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241-AP-107

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Tank Characterization Report for Double-Shell Tank 241-AP-107

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MASTER

EXECUTIVE SUMMARY

Double-Shell Tank 241-AP-107 is a radioactive waste tank most recently sampled in August of 1993. Sampling and characterization of the waste in Tank 241-AP-107 contributes toward the fulfillment of Milestone M-44-05 of the *Hanford Federal Facility Agreement and Consent Order*. Characterization is also needed to evaluate the waste's fitness for safe processing through an evaporator.

Tank 241-AP-107, located in the 200 East Area AP Tank Farm, was constructed and went into service in 1986 as a dilute waste receiver tank. The tank has an operational capacity of 1,140,000 gallons, and currently contains 1,108,000 gallons of dilute non-complexed waste. The waste exists as an aqueous liquid, although the presence of a sludge layer cannot be disproved decisively until further sampling is done. Final disposal of the waste in Tank 241-AP-107 will be as high- and low-level glass fractions. The tank is not classified as a Watch List tank and is considered to be sound. There are no Unreviewed Safety Questions associated with Tank 241-AP-107 at this time.

The waste in Tank 241-AP-107 exists as an aqueous solution of metallic salts and radionuclides. The most prevalent soluble analytes include sodium, fluoride, nitrate, and nitrite. The only radionuclides present in concentrations above their detection limits are ^{14}C , ^{137}Cs , ^{90}Sr , and ^3H . The waste is approximately 98 wt% water. Comparisons to established limits of concern of selected analytes can be made by referring to the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

The results of the analyses have been compared to the dangerous waste codes in the Washington Dangerous Waste Regulations (WAC 173-303). This assessment was conducted by comparing tank analyses against dangerous waste characteristics ("D" waste codes) and against state waste codes. It did not include checking tank analyses against "U", "P", "F", or "K" waste codes since application of these codes is dependent on the source of the waste and not on particular constituent concentrations. The results indicate that the waste in this tank is adequately described in the Dangerous Waste Permit Application for the Double-Shell Tank System; this permit is discussed in the *Tank Characterization Reference Guide* (De Lorenzo, et al., 1994).

Tank 241-AP-107

TANK DESCRIPTION

Type: Double-Shell
 Constructed: 1986
 In Service: 1986
 Diameter: 75' (23 m)
 Usable Depth: 35' (10.7 m)
 Capacity: 1,140,000 gal
 (4,315,000 L)
 Bottom Shape: Flat
 Hanford Coordinates: 40,286° North
 47,100° West
 Ventilation: Operating Exhauster

TANK STATUS: (as of May 1994)

Contents: Dilute Non-Complexed Waste
 Total Waste: 1,108,000 gal
 (4,190,000 L)
 Supernate Volume: 1,108,000 gal
 (4,190,000) L
 Solids Volume: -0-
 Drainable Interstitial Liquid: -0-
 Manual Tape Surface Level: 402.25 inches
 03/23/94
 FIC Surface Level: 403.6 inches (03/23/94)
 Integrity Status: Sound

Double-Shell Tank 241-AP-107 Concentrations and Inventories for Critical List Analytes (as of May 1994)		
Total Operating Tank Volume	1,140,000 gallons (4,315,000 L)	
Total Waste Volume	1,108,000 gallons (4,190,000 L) 4,144,000 kg	
Liquid Volume	1,108,000 gallons (4,190,000 L) 4,144,000 kg	
Physical Properties		
Specific Gravity	0.989	
H ₂ O	98.5 wt% 4,082,000 kg Inventory	
Temperature	54°F (4/27/94)	
pH	12.2	
Energetics	no exotherms	
Chemical Constituents	Average Concentration	Bulk Inventory
Al (Aluminum)	1.07E-04 wt%	4.44 kg
Ca (Calcium)	2.03E-03 wt%	84.3 kg
Mg (Magnesium)	1.57E-04 wt%	6.51 kg
Na (Sodium)	0.230 wt%	9,540 kg
Zn (Zinc)	1.0E-06 wt%	4.15 kg
F (Fluoride)	0.014 wt%	594 kg
OH ⁻ (Hydroxide)	0.0268 wt%	1,110 kg
NO ₃ ⁻ (Nitrate)	0.103 wt%	4,270 kg
NO ₂ ⁻ (Nitrite)	0.112 wt%	4,650 kg
Total Organic Carbon	5.31E-03 wt%	220 kg
Radionuclides		
Total Plutonium	< 1.18 µCi/L	< 4.97 Ci
Total Uranium	2.36E-06 wt%	0.0980 kg
¹³⁷ Cs	0.123 µCi/L	0.515 Ci
⁹⁰ Sr	0.118 µCi/L	0.494 Ci
³ H	35.2 µCi/L	147 Ci

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LIST OF TERMS

AEA	alpha energy analysis
APC	alpha proportional counting
BPC	beta proportional counting
CFR	<i>Code of Federal Regulations</i>
CVAA	cold vapor atomic absorption
DNFSB	Defense Nuclear Facilities Safety Board
DOE	United States Department of Energy
DQO	Data Quality Objective
DSC	differential scanning calorimetry
EPA	United States Environmental Protection Agency
FIC	Food Instrument Corporation
GC	gas chromatography
GEA	gamma energy analysis
GHAA	gaseous hydride atomic absorption
IC	ion chromatograph
ICP	inductively coupled plasma atomic emission spectrometry
KTN	Kjeldahl's Total Nitrogen
LEPS	low energy photo spectroscopy
LF	laser fluorimetry
LSC	liquid scintillation counting
MS	mass spectrometry
ND	not detected
NDIR	non-dispersive
PNL	Pacific Northwest Laboratory
PUREX	Plutonium-Uranium Extraction Plant
RPD	relative percent difference
SpG	specific gravity
SVOA	semivolatile organic analysis
TC	total carbon
TIC	total inorganic carbon
TOC	total organic carbon
TWRS	Tank Waste Remediation System
VOA	volatile organic analysis
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

In August of 1993, Double-Shell Tank 241-AP-107 was sampled to determine proper handling of the waste, to address corrosivity and compatibility issues, and to comply with requirements of the *Washington Administrative Code* (Ecology, 1991). This Tank Characterization Report presents an overview of that tank sampling and analysis effort, and contains observations regarding waste characteristics, expected inventory, and concentration data for the waste contents based on this latest sampling data and historical tank information. Finally, this report makes recommendations regarding operational safety issues.

1.1 PURPOSE

The purpose of this Tank Characterization Report is to describe and characterize the waste in Double-Shell Tank 241-AP-107 (hereafter Tank 241-AP-107) based on information gathered from various sources. This report summarizes the available information regarding the waste in Tank 241-AP-107, and arranges it in a useful format for making management and technical decisions concerning this particular waste tank. In addition, conclusions and recommendations based on safety and further characterization needs are given. Specific objectives reached by the sampling and characterization of the waste in Tank 241-AP-107 are:

- Contribute toward the fulfillment of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-44-05 concerning the characterization of Hanford Site high-level radioactive waste tanks (Ecology, EPA & DOE; 1993).
- Complete safety screening of the contents of Tank 241-AP-107 to meet the characterization requirements of the *Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 93-5* (Conway, 1993).
- Provide tank waste characterization to the Tank Waste Remediation System (TWRS) Program Elements in accordance with the *TWRS Tank Waste Analysis Plan*, (Bell, 1994).

1.2 SCOPE

This report begins with a broad background of historical information that was available prior to the sampling activity. The result of this review is the estimation of the contents of Tank 241-AP-107 based on historical process information and detailed transaction records. Next, the results of the sampling and analysis effort are summarized, and interpreted both qualitatively and quantitatively. The information obtained from historical sources is then evaluated with the actual waste measurements to arrive at final waste inventory and concentration estimates. Finally, conclusions and recommendations are given based on the current waste inventory and tank status.

1.3 ASSUMPTIONS

The concentration and inventory estimates derived for this report are considered by the authors and by the Westinghouse Hanford Company Characterization Program to be the most accurate, defensible, technically valid, and contemporary data concerning Tank 241-AP-107. This Tank Characterization Report incorporates all available previous sampling, characterization, and transfer data concerning Tank 241-AP-107. In addition, estimates of the current tank contents based on process knowledge and waste transaction records provide important cross-checks and corroboration to the inventory estimates derived from recent analytical data. Given that the analytical data is valid and defensible, this report is therefore the definitive characterization of the contents of Tank 241-AP-107.

The term "analytical results" is used in this report to denote sample results from the most recent sampling event. Characterization data from these samples are used for the analytical section of this report, Section 5.0. The historical characterization of this tank, Section 2.4, is based on the available "historical results" prior to the 1993 sampling.

Tank 241-AP-107 remains in active service for waste management operations. Although the future contents of the tank will likely change, the characterization of Tank 241-AP-107 is considered accurate and representative of the tank contents as of the date of preparation of this report: May 1994.

2.0 HISTORICAL TANK INFORMATION

The purpose of this section is to describe Tank 241-AP-107 based on historical tank information, and to use this information to predict the tank waste composition and constituent concentrations. This section is divided into five parts. A brief description and historical background of the tank comprise the first part, followed by the current tank status, a summary of the process sources that contributed to the tank waste, and an estimation of the contents of Tank 241-AP-107 based on historical information. The final part details the surveillance data taken on the tank.

2.1 TANK HISTORY

Tank 241-AP-107 is a tank-in-tank design consisting of a heat-treated primary steel liner, inside a second steel liner. The tank has a design capacity of 1.16 million gallons; however, safety considerations require a maximum operating capacity of 1.14 million gallons. Instruments enter Tank 241-AP-107 through risers and monitor the pressure, temperature, liquid level, sludge level, and other tank characteristics (Bell, 1994). A detailed diagram of a double-shell tank is presented in Figure 2-1 (Hanlon, 1994).

