INC.

P.O. BOX 1528
MOUNT AIRY, NORTH CAROLINA 27030
919-789-9161

Date Prepared: 2/22/89

## SARA 313 INFORMATION

The isocyanate (A) product contains the following toxic substance subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

| CHEMICAL NAME | CAS NUMBER | CONCENTRATION |
|---|---|---|
| METHYLENE BIS(PHENYLISOCYANATE) (MBI) [Same as Diphenylmethane diisocyanate (MDI)] | 000101-68-8 | 39-50% |

IMPORTANT NOTICE:

This notification is a part of the Material Safety Data Sheet and must not be detached. Any copying and redistribution of the Material Safety Data Sheet shall include copying of this notice and attaching the copy to the redistributed Material Safety Data Sheet copies.

# APPENDIX D

Sample Analysis Lab Data Sheets
(See Volume Two)

E 2,081,711 E 2,082,000 E 2,083,000 E 2,084,000 E 2,084,653

N 751,368 N 751,000 N 750,000 N 749,000 N 748,353

E 750,000 E 749,000 E 748,353

T-16
T-14
Building 774
T-10
Building 730
Building 441
T-2 & T-3
Building 889
T-40

# Figure 1-1

## IAG Underground Storage Tanks Location Map

### EXPLANATION

Tanks of Immediate Interest

**Standard Map Features**

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads

*DATA SOURCE:*
*Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.*
*Hydrology provided by USGS - (date unknown)*

*DISCLAIMER:*
*Neither the United States Government nor Kaiser Hill Co., nor Rocky Mountain Remediation Services, L.L.C., nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.*

N

Scale = 1 : 2730
1 inch represents approximately 228 feet

80 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: x8682

September 23, 1996

/gis/data/ftp-map-emi/iag-tanks/iag-tanks.aml