Tank 241-AP-107 was constructed and went into service in 1986 as a Dilute Receiver Tank. It is one of eight tanks that comprise the AP Tank Farm in the southeast corner of the 200 East Area. Figure 2-2 details the Hanford Site's 200 East Area and the location of the 241-AP Tank Farm. This particular tank is located in the Tank Farm's southwest corner.

Tank 241-AP-107 contains only dilute non-complexed waste, primarily from two sources. Approximately 98% of the waste is from the PUREX Ammonia Scrubber; the rest is flush water from miscellaneous sources.

2.2 TANK STATUS

Tank 241-AP-107 currently contains 1,108,000 gallons of dilute non-complexed waste. The tank is at 97% capacity (volume) with 32,000 gallons of reserve capacity. Tank 241-AP-107 is still in service, as are all eight tanks in the AP Tank Farm. The "in service" designation allows these tanks to continue receiving waste in conjunction with production and/or waste processing operations. The tank integrity is classified as sound and it currently is not on any Watch List. There are no Unreviewed Safety Questions associated with Tank 241-AP-107 at this time.

Tank 241-AP-107 is equipped with both a manual tape and an automated liquid indicator device for surface level readings; both are still operable. The waste occupies approximately the bottom 403 inches of the tank. Active ventilation through a filtration system is used to keep the tank contents cool and to minimize the potential for release of airborne contaminants to the environment (Husa et al., 1993). All tank instruments, with the exception of the Leak Detection Pit radiation readings, are in monitoring compliance (Hanlon, 1994). Tank temperatures are stable, with 54°F reported on April 27, 1994.

Figure 2-1. Double-Shell Tank Configuration.

Figure 2-2. Location of the 241-AP Tank Farm.

2.3 PROCESS KNOWLEDGE

Figure 2-3 depicts the fill history of Tank 241-AP-107 from August 1986, the time it became operational, to the end of the fourth quarter 1993, the last entry in the *Waste Volume Projection Historical Database* (Koreski, 1994). A detailed description of the transfers responsible for the waste level fluctuations shown in Figure 2-3 follows. All of the volume data were taken from Koreski.

Tank 241-AP-107 entered service with a transfer of 19,000 gallons of flush water in August 1986. It continued to receive small additions of flush water until the first quarter of 1990, when it received three transfers of dilute non-complexed waste from the PUREX Ammonia Scrubber. The three transfers totaled 1,115,000 gallons, from individual transfers of 305,000 gallons, 755,000 gallons, and 55,000 gallons. This PUREX Ammonia Scrubber waste constituted approximately 98% of Tank 241-AP-107's total volume of 1,139,000 gallons at the end of the first quarter of 1990.

The peak volume for Tank 241-AP-107 is 1,139,000 gallons, as it has not received any transfers since the end of the first quarter of 1990. In fact, the only entries since the first quarter of 1990 in Koreski are periodic small losses, and one gain due to instrumentation. Unknown losses are most likely caused by evaporation. Losses or gains due to instrumentation also account for changes reported in tank volume. A switch from one measurement gauge to another would be recorded as a gain or loss in depth since the methods do not have the same reference zero. An example of this is changing from automatic to manual tape, or vice versa. If the tank volume calculation for Tank 241-AP-107 was changed today from automatic to manual tape, a loss of about 4,000 gallons would be reported. The difference between the Food Instrument Corporation automatic measurement level and the manual tape level is 1.35 inches (2,750 gallons per inch). The final volume for the tank according to Koreski, as of December 24, 1993, was reported at 1,108,000 gallons following a loss of 31,000 gallons over nearly four years, due to the aforementioned causes. This gradual and constant decline in waste level, representing a loss of approximately 21 gallons per day, can be attributed to evaporation from the waste's surface. Recently, surveillance data have shown that the tank volume remains 1,108,000 gallons.

2.4 HISTORICAL ESTIMATION OF THE CONTENTS OF TANK 241-AP-107

A preliminary estimate of the present waste constituents in Tank 241-AP-107 can be generated by reviewing the historical analytical data for the tank. This estimation is useful as a baseline for comparison with the most recent characterization data.

Unfortunately, Tank 241-AP-107 had never been sampled and characterized before the August 1993 sampling date, so no historical characterization data exists. However, a suitable approximation of the contents of the tank can be made by examining the sources of the waste.

Excluding flush water, all of the waste in Tank 241-AP-107 originated from three transfers from the PUREX Ammonia Scrubber (Koreski, 1994). The waste from the PUREX Ammonia Scrubber is relatively constant in chemical composition. Evidence which supports this is shown in Tables 2-1a and 2-1b. These tables contain sampling data over a week (8/1/88 to 8/7/88) for PUREX Tank G-7, which stored PUREX Ammonia Scrubber waste before transfer to the Tank Farms. Table 2-1a presents pH and anion data for the week, while radionuclide data are given in Table 2-1b. No data on metal constituents was available.

Figure 2-3. Waste Volume History of Tank 241-AP-107.

Table 2-1a. Estimated Waste Composition of Tank 241-AP-107 Chemical Constituents
(from PUREX Tank G-7 Sample Data 8/1/88 - 8/7/88)

Sample Number and Date	NH_4^+ (M)	F^- (M)	NO_2^- (M)	OH^- (M)	pH
1 ^a 8/1/88	0.0713	1.925E-04	0.0202	0.0212	12.32
2 8/2/88	0.0363	3.140E-05	0.0108	0.0054	11.74
3 8/2/88	0.0147	6.180E-05	0.0241	0.0092	12.16
4 ^a 8/2/88	0.0160	5.57E-05	0.0326	0.0121	12.27
5 8/3/88	0.4460	2.520E-04	0.0092	< 0.0491	11.74
6 8/3/88	0.3110	2.780E-04	0.0201	0.0112	12.18
7 ^a 8/5/88	0.0791	2.425E-04	0.0184	0.0103	11.34
8 ^a 8/5/88	0.0554	2.65E-04	0.0426	0.0462	12.97
9 8/5/88	0.3910	2.480E-04	0.0261	0.0061	12.43
10 8/6/88	0.2140	6.670E-04	0.0247	0.0071	12.21
11 8/6/88	0.0828	2.610E-04	0.0079	< 0.0049	11.35
12 8/6/88	0.0485	1.430E-04	0.0357	0.0181	12.13
13 8/7/88	0.0598	1.210E-04	0.0356	0.0034	12.33
14 8/7/88	0.0456	5.300E-04	0.0314	0.0095	11.99
Mean Concentration	0.134 M	2.39 E-04 M	0.0242 M	0.0153 M	12.08
Mean Concentration ($\mu\text{g/L}$)	2.41E+06	4,540	1.11E+06	2.60E+05	---

^aAverage of two duplicate samples.

Table 2-1b. Estimated Waste Composition of Tank 241-AP-107 Radionuclides
(from PUREX Tank G-7 Sample Data 8/1/88 - 8/7/88)

Sample Number and Date	¹⁴⁴ Ce/Pr μCi/L	⁶⁰ Co μCi/L	¹³⁴ Cs μCi/L	¹³⁷ Cs μCi/L	⁹⁵ Nb μCi/L
1 ^a 8/1/88	13.65	< 0.0195	< 0.0252	0.374	0.283
2 8/2/88					0.106
3 8/2/88	5.590	< 0.0187	< 0.0176	0.446	0.184
4 ^a 8/2/88	11.00	< 0.02475	< 0.0248	0.447	0.3875
5 8/3/88	1.850	< 0.0190	0.0180	0.1990	0.0609
6 8/3/88	4.790	< 0.0300	< 0.0233	0.217	0.1540
7 ^a 8/5/88					0.13
8 ^a 8/5/88	2.085	< 0.0239	0.248	3.98	< 0.0678
9 8/5/88					0.5310
10 8/6/88	4.290	< 0.0314	0.1670	2.600	0.1210
11 8/6/88	1.630	< 0.0187	0.0981	1.590	< 0.0225
12 8/6/88	0.921	< 0.0396	< 0.0200	1.110	< 0.0211
13 8/7/88					0.1090
14 8/7/88	2.820	< 0.0357	< 0.0301	0.956	0.1080
Mean Concentration (μCi/L)	4.86	< 0.0261	< 0.0672	1.19	0.163

^aAverage of two duplicate samples.

PUREX Tank G-7 was sampled 14 times during that week, and as can be seen from the tables the concentrations of the waste constituents varied little. However, the waste in the tank was changing continually, so the samples were not taken of the same waste. Since the analytes in PUREX Ammonia Scrubber waste generally have standard concentrations, the means listed in the tables have been determined a good representation of all PUREX Ammonia Scrubber waste, including that received by Tank 241-AP-107 in 1990. Consequently, these means have been used as the historical estimation of the waste composition of Tank 241-AP-107, and have been included in Table 5-4 as the Historic Tank Content Estimate.

In the case where an analyte was present at a value less than the analytical procedure detection limit, the maximum detection limit value was maintained as the tank estimate. This provides a conservative estimate which does not attempt to alter the predetermined lower limit of quantitation.

2.5 SURVEILLANCE DATA

2.5.1 Surface Level Readings

Tank 241-AP-107 is equipped with a liquid level gauge manufactured by the Food Instrument Corporation (FIC) which can be monitored either automatically or manually. The FIC indicator uses a conductivity probe to detect the level of the tank's contents and, in the automatic mode, is electrically connected to a computer for data transmission via the Computer Automated Surveillance System. Tank 241-AP-107 is also equipped with a manual tape from which readings are taken when the FIC indicator is out of service. Both devices are currently operable. The most recent FIC liquid level measurement available was 403.6 inches on March 23, 1994. The manual tape reading for the same date was 402.25 inches (Rios, 1994). This small difference (1.35 inches) represents a relative percent difference of only 0.3%

2.5.2 Internal Tank Temperatures

Tank 241-AP-107, as well as all other AP Farm double-shell tanks, is equipped with approximately 100 thermocouples (thermoelectric temperature measuring devices) in the tank interior, the annular space, and in the concrete outer shell. A thermocouple tree, with 18 thermocouples assembled in a pipe and inserted into a waste tank, is used to monitor the waste temperatures at various levels in the primary tank, usually every two feet. Temperature readings for Tank 241-AP-107 have been automatically and manually recorded since July 1989 by surveillance analysis computer systems. The maximum waste temperatures from the weekly manual readings have been plotted over time starting in 1990 and are presented in Figure 2-4 (Rios, 1994). The most recent tank temperature reported was 54°F on April 27, 1994.

It is apparent from the plotted temperature graph that the temperature of the tank contents exhibits seasonal fluctuations. This is expected since the soil between the surface level and approximately 10 feet below surface level creates a zone that is thermally transient, thus displaying diurnal and seasonal variations in temperature (Freeze and Cherry, 1979).

Figure 2-4. Thermocouple Tree Raw Temperature Plot for Tank 241-AP-107 (Rios, 1994).

Usually the soil below this 10-foot zone attenuates the effects of changing ambient air temperature. The bottom of the tank is 55 feet below the surface level, but unlike a solid mass of soil the effects of changing air temperature are still felt because the tank is a more efficient heat conductor. The tank's metal and concrete container filled with liquid, surrounded by actively ventilated annular space and connected to the surface by risers and drywell openings, will transfer heat to and from the surface more readily. Furthermore, the active ventilation system forces heat transfer between the tank contents and the ambient air. Seasonal variations have caused the temperatures of the waste in Tank 241-AP-107 to fluctuate between a high of 70°F to a low of 54°F.

Except for three periods when the thermocouple equipment was out of service, the internal temperature of Tank 241-AP-107 has been monitored approximately weekly. As seen in Figure 2-4, the three periods with no thermocouple data are from the end of the fourth quarter 1990 to the second quarter 1991, from the third quarter 1991 to the fourth quarter 1992, and from the end of the fourth quarter 1992 to the middle of the second quarter 1993.

Up to the first quarter of 1990, Tank 241-AP-107 contained only flush water. Temperatures rose rapidly in early 1990 as the tank received waste from the PUREX Ammonia Scrubber. Temperatures peaked at 70°F near the start of the third quarter and then began a downward trend. Tank temperatures would be expected to continue this downward trend into the first quarter of 1991. However, the final reading in 1990 was 70°F. This data point is preceded by several readings in the lower 60s, and followed by a period of several months when data were not available. Since no waste was added to or taken from Tank 241-AP-107 since the first quarter of 1990, a change in the tank's waste composition caused by a transfer can be eliminated as a possible cause. The most likely cause for this apparent anomaly appears to be an instrument malfunction. This conclusion is supported by the thermocouple equipment being out of service for several months following the high reading.

3.0 TANK SAMPLING OVERVIEW

The sampling program for Tank 241-AP-107 was designed primarily to determine whether the waste is acceptable feed for an evaporator. Characterization of the waste provides sufficient information to decide whether constituent concentrations are within safe operating limits. It should also provide data to predict the types and amounts of environmentally hazardous waste likely to occur in the evaporator product streams.

3.1 DESCRIPTION OF SAMPLING EVENT

Tank 241-AP-107 was sampled on August 1, 1993 from three vertical risers within the tank. Two sample locations were selected at random depths from each of the first two risers. The fifth remaining location was selected at a random depth within the third riser. These risers were 1 (NW), 1 (E), and 1 (SW). Duplicate samples were collected at all five sampling locations. In addition, a sample was taken from the waste surface at riser 1 (SW). Figure 3-1 depicts the specific sampling locations.

Samples were obtained by using the "bottle-on-a-string" method. Each glass sample bottle collected approximately 100 milliliters of liquid and was closed with a Teflon seal cap. Duplicate field blanks were prepared by placing deionized water into sampling bottles and sealing them with the same type caps used for the tank samples. For a further description of sampling procedures, see the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

3.2 SAMPLING NUMBERS AND HANDLING PROCEDURES

One complete set of samples was submitted to the WHC 222-S Laboratory and the other complete set was submitted to the Pacific Northwest Laboratory (PNL). The WHC and PNL sample numbers are listed in Tables 3-1 and 3-2, respectively. The sample collected from the surface of the tank was transported to PNL for a Total Organic Carbon analysis. A list of analyses requested from each laboratory is presented in Table 3-3. While the samples were still in their transport containers, radioactive dose rates were taken over the top end. All samples measured less than 2 mrem per hour.

To be consistent with safety procedures that help to limit personnel exposure to hazardous ionizing radiation, no attempt was made to completely fill the bottles; as a result, there was the potential for headspace in all sample bottles. No acidification or refrigeration was done to preserve the samples. While the samples were still in their transport containers, radioactive dose rates were taken over the top end. All samples measured less than 2 mrem per hour.

Figure 3-1. Tank 241-AP-107 Sample Locations.

Table 3-1. WHC Sample Numbers.

Riser, Angle	Depth (inches from the bottom of the tank)	Tank Farm Sample Number	Laboratory Sample Number
1, (NW) 330°	144	R3621	V-23 (107-AP-B)
	60	R3619	V-21 (107-AP-A)
1, (E) 90°	204	R3623	V-26 (107-AP-C)
	24	R3625	V-27 (107-AP-D)
1, (SW) 210°	228	R3627	V-28 (107-AP-E)
	228	R3630	V-31 (107-AP-FB)*
Composite of all Samples			V-34 (107-AP-COM)

* Sample V-31 (107-AP-FB) used for internal, non-characterization purposes

Table 3-2. PNL Sample Numbers

Riser, Angle	Depth (inches from the bottom of the tank)	Tank Farm Sample Number	Laboratory Sample Number
1, (NW) 330°	144	R3622	93-08652
	60	R3620	93-08651
1, (E) 90°	204	R3624	93-08653
	24	R3626	93-08654
1, (SW) 210°	402	R3629	93-08656*
	228	R3628	93-08655
Field Blank		R3631	93-08657

* Sample 93-08656 analyzed for Total Organic Carbon and appearance only

Table 3-3. Tank 241-AP-107 Samples and the Analytes Evaluated.

Tank Farm Sample Numbers	Laboratory Sample Numbers	Laboratory	Analytes Evaluated
R3619 R3621 R3623 R3625 R3627	V-21 (107-AP-A) V-23 (107-AP-B) V-26 (107-AP-C) V-27 (107-AP-D) V-28 (107-AP-E)	WHC 222-S	Al, As, Ba, Cd, Ca, Cr, Fe, Mg, Mn, Hg, Pb, Se, Ag, Na, U, Zn, NH ₃ , Cl ⁻ , CN ⁻ , F ⁻ , OH ⁻ , NO ₂ ⁻ , NO ₃ ⁻ , PO ₄ ³⁻ , SO ₄ ²⁻ , SpG, TIC,
R3630	V-31 (107-AP-COM)	WHC 222-S	²⁴¹ Am, ¹⁴ C, ¹⁴⁴ Ce/Pr, ¹³⁴ Cs, ¹³⁷ Cs, ⁶⁰ Co, ^{243/244} Cm, ¹⁵⁴ Eu, ¹⁵⁵ Eu, ¹²⁹ I, ²³⁷ Np, ⁹⁴ Nb, ²³⁸ Pu, ^{239/240} Pu, ²²⁶ Ra, ¹⁰⁶ Ru/Rh, ⁷⁹ Se, ⁹⁰ Sr, ⁹⁹ Tc, ³ H, Total Alpha, Total Beta
R3620 R3622 R3624 R3626 R3628 R3629 R3631	93-08651 93-08652 93-08653 93-08654 93-08655 93-08656 93-08657	PNL	Volatiles, Semivolatiles, TOC

4.0 SAMPLE HANDLING AND ANALYTICAL SCHEME

4.1 WASTE DESCRIPTION

At the time of collection, all samples were reported as clear colorless liquid with no solids or multiple phases present. However, at the time the samples were received by the Pacific Northwest Laboratory, reports of a white precipitate in small flaked shapes, and deep maroon colored masses (possibly rust) were found in all but one sample. This information was handwritten on Sample Receipt Appearance forms and was not pursued or addressed again in the laboratory report.

4.2 HOLD TIME CONSIDERATIONS

For a description of hold time considerations see the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

4.2.1 WHC - 222-S Laboratory

Tank 241-AP-107 was sampled on August 1, 1993. The samples were delivered to the 222-S Laboratory on August 2, 1993. Ion chromatography analyses were performed on dilutions of the direct samples. Samples V19 through V23 were originally analyzed on August 11, and August 16, 1993, (holding time of 10 and 15 days). Samples V24 through V28 were completed on August 11, 12, and 16, 1993 (holding times of 10, 11, and 15 days, respectively). Samples V29 through V31 were analyzed on August 12, 1993, (an 11-day holding time). On September 7, 1993, samples V19 through V21 were rerun for fluoride only (a 37-day holding time).

Of those analytes detected by ion chromatography analysis, only nitrate failed to satisfy the required holding time (48 hours).

4.2.2 Pacific Northwest Laboratory

Six samples were delivered to the Pacific Northwest Laboratory (PNL) Analytical Chemistry Laboratory on August 3, 1993 for volatile organic analyses (VOA) and semivolatile organic analyses (SVOA). All samples were received at room temperature with headspace. Upon arrival, extractions of both samples and spiked samples were performed for SVOA, then all samples were refrigerated. Holding time requirements (based on EPA, 1991 protocol) were not met (refer to Section 5.3 for further discussion).

4.3 SAMPLE PREPARATION

A discussion concerning sample preservation is provided in the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994)

4.4 ANALYTICAL METHODS

This section briefly describes the analytical methods used to characterize Tank 241-AP-107 waste designated for the evaporator feed program. All samples were tested for the chemical and radionuclide constituents. Table 4-2 lists the analytical methods used to determine the presence of each constituent.

Table 4-2. Analytical Methods (WHC, 1994)

Analyte	Method	Procedure
Hg	CVAA ¹	LA-325-104
As	GHAA ²	LA-355-131
Se	GHAA ²	LA-365-131
^{238,239,240} Pu, ²⁴¹ Am, ²⁴⁴ Cm,	separation/Alpha/AEA ³	LA-503-156
Ag, Ba, Cd, Cr, Na, Pb, Al, Fe, Ca, Mg, Mn, Zn	Inductively Coupled Plasma	LA-505-151
U	Laser Fluorimetry	LA-925-106
NH ₃	Kjeldahl ⁴	LA-634-102
CN ⁻	Distillation/Spectrometric/Analysis	LA-695-102
F ⁻ , Cl ⁻ , NO ₂ ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , PO ₄ ²⁻	Ion Chromatography	LA-533-105
⁷⁹ Se	Ion Exchange/Distillation/LSC ⁵	LA-365-132
CO ₃ ²⁻	Total Inorganic Carbon	LA-622-102
⁹⁰ Sr	separation/Beta ⁶	LA-220-101
⁹⁹ Tc	separation/LSC ⁵	LA-438-101
¹⁴ C	separation/LSC ⁵	LA-348-104
¹³⁴ Cs, ¹³⁷ Cs, ⁹⁴ Nb, ¹⁴⁴ Ce/Pr, ⁶⁰ Co, ¹⁴⁴ Cr, ¹⁵⁵ Eu, ²²⁶ Ra, ¹⁰⁶ Ru	Gamma Energy Analysis	LA-548-121
¹²⁹ I	separation/LEPA ⁷	LA-378-103
³ H	separation/LSC ⁵	LA-218-114
Total Alpha, Total Beta	Proportional Counting	LA-508-101
²³⁷ Np	Alpha Proportional Counting	LA-933-141

¹Cold Vapor Atomic Absorption

²Gaseous Hydride Atomic Absorption

³Chemical Separation along with Alpha Proportional Counting and Alpha Energy Analysis

⁴Ammonia analysis by caustic addition, distillation, and capture in a boric acid solution

⁵LSC: Liquid Scintillation Counting

⁶Chemical Separation along with total Beta Proportional Counting

⁷Chemical Separation along with Low Energy Photon Spectroscopy

4.4.1 Volatile and Semivolatile Organic Constituent Analysis

All five samples of waste from Tank 241-AP-107 were analyzed for volatile and semivolatile constituents by Pacific Northwest Laboratory (PNL). Samples were received at ambient temperature with headspace.

For Volatile Organic Analyses (VOA), each sample was extracted and analyzed directly by procedure PNL-ALO-335. The analyses followed EPA *Contract Laboratory Program Statement of Work* (EPA, 1991) procedures for analysis of volatile compounds with a heated purge option for better recoveries. Going beyond the requirements listed in EPA, 1991, analyses for additional compounds were performed. These compounds were: tetrahydrofuran, isopropylbenzene, 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

For Semivolatile Organic Analyses (SVOA), samples were analyzed by gas chromatography/mass spectrometry, and 1-Butanol and 2-butoxyethanol were added to the list of target compounds. Normally it would be difficult to extract low molecular weight polar compounds, such as 1-butanol and 2-butoxyethanol. However, the high ionic strength of the sample helped to "salt out" these compounds, so that a single (pH 7.0) methylene chloride extraction could be used. Since the initial pH of these samples was alkaline, it was adjusted to neutral before the extraction step. The spike recovery criteria used for comparison were derived from EPA, 1991 limits, which are not necessarily appropriate for this type of sample matrix.

The quality control features in the analytical procedures for VOA and SVOA met all requirements except the following deviations:

- Holding time requirements were not met.
- The samples were received at room temperature with headspace present.

Since the tank is not expected to contain an appreciable concentration of organic compounds, these deviations were considered to be of little consequence. Active ventilation of Tank 241-AP-107 throughout its service life has almost certainly removed any volatile or semivolatile organics that may have been present (however unlikely) in the waste feed streams.

4.5 MODULE SPECIFIC ANALYSES

The characterization program for Tank 241-AP-107 was intended to satisfy criteria set by the Tank Waste Remediation System (TWRS). The TWRS sample characterization objectives are to provide adequate characterization of physical, chemical, and radiological properties of Hanford Site tank wastes to support the resolution of Unreviewed Safety Questions, other safety issues surrounding the Watch List tanks, and the design of retrieval, pretreatment, and final disposal systems (Bell, 1994). For this specific tank, analyses should provide sufficient information regarding the waste composition to confidently decide whether constituent concentrations are within safe operation limits. The limits deal specifically with waste flammability and explosiveness. In addition, the analyses are useful in determining functional limits, such as solids formation, for operation of the evaporator. Characterization of this tank should also provide data to enable a prediction of where the types and amounts of hazardous waste are likely to occur in the evaporator product streams.

5.0 ANALYTICAL RESULTS AND WASTE INVENTORY

The chemical, radiochemical, physical, and organic results associated with Tank 241-AP-107 are presented within this document as indicated in Table 5-1. The samples from which these results were derived were collected on August 1, 1993. This is the only sampling performed on Tank 241-AP-107 and reflects the most accurate characterization of the tank waste available at the present time. A detailed discussion of the sampling process was presented in Section 3.0.

Table 5-1. Analytical Data Presentation Tables.

Analysis	Table
Metals	A-1
Anions	A-2
Radionuclides	A-3
Physical and General Chemical Data	A-4
Volatile Organics	A-5
Semivolatiles Organics	A-6
Tank Characterization Report Results	5-4

In cases where a duplicate analysis was performed on a sample, the data presented in the Appendix A tables were obtained by calculating an average concentration value from the initial and duplicate results. If an analyte was detected by the original but not by the duplicate sample evaluation, or vice-versa, only the single positive result was reported. When both sample runs failed to detect an analyte, the detection limit preceded by a less than (<) sign was recorded as the sample result.

A representative tank concentration for each analyte was included in the Appendix A tables under the "Evaluated Data Result" column. These values were derived by calculating simple means from samples which yielded analyte concentrations above reported detection limits. If all available samples analyses failed to detect a particular analyte, the tank concentration of the analyte was reported to be less than the highest recorded detection limit. Detection limit values were not utilized to calculate means nor corresponding standard deviation values.

The range of the tabulated sample data associated with each analyte was also included in the Appendix A tables. The projected tank inventory value reported in the Appendix A tables was obtained by multiplying the representative tank concentration of each analyte by the volume of waste in the tank. At the time of sampling, the tank contained $4.19\text{E}+06$ liters of waste. The appropriate conversion factors were included in the calculations to obtain the reported units.

5.1 CHEMICAL ANALYSES

5.1.1 Metals

The following analytes were analyzed by Inductively Coupled Plasma Atomic Emission Spectroscopy: Al, Ba, Cd, Ca, Cr, Fe, Pb, Mg, Mn, Ag, Na, and Zn. Since the spiking solution associated with the analysis did not contain several metals, one of the samples, 107-AP-B, was reevaluated by the laboratory in order to obtain the necessary quality control parameters. The reported analyte concentrations regarding this sample in Table A-1 were derived by considering both the original and reanalyzed sets of data. Arsenic and selenium were determined by Gaseous Hydride Atomic Absorption Spectroscopy, and mercury was analyzed by Cold Vapor Atomic Absorption Spectroscopy. The laser fluorimetry method was utilized to evaluate uranium.

Sodium was determined to be the major metal constituent in Tank 241-AP-107; however, the calculation of a charge balance indicated that the reported sodium concentration may be low. This is further discussed in Section 7.1. Calcium demonstrated the second highest concentrations among the metal constituents. The laboratory indicated that the calcium results may be biased high due to sample contamination from talcum powder originating from rubber gloves worn by laboratory technicians and sampling personnel.

The following analytes were also detected in the waste, but their concentrations were less than 2 ppm: Al, Ba, Cr, Pb, Mg, Mn, Ag, U, and Zn. The sample analyses of Tank 241-AP-107 determined that arsenic, cadmium, iron, mercury, and selenium were not present in detectable concentrations.

As a note, field blank contamination was prevalent among the metals analyses and may have caused the Al, Mg, Mn, and Zn results to be biased high. Historical estimates concerning the metal constituents of Tank 241-AP-107 were unavailable for comparison with the laboratory data.

5.1.2 Anions

The following anions were determined by ion chromatography: fluoride, chloride, nitrite, nitrate, sulfate, and phosphate. The data demonstrated that fluoride was present in Tank 241-AP-107, but these findings are suspect. An unidentified compound co-eluted with fluoride and interfered with peak integration. An attempt to rerun a sample after further dilution failed to yield a detectable result. The historical data presented in Table 5-2 revealed a fluoride value which was much less than the analytically derived result. The laboratory results for fluoride are, therefore, considered to be biased high.

With respect to nitrite, the available historical data indicated that the laboratory values were higher than expected. Furthermore, a large charge imbalance (Section 7.1) is demonstrated by the data and is attributed to either a low sodium result or a high nitrite value. A charge balance calculated with the historical rather than the analytical nitrite data yielded a more realistic conclusion; therefore, the historical value of $1.11\text{E}+06 \mu\text{g/L}$ was reported as the accepted tank concentration in Table 5-4. The laboratory nitrate data is presented in Appendix A.

Table 5-2. Comparison of Analytical and Historical Estimates of Anionic Constituents in Tank 241-AP-107.

Analyte	Laboratory Result ($\mu\text{g/L}$)	Historical Estimate ($\mu\text{g/L}$)	Relative Percent Difference
Ammonia	< 80,000	2.41E+06	N/A
Fluoride	1.42E+05	4,540	190%
Hydroxide	2.66E+05	2.60E+05	2.3%
Nitrite	2.35E+07	1.11E+06	180%

Only minor analytical difficulties were encountered with the other ion chromatography analyses. In addition to fluoride and nitrite, nitrate was detected in Tank 241-AP-107, but chloride and phosphate were not. Sulfate was detected in a single sample, and this lone value was considered to be a worse case estimate of the representative tank concentration.

Ammonia, which was analyzed by the Kjeldahl method, was not detected in the tank waste. No major problems were encountered during the analyses, but the reported results are considered to have a low bias. The samples were analyzed between 19 and 30 days after collection and were not preserved by acidification. Therefore, the potential existed for ammonia to dissipate before analysis. In addition, the historical data indicates that ammonia should have yielded a detectable result.

Hydroxide was analyzed by titration, but only one sample yielded a detectable result. Since the pH of Tank 241-AP-107 is known to be relatively high, the single detected value of 2.66E+05 $\mu\text{g/L}$ was reported as the tank hydroxide concentration. This value translates to a pH of 12.2 which is reasonable when compared to historical observations.

Cyanide was evaluated spectrophotometrically after samples were initially distilled, and the analyte was present in detectable concentrations. According to the validation guidelines, the results were considered to be estimated since instrument calibration was not performed before conducting the analyses. The carbonate value reported in Table 5-4 was calculated from the Total Inorganic Carbon data.

5.2 RADIOLOGICAL DETERMINATIONS

All radiochemical results were derived from composite waste samples. The activities of the following radionuclides were determined by gamma energy analysis: $^{144}\text{Ce/Pr}$, ^{134}Cs , ^{137}Cs , ^{60}Co , ^{154}Eu , ^{155}Eu , ^{94}Nb , ^{226}Ra , and ^{106}Ru . Tritium and ^{14}C were analyzed after distillation by liquid scintillation. The ^{79}Se isotope was separated by ion exchange and distillation techniques before evaluation by liquid scintillation, and ^{99}Tc samples were digested and separated before scintillation counting. Acid digestion and separation, followed by beta proportional counting, were utilized to determine ^{90}Sr activity, and ^{129}I was analyzed by low energy photon spectroscopy. Neptunium-237 was determined by alpha proportional counting of a separated fraction. The following were evaluated by alpha energy analysis: $^{239/240}\text{Pu}$, ^{238}Pu , ^{241}Am , and $^{243/244}\text{Cm}$. Total alpha and beta were determined by gas flow proportional counting.

The ^{79}Se results were rejected according to data validation guidelines due to poor carrier recoveries; therefore, a value for the isotope was not reported in this document. No separations were performed to accurately quantitate Cm, Nb, and Ra isotopes. The initial ^3H analysis was rejected due to high spike recoveries, but a reanalysis yielded acceptable data. Low spike recoveries were exhibited by the total alpha evaluations, and the result was considered to have a low bias. No other major problems were encountered with the radiochemical data.

The following radionuclides demonstrated activities above their corresponding detection limits in Tank 241-AP-107: ^{14}C , ^{137}Cs , ^{90}Sr , and ^3H . The ^3H value was extremely high. Additionally, the observed total beta activity was consistent with the reported ^{90}Sr , ^{99}Tc , and ^{137}Cs results. The analytical and historical data available for comparison are presented in Table 5-3. It should be noted that the radionuclides have not been decay corrected.

Table 5-3. Comparison of Analytical and Historical Estimates of Anionic Constituents in Tank 241-AP-107.

Analyte	Laboratory Result ($\mu\text{Ci/g}$)	Historical Estimate ($\mu\text{Ci/g}$)	Relative Percent Difference
$^{144}\text{Ce/Pr}$	< 34.0	4.86	N/A
^{134}Cs	< 0.058	0.0672	N/A
^{137}Cs	0.123	1.19	160%
^{60}Co	< 0.0690	< 0.0396	N/A

5.3 ORGANIC CONSTITUENTS

None of the volatile organic analytes were found to be present above their corresponding detection limits. The semivolatile organic analyses demonstrated the presence of one target analyte, 1-butanol, and two tentatively identified compounds, cyclohexene and tributylphosphate. No other semivolatile compounds were found in the tank. Since methylene chloride utilized during the extraction process also contained cyclohexene, the detection of cyclohexene in the samples was attributed to contamination and not reported as a tank constituent. The tributylphosphate and butanol results were acceptable. Due to their polar characteristics, these compounds exhibit a reduced volatility and are somewhat soluble in water, the primary component of the tank waste.

The Pacific Northwest Laboratory performed total carbon and total inorganic carbon analyses by ultraviolet light catalyzed persulfate oxidation, and the carbon dioxide oxidation product was measured directly by a nondispersive infrared analyzer. Additionally, the WHC 222-S Laboratory conducted a total inorganic carbon analysis by coulometry. The relative percent difference between the total inorganic carbon results derived by the two labs was 9% and demonstrated good agreement. Most of the carbon present in Tank 241-AP-107 is inorganic and assumed to be in the form of carbonate. Total organic carbon data were calculated by subtracting total inorganic carbon from total carbon; the result was 52,000 $\mu\text{g/L}$. Since the sum of the carbon content from butanol, 6,410 $\mu\text{g C/L}$, and tributylphosphate, 1,620 $\mu\text{g C/L}$, is only 8,030 $\mu\text{g C/L}$, the presence of organic complexants is assumed to account for the remaining organic carbon in the waste. There is no historical data available with which to compare the total organic carbon result.

5.4 PHYSICAL MEASUREMENTS

5.4.1 Specific Gravity

The specific gravity (SpG) of the tank was determined to be 0.989. This value is supported by the low dissolved salts content of the tank waste (98.5 wt% water). In addition, the temperature of the waste at the time of the SpG measurement was greater than 4.0°C (the maximum density of water); therefore the SpG reading for the waste would be expected to be less than 1.0.

5.4.2 Rheology

No rheological analyses were performed on the waste samples, however the viscosity of the tank waste is estimated at 1 centipoise (0.000672 lbs/ft-s), the equivalent of water at 20°C (68°F). This estimate is based on an assessment of the tank contents.

5.4.3 Energetics

Exotherms were not observed in any of the tank waste samples during the differential scanning calorimetry analyses.

5.5 DATA PRESENTATION

The Tank Characterization Report Results recorded in Table 5-4 are the final constituent estimates for this document. The values are equal to the "Evaluated Data Results" presented in the Appendix A tables. Exceptions have either been previously or are subsequently discussed in this text. If laboratory results were not available for an analyte, the Tank Characterization Result was, if possible, derived from historical data.

Table 5-4. Tank 241-AP-107 Analytical Data. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Metals	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/g}$)	(kg)
Aluminum (Al)	---	1,060	1.07	4.44
Antimony (Sb)	---	---	---	---
Arsenic (As)	---	< 13	< 0.013	< 0.054
Barium (Ba)	---	24.8	0.0250	0.103
Beryllium (Be)	---	---	---	---
Bismuth (Bi)	---	---	---	---
Boron (B)	---	---	---	---
Cadmium (Cd)	---	< 20.0	< 0.0202	< 0.0838
Calcium (Ca)	---	20,100	20.3	84.3
Chromium (Cr)	---	< 30.8	< 0.0311	< 0.129
Iron (Fe)	---	< 55.0	< 0.0556	< 0.231
Lead (Pb)	---	< 329	3.33	1.38
Magnesium (Mg)	---	1,550	1.57	6.51
Manganese (Mn)	---	77.3	0.0782	0.324
Mercury (Hg)	---	< 3.00	< 3.03E-03	< 0.013
Molybdenum (Mo)	---	---	---	---
Neptunium (Np)	---	---	---	---
Nickel (Ni)	---	---	---	---
Phosphorus (P)	---	---	---	---
Potassium (K)	---	---	---	---
Selenium (Se)	---	< 13.0	< 0.0131	< 0.054
Silicon (Si)	---	---	---	---
Silver (Ag)	---	49.2	0.0497	0.206
Sodium (Na)	---	2.28E+06	2310	9,540
Titanium (Ti)	---	---	---	---
Uranium (U)	---	23.4	0.0237	0.0980
Zinc (Zn)	---	990	1.00	4.15
Zirconium (Zr)	---	---	---	---
Ions	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/g}$)	(kg)
Ammonia (NH_3)	2.41E+06	< 80,000	< 80.9	< 335
Carbonate (CO_3^{2-})	---	1.48E+06	1500	6,150
Chloride (Cl^-)	---	< 22,000	< 22.2	< 92
Cyanide (CN^-)	---	579	0.585	2.43

Table 5-4. Tank 241-AP-107 Analytical Data. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Ions (continued)	($\mu\text{g/L}$)	($\mu\text{g/L}$)	($\mu\text{g/g}$)	(kg)
Fluoride (F)	4,540	1.42E+05	144	594
Hydroxide (OH ⁻)	2.60E+05	2.66E+05	269	1,110
Nitrate (NO ₃ ⁻)	---	1.02E+06	1030	4,270
Nitrite (NO ₂ ⁻)	1.11E+06	1.11E+06	1120	4,650
Phosphate (PO ₄ ⁻³)	---	< 10,000	< 10.1	< 42
Sulfate (SO ₄ ⁻²)	---	2.03E+05	205	851
Radionuclides	($\mu\text{Ci/L}$)	($\mu\text{Ci/L}$)	($\mu\text{Ci/g}$)	(Ci)
²¹⁴ Am	---	< 0.637	< 6.44E-04	< 2.67
¹⁴ C	---	0.00318	3.21E-06	0.0133
¹⁴⁴ Ce/Pr	4.86	< 34.0	< 0.0344	< 142
¹³⁴ Cs	0.0672	< 0.058	< 5.86E-05	< 0.234
³⁷ Cs	1.19	0.123	1.24E-04	0.515
⁶⁰ Co	< 0.0261	< 0.0690	< 6.98E-05	< 0.289
^{243/244} Cu	---	< 0.637	< 6.44E-04	< 2.67
¹⁵⁴ Eu	---	< 0.192	< 1.94E-04	< 0.805
¹⁵⁵ Eu	---	< 0.129	< 1.30E-04	< 0.541
¹²⁹ I	---	< 0.0435	< 4.4E-05	< 0.182
²³⁷ Np	---	< 0.0148	< 1.5E-05	< 0.0620
⁹⁴ Nb	---	< 0.0496	< 5.02E-05	< 0.208
⁹⁵ Nb	0.163	< 0.163	< 6.84E-04	< 0.677
²³⁸ Pu	---	< 0.651	< 6.58E-04	< 2.73
^{239/240} Pu	---	< 0.534	< 5.40E-04	< 2.24
²²⁶ Ra	---	< 1.19	< 1.20E-03	< 4.99
¹⁰⁶ Ru/Rh	---	< 0.950	< 9.61E-04	< 3.98
⁹⁰ Sr	---	0.118	1.19E-04	0.494
⁹⁹ Tc	---	< 0.0205	< 2.07E-05	< 0.0859
³ H	---	35.2	0.0356	147
Total Alpha	---	< 0.00196	< 2.0E-06	< 0.00821
Total Beta	---	0.211	2.13E-04	0.884
Physical Properties				
Specific Gravity	---	0.989	N/A	N/A
wt% water	---	98.5%	N/A	N/A
pH	12.1	12.2	N/A	N/A

Table 5-4. Tank 241-AP-107 Analytical Data. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Physical Properties (continued)				
Energetics	---	no exotherms		N/A
Viscosity	---	1.0 centipoise		N/A
Total Carbon (TC)	---	3.59E+05 µg/L	363 µg/g	1,500 kg
Total Inorganic Carbon (TIC)	---	2.95E+05 µg/L	298 µg/g	1,240 kg
Total Organic Carbon (TOC)	---	52,000 µg/L	52.6 µg/g	220 kg
Semivolatile Organics	(µg/L)	(µg/L)	(µg/g)	(kg)
1-Butanol	---	9,900	10	41
Tributyl Phosphate	---	3,000	3.03	13

6.0 ANALYTICAL RESULT INTERPRETATION

6.1 TANK WASTE PROFILE

Examination of the analytical results reveals that the waste in Tank 241-AP-107 is primarily a dilute aqueous solution of inorganic salts. The most abundant ions in the tank are sodium, nitrite, nitrate, and hydroxide; carbonate, as indicated by the total inorganic carbon analysis, is also present at a relatively high concentration. Radionuclides which demonstrated a detectable activity included ^{14}C , ^{137}Cs , ^{90}Sr , and ^3H . The only organic constituents found in the tank were 1-butanol and tributylphosphate.

6.2 WASTE SUMMARY AND CONDITIONS

6.2.1 Regulatory Limits

Analysis of the contents of Tank 241-AP-107 has demonstrated that the waste does not exhibit the characteristics of corrosivity, reactivity, or toxicity, as defined in the *Code of Federal Regulations* 40 CFR Part 261 (EPA, 1990). It can also be assumed that, since the samples contained no significant quantities of volatile organics, the waste will not exhibit the characteristic of ignitability.

6.2.2 Projected Heat Load

The very low relative level of radionuclides in Tank 241-AP-107 is reflected in the low heat load (Table 6-1). Only three of the radionuclides reported in this table were detected by the analytical methods used. Detection limits for the other analytes were included in the calculation in order to obtain the most conservative estimate possible. Thus the heat load is insignificant.

6.3 PROGRAM ELEMENT SPECIFIC ANALYSES

The sampling and analysis of Hanford Site waste tanks is driven by the need to satisfy the characterization requirements of the various Tank Waste Remediation System (TWRS) program elements. These characterization needs are implemented and documented through the Data Quality Objective (DQO) process, and expressed in a series of program specific DQO documents. The data needs are summarized in the *TWRS Tank Waste Analysis Plan* (Bell, 1994).

This Tank Characterization Report is the final step in the characterization of Tank 241-AP-107. According to the process and issue based data requirements, the inventory estimates and waste properties contained in this report can be applied to the data requirements of the various program elements. Contained in Table 6-2 is a summary of which program data needs are fulfilled through this characterization of the waste in Tank 241-AP-107, based on a review of the stated sampling and analysis requirements. In the future, the applicability of Tank Characterization Report results to each TWRS program element will be documented in tank specific Tank Characterization Plans, prior to the tank sampling.

Table 6-1. Tank 241-AP-107 Projected Heat Load.

Radionuclide	Ci	Watts
²⁴¹ Am	< 2.67	< 0.0876
¹⁴⁴ Ce/Pr	< 142	< 1.14
¹³⁴ Cs	< 0.243	< 2.48E-03
¹³⁷ Cs	0.515	2.43E-03
⁶⁰ Co	< 0.289	< 4.45E-03
¹⁵⁴ Eu	< 0.805	< 7.27E-03
¹⁵⁵ Eu	< 0.541	< 3.93E-04
¹²⁹ I	< 0.182	< 8.52E-05
²³⁷ Np	< 0.0620	< 1.79E-03
²³⁸ Pu	< 2.73	< 0.0890
^{239/240} Pu	< 2.24	< 0.0684
¹⁰⁶ Ru/Rh	< 98	< 0.946
⁹⁰ Sr	0.494	3.31E-03
⁹⁹ Tc	< 0.059	< 4.31E-05
³ H	147	4.96E-03
Total Watts		< 2.35

Table 6-2. Applicability of Characterization Information to the Data Needs of the TWRS Program Elements.

Data Quality Objective	Applicability to Characterization of Tank 241-AP-107
Tank Safety Screening	applies ¹
Ferrocyanide Safety Issues	does not apply
Flammable Gas Tanks Crust Burn Issue	does not apply
Generic Tank Vapor Issue Resolution	not addressed
Flammable Gas Tank	not completed
Waste Compatibility	applies
Organic Fuel Rich Tank	does not apply
Rotary Core Vapor Sampling	not completed
Evaporator Operations	not completed
Process Control	not completed
Waste Tank Retrieval	not completed
Waste Tank Pretreatment	not completed
High-Level Immobilization	not completed
Low-Level Immobilization	not completed
Solid, Low-Level Waste Disposal	not completed
RCRA Part B Permit Application	not completed
Tank C-106 High-Heat Safety Issue	does not apply
Organic Layer Sampling of Tank C-103	does not apply
Tank C-103 Vapor and Gas Sampling	does not apply

¹The sampling requirement for the Safety Screening Data Quality Objective (Babad, 1994) calls for both vertical waste samples and a vapor space sample. The sampling and analysis of Tank 241-AP-107 supports full characterization of the waste in the tank; vapor space sampling or characterization was not conducted as part of this activity.

applies - The data needs expressed in this Data Quality Objectives document are fulfilled through this characterization report.

does not apply - The data needs expressed in this Data Quality Objectives document do not apply to the waste in Tank 241-AP-107.

not addressed - The data needs expressed in this Data Quality Objectives document were not addressed by this characterization report.

not complete - At the date of preparation of this report, this Data Quality Objectives document has not yet been completed.

7.0 STATISTICAL INTERPRETATION

7.1 MASS AND CHARGE BALANCES

The principal objective for performing a mass and charge balance is to determine if the measurements are self-consistent. The mass and charge balance calculations also provide a method for estimating the weight percent of water. In calculating the balances, only analytes detected at a concentration of 1 ppm or greater were considered. A realistic charge balance could not be obtained when the laboratory derived nitrite results was used in the calculations; however, further attempts to balance the charges in Tank 241-AP-107 proved the historical value to be a better estimate of the nitrite concentration.

Even after adjusting the nitrite results, a charge imbalance persisted due to a shortage of positively charged ions. In order to correct the deficiency, the concentration of additional sodium required to balance the charges was calculated. As a result, the charge balance predicts the sodium concentration of Tank 241-AP-107 to be $2.69\text{E} + 06 \mu\text{g/L}$, approximately 1.2 times the laboratory derived result.

Mass and charge balance results are reported in Table 7-1. The mass concentration, $\mu\text{g/g}$, resulting from the sum of the cations, anions, and organic constituents was subtracted from a million in order to obtain an estimated value for the weight percent of water. In other words, mass not accountable to the analyte concentrations is attributed to water. Inspection of the table demonstrates that the predicted weight percent of water in Tank 241-AP-107 is 98.5%.

7.2 TANK HOMOGENEITY

The homogeneity of Tank 241-AP-107 waste was determined using two methods, the first being direct observation. As stated in section 4.1, at the time of collection, all samples were colorless, clear, and void of solids or multiple phases. None required heating or dilution to maintain solubility. However, a white precipitate and dark maroon colored masses were reported in most samples upon receipt by Pacific Northwest Laboratory.

A second method to evaluate homogeneity was employed by determining the Relative Percent Difference (RPD) of concentrations between the five individual samples (five separate tank locations) for selected analytes. To produce a standard for comparison, the maximum RPD between the five samples and their duplicates for each analyte were calculated. Table 7-2 details the comparison of the RPD data by analyte. Column 2 contains the RPD range for each analyte between the five individual samples, while Column 3 lists the maximum RPD between a sample and its duplicate for each analyte. Column 4 compares the two and is derived by dividing Column 2 by Column 3 (WHC, 1994).

Table 7-1. Mass and Charge Balance Data.

	Mass $\mu\text{g/g}$	Charge $\mu\text{mol/g}$
Cations		
Aluminum	1.07	0.12
Calcium	20.3	1.02
Magnesium	1.57	0.13
Sodium	2310	100
Zinc	1.00	0.031
Anions		
Hydroxide	269	15.8
Fluoride	144	7.56
Nitrate	1030	16.6
Nitrite	1120	24.3
Carbonate (TIC)	1500	50.0
Sulfate	205	4.27
Totals		
Cations	2334	101
Anions	4268	119
Additional Sodium (Est.)	414	18
Butanol and Tributylphosphate	8030	
Water (Est.)	985000	

Table 7-2. Homogeneity Analysis, a Comparison of RPD Data for Tank 241-AP-107.

Column 1 Analyte	Column 2 RPD Range	Column 3 Max. RPD	Column 4 Comparative Precision
Specific Gravity	0.7	4.0	0.2
Aluminum	63.9	40.4	1.6
Sodium	21.2	9.9	2.1
Nitrate	7.9	2.0	4.0
Nitrite	11.1	3.1	3.6
Cyanide	25.6	22.2	1.2
Carbonate	73.5	19.3	3.8
Uranium	87.9	66.1	1.3

For all the analytes listed, the range of RPDs between individual samples was no greater than 4.0 times the maximum RPD between duplicate samples. Since the average value of Column 4 was 2.2, the overall precision between the five samples was only 2.2 times the maximum deviation that existed between the samples and their duplicates. This is considered a fairly minor difference. From Column 2, several analytes with high RPDs raise the possibility that the tank contents are heterogeneous. However, two of these analytes, aluminum and uranium, had maximum RPDs between samples and their duplicates (column 3) of 40.4 and 66.1, respectively. This indicates that experimental variability was to a large degree responsible for their inflated values in Column 2. In fact, both of these analytes had sample concentrations near their detection limits, a situation that often produces high RPDs. Carbonate had a maximum RPD range of 73.5, but when compared to the maximum RPD between a sample and its duplicate, there was only a 3.8 fold difference, which is not thought substantial. Since the RPDs between concentrations of the remaining analytes at the five sampling locations are not large, the waste in Tank 241-AP-107 is considered reasonably homogeneous.

7.3 ANALYTICAL ERROR ESTIMATION

Several methods were employed to estimate analytical error in the sample analyses. RPD between samples and their duplicates, RPD between matrix spikes and their duplicates, and sample standard deviations were all calculated for each analyte.

All RPD values obtained from initial and duplicate sample analyses satisfied the quality control criteria of $\pm 20\%$ except the following:

* Aluminum ^{1,2} (Al)	The RPD for the samples and duplicates ranged from 6.9 to 40.4%, with two of the samples exceeding the 20% criterion.
* Barium ^{1,2} (Ba)	The RPD for the samples and duplicates ranged from 10.6 to 35.0%, with two of the samples exceeding the 20% criterion.
* Calcium ¹ (Ca)	The RPD for the samples and duplicates ranged from 15.3 to 192.5%, with only one of the samples below the 20% criterion. The poor results were partially due to the 27 fold difference between the lowest and highest Ca concentration.
* Cyanide (CN)	The RPD for the samples and duplicates ranged from 0.0 to 22.2%, with just one sample exceeding the 20% criterion.
* Iron ¹ (Fe)	The RPD for the samples and duplicates ranged from undetermined to 102.5%. The field blank had the highest RPD, which indicates an obvious contamination of the sample. Although the tank contents appear homogeneous with respect to most analytes, there was a 10 fold difference between the low and high sample concentration.
* Magnesium ¹ (Mg)	The RPD for the samples and duplicates ranged from 4.5 to 163.8%.

- *Uranium² (U) The RPD for the samples and duplicates ranged from 0.0 to 26.8%, with just one sample exceeding the 20% criterion.
- *Zinc¹ (Zn) The RPD for the samples and duplicates ranged from 12.3 to 177.4%.
- *Total beta The RPD for the samples and duplicates was 35.0%, but the rerun result was a reasonable 4.9%.

¹High RPDs possibly due to contamination during sample preparation.

²High RPD possibly due to sample concentration near the detection limit.

All RPD values obtained from matrix spikes and their duplicates satisfied the quality control criteria of $\pm 20\%$ except:

- *²⁴¹Am The RPD for the spike and spike duplicate was 24.1%, but the rerun generated an acceptable value of 10.7%.
- *^{242/244}Cu The RPD for the spike and spike duplicate was 24.1%, but the rerun generated an acceptable value of 10.7%.

The sample standard deviations for each analyte are listed in the Appendix A tables, and were calculated only for analytes in which three or more of the samples were detected. With the exception of specific gravity, all of these analytes had some or all of their sample data estimated and/or near the detection limit. This resulted in most of the standard deviations being well over 10% of the concentration mean.

7.4 DATA VALIDATION FINDINGS

The primary objective of data validation is to ensure the usability and defensibility of the data produced for the tank. This was accomplished through a detailed examination of the data package which attempted to verify that proper and acceptable analytical techniques had been applied. Evaluations such as instrument calibration checks, matrix spikes, duplicates, and blank analyses were reviewed, and the corresponding results were compared to relevant quality control criteria. Additionally, the data package was checked for the correct submission of required deliverables, correct transcription of raw data to the summary forms, and for proper calculation of a number of parameters. Questionable data which was not supported by proper quality control analyses as noted by the validation process are discussed throughout Section 5. The processes of data validation and statistical analyses confirm the accuracy of the characterization results for Tank 241-AP-107.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 SAFETY ISSUES

Characterization of Double-Shell Tank 241-AP-107 supports the classification of the tank as non-Watch List. Given the current tank inventory of fissionable radionuclides and organic or exothermic waste constituents, no credible potential exists for loss of tank integrity or release of radioactivity due to in-tank processes. Tank 241-AP-107 is within established operating safety requirements, as defined by applicable Data Quality Objectives.

Tank 241-AP-107 is considered sound and non-leaking (Hanlon, 1994), and examination of the waste volume history supports this conclusion (Koreski, 1994). Thermocouple data indicate that while tank temperatures are elevated above ambient soil temperatures, there is no credible risk of self-boiling or excessive heating of the current tank contents. Given the present tank integrity and waste properties, the continued active operation of Tank 241-AP-107 for waste management and storage functions poses no unreasonable risk to personnel, the public, or the environment.

8.2 FURTHER CHARACTERIZATION NEEDS

Accurate and defensible characterization of the liquid contents of Tank 241-AP-107 has been performed in this report; however, the following studies which may involve further sampling and analysis are recommended.

- An analysis of the tank vapor space would allow final resolution of any safety concerns regarding the presence of flammable or noxious fumes.
- The analytically derived fluoride, nitrite, hydroxide, and ammonia concentrations were suspect and should be reevaluated.
- The white solid observed in sample containers should be identified, and further precipitation studies may be necessary.
- The extreme bottom of the tank should be sampled to decisively determine if a sludge layer exists.

9.0 REFERENCES

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APPENDIX A
ANALYTIC RESULTS

A.1 Introduction

A.1.1 Appendix A presents the chemical and radiological characteristics of Tank 241-AP-107 in a tabular form, in terms of the specific concentrations of anions, metals, and radionuclides. In addition, the physical characteristic specific gravity is listed.

The data table for each analyte lists laboratory sample identification, analytical result, standard deviation, range of results, an evaluated data result, and a projected tank inventory for the particular analyte. The projected tank inventory column is not applicable for the specific gravity data.

A.2 Table Description

A.2.1 Abbreviations

Standard abbreviations are used to describe analytical methods.

Metals:	ICP - Inductively Coupled Plasma (generic for all metals unless otherwise known)
	GHAA - Gaseous Hydride Atomic Absorption
	CVAA - Cold Vapor Atomic Absorption
Anions:	IC - Ion Chromatograph
	KTN - Kjeldahl's Total Nitrogen
Radionuclides	GEA - Gamma Energy Analysis
	AEA - Alpha Energy Analysis
	APC - Alpha Proportional Counting
	BPC - Beta Proportional Counting
	LEPS - Low Energy Photon Spectroscopy
	LSC - Liquid Scintillation Counting
Physical Properties	Coul - Coulometric Analysis
	DM - Direct Measurement
	NDIR - Non Dispersive

A.3 Column Headings

A.3.1 The 'Analyte' column contains, in addition to the name of the analyte or physical characteristic, information about the method of measurement and, in the case of the metals, information about the method of digestion. The method of digestion is listed for the metals because, unlike the other analytes, different digestion procedures are typically used for the same metal.

Possible digestion methods are: d - direct; a - acid digestion; w - water leach; and f - acid digestion followed by potassium hydroxide fusion.

The analyte and method are presented as follows: 'method.analyte', or, (in the case of a metal) 'method.digestion.analyte'. For example, the activity of ^{90}Sr was measured with a beta proportional counter and is listed as 'BPC. ^{90}Sr '. The concentration of Pb was determined by inductively coupled plasma, which was preceded by acid digestion, and is listed as 'ICP.a.Pb'.

A.3.2 The 'Laboratory Sample Identification' column lists the samples for which the analyte was measured. The 'Sampling Identification Number' is different from the number assigned to the samples at the tank farm. Sampling rationale, locations, and descriptions of sampling events are contained in Section 3.0.

A.3.3 'Analytical Data Result' is the specific concentration of the analyte determined at different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. This information may be obtained from the Tank 241-AP-107 data package (WHC, 1994). Data which was qualified as estimated (denoted by 'J' or 'UJ' in the data package) will be enclosed in parentheses, i.e., (395) $\mu\text{g/ml}$. Unusable data (denoted by 'R' in the data package) will be entered with a strikeout, i.e., ~~395~~ $\mu\text{g/ml}$. Unqualified data will be entered in standard form.

A.3.4 The 'Range of Values' column lists the highest and the lowest values for a particular analyte. If a measurement method has a constant method detection limit, and all results are less than the method detection limit, no range is given. However, if the method detection limit changes, i.e., due to radiation background variations in radiochemistry, a range of detection limit values is given. Note: Since all radiochemical analyses were performed on sub-samples from the tank composite, and since all sample results were below the associate detection limits (with the exception of ^{14}C , ^{137}Cs , ^{90}Sr , ^3H , and total beta), a standard deviation and range of values have not been reported in this Appendix.

A.3.5 Column 6 'Evaluated Data Result' was derived as stated in Section 5.0. As in the case of the standard deviation column, no unusable or rejected data will be used for computation.

A.3.6 Column 7, 'Projected Inventory', is the product of the concentration of the analyte and the volume of the waste in the tank.

LIST OF TABLES FOR APPENDIX A

Table A-1. Tank 241-AP-107 Analytical Data:

Aluminum	A-4
Arsenic	A-4
Barium	A-4
Cadmium	A-5
Calcium	A-5
Chromium	A-5
Iron	A-6
Lead	A-6
Magnesium	A-6
Manganese	A-7
Mercury	A-7
Selenium	A-7
Silver	A-8
Sodium	A-8
Total Uranium	A-8
Zinc	A-9

A-2. Tank 241-AP-107 Analytical Data:

Ammonia	A-9
Chloride	A-9
Cyanide	A-10
Fluoride	A-10
Hydroxide	A-10
Nitrate	A-11
Nitrite	A-11
Phosphate	A-11
Sulfate	A-12

Table A-3. Tank 241-AP-107 Analytical Data:

Radionuclides	A-12
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Table A-4. Tank 241-AP-107 Analytical Data:

Specific Gravity	A-13
Total Carbon	A-13
Total Inorganic Carbon	A-14
Total Organic Carbon	A-14

Table A-5. Tank 241-AP-107 Analytical Data:

Volatile Organic Compound	A-15
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Table A-6. Tank 241-AP-107 Analytical Data:

Semivolatile Organic Analysis	A-16
1-Butanol	A-17
Phosphoric acid, Tributyl ester	A-17

Table A-1. Tank 241-AP-107 Analytical Data: Aluminum

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP. Al	Sample 107-AP-A	864	123	864 to 1,200	1,060	4.44
	Sample 107-AP-B	1,200				
	Sample 107-AP-C	1,100				
	Sample 107-AP-D	(1,090)				
	Sample 107-AP-E	(1,050)				

Table A-1. Tank 241-AP-107 Analytical Data: Arsenic

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
GHAA.As	Sample 107-AP-A	(< 0.013)	N/A	N/A	< 0.013	< 0.054
	Sample 107-AP-B	(< 0.013)				
	Sample 107-AP-C	(< 0.013)				
	Sample 107-AP-D	(< 0.013)				
	Sample 107-AP-E	(< 0.013)				

Table A-1. Tank 241-AP-107 Analytical Data: Barium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Ba	Sample 107-AP-A	< 15.0	13.3	< 15.4 to 44.6	24.8	0.103
	Sample 107-AP-B	(19.0)				
	Sample 107-AP-C	19.6				
	Sample 107-AP-D	(15.8)				
	Sample 107-AP-E	44.6				

Table A-1. Tank 241-AP-107 Analytical Data: Cadmium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$		$\mu\text{g/L}$	kg
ICP.Cd	Sample 107-AP-A	< 20.0	N/A	N/A	< 20.0	< 0.0838
	Sample 107-AP-B	(< 20.0)				
	Sample 107-AP-C	< 20.0				
	Sample 107-AP-D	< 20.0				
	Sample 107-AP-E	< 20.0				

Table A-1. Tank 241-AP-107 Analytical Data: Calcium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$		$\mu\text{g/L}$	kg
ICP.Ca	Sample 107-AP-A	(14,700)	14,300	6,100 to 40,000	20,100	84.3
	Sample 107-AP-B	(29,900)				
	Sample 107-AP-C	(9,850)				
	Sample 107-AP-D	(6,100)				
	Sample 107-AP-E	(40,000)				

Table A-1. Tank 241-AP-107 Analytical Data: Chromium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Cr	Sample 107-AP-A	(30.8)	N/A	N/A	30.8	0.129
	Sample 107-AP-B	(< 77.6)				
	Sample 107-AP-C	< 30.0				
	Sample 107-AP-D	< 30.0				
	Sample 107-AP-E	< 30.0				

Table A-1. Tank 241-AP-107 Analytical Data: Iron

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Fe	Sample 107-AP-A	< 55.0	N/A	N/A	< 55.0	< 0.231
	Sample 107-AP-B	< 55.0				
	Sample 107-AP-C	< 55.0				
	Sample 107-AP-D	< 55.0				
	Sample 107-AP-E	< 55.0				

Table A-1. Tank 241-AP-107 Analytical Data: Lead

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Pb	Sample 107-AP-A	(353)	133	233 to 507	329	1.38
	Sample 107-AP-B	507				
	Sample 107-AP-C	(232)				
	Sample 107-AP-D	< 190				
	Sample 107-AP-E	223				

* The data are inconclusive as to whether Pb is actually present in the tank, but the results demonstrate that the concentration is less than 5,000 $\mu\text{g/L}$, the Toxicity Characteristic Leaching Procedure (EPA, 1991).

Table A-1. Tank 241-AP-107 Analytical Data: Magnesium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Mg	Sample 107-AP-A	(856)	1,300	684 to 3,800	1,550	6.51
	Sample 107-AP-B	(866)				
	Sample 107-AP-C	(684)				
	Sample 107-AP-D	1,560				
	Sample 107-AP-E	(3,800)				

Table A-1. Tank 241-AP-107 Analytical Data: Manganese

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Mn	Sample 107-AP-A	< 15.0	77.7	< 15.8 to 189	77.3	0.324
	Sample 107-AP-B	69.2				
	Sample 107-AP-C	(35.2)				
	Sample 107-AP-D	(15.8)				
	Sample 107-AP-E	(189)				

Table A-1. Tank 241-AP-107 Analytical Data: Mercury

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
CVAA.Hg	Sample 107-AP-A	< 0.003	N/A	N/A	< 0.003	< 0.013
	Sample 107-AP-B	< 0.003				
	Sample 107-AP-C	< 0.003				
	Sample 107-AP-D	< 0.003				
	Sample 107-AP-E	< 0.003				

Table A-1. Tank 241-AP-107 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
GHAA.Se	Sample 107-AP-A	(< 0.013)	N/A	N/A	< 0.013	< 0.054
	Sample 107-AP-B	(< 0.013)				
	Sample 107-AP-C	(< 0.013)				
	Sample 107-AP-D	(< 0.013)				
	Sample 107-AP-E	(< 0.013)				

Table A-1. Tank 241-AP-107 Analytical Data: Silver

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Ag	Sample 107-AP-A	< 30.0	6.12	43.4 to 55.6	49.2	0.206
	Sample 107-AP-B	< 30.0				
	Sample 107-AP-C	(55.6)				
	Sample 107-AP-D	(43.4)				
	Sample 107-AP-E	(48.7)				

* The data are inconclusive as to whether Ag is actually present in the tank, but the results demonstrate that the concentration is less than 5,000 $\mu\text{g/L}$, the Toxicity Characteristic Leaching Procedure (EPA, 1990).

Table A-1. Tank 241-AP-107 Analytical Data: Sodium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Na	Sample 107-AP-A	2.08E+06	1.33E+06	2.08E+06 to 2.44E+06	2.28E+06	9,540
	Sample 107-AP-B	(2.23E+06)				
	Sample 107-AP-C	2.32E+06				
	Sample 107-AP-D	2.44E+06				
	Sample 107-AP-E	2.31E+06				

Table A-1. Tank 241-AP-107 Analytical Data: Total Uranium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
LF.Tot U	Sample 107-AP-A	(0.0243)	0.00485	0.0178 to 0.0310	0.0234	0.0980
	Sample 107-AP-B	(0.0222)				
	Sample 107-AP-C	0.0178				
	Sample 107-AP-D	0.0218				
	Sample 107-AP-E	0.0310				

Table A-1. Tank 241-AP-107 Analytical Data: Zinc

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Metal		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
ICP.Zn	Sample 107-AP-A	(369)	992	332 to 2,660	990	4.15
	Sample 107-AP-B	(1,150)				
	Sample 107-AP-C	(440)				
	Sample 107-AP-D	(332)				
	Sample 107-AP-E	(2,660)				

Table A-2. Tank 241-AP-107 Analytical Data: Ammonia

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Cation		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
KTN.NH ₃	Sample 107-AP-A	(< 80)	N/A	N/A	< 80	< 335
	Sample 107-AP-B	(< 40)				
	Sample 107-AP-C	(< 40)				
	Sample 107-AP-D	(< 40)				
	Sample 107-AP-E	(< 40)				

Table A-2. Tank 241-AP-107 Analytical Data: Chloride

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
IC.Cl ⁻	Sample 107-AP-A	(< 22)	N/A	N/A	< 22	< 92
	Sample 107-AP-B	(< 22)				
	Sample 107-AP-C	(< 22)				
	Sample 107-AP-D	(< 22)				
	Sample 107-AP-E	(< 22)				

Table A-2. Tank 241-AP-107 Analytical Data: Cyanide

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
Spectrophot.CN ⁻	Sample 107-AP-A	(0.575)	0.0519	0.522 to 0.650	0.579	2.43
	Sample 107-AP-B	(0.650)				
	Sample 107-AP-C	(0.522)				
	Sample 107-AP-D	(0.610)				
	Sample 107-AP-E	(0.540)				

Table A-2. Tank 241-AP-107 Analytical Data: Fluoride

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
IC.F ⁻	Sample 107-AP-A	(136)	4.39	136 to 146	142	594
	Sample 107-AP-B	(138)				
	Sample 107-AP-C	(146)				
	Sample 107-AP-D	(145)				
	Sample 107-AP-E	(143)				

Table A-2. Tank 241-AP-107 Analytical Data: Hydroxide

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
AUTOTIT.OH ⁻	Sample 107-AP-A	(< 250)	N/A	N/A	266	1,110
	Sample 107-AP-B	(266)				
	Sample 107-AP-C	(< 250)				
	Sample 107-AP-D	(< 250)				
	Sample 107-AP-E	(< 250)				

Table A-2. Tank 241-AP-107 Analytical Data: Nitrate

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
IC.NO ₃ ⁻	Sample 107-AP-A	(987)	26.4	987 to 1,060	1,020	4,270
	Sample 107-AP-B	(1,020)				
	Sample 107-AP-C	(1,020)				
	Sample 107-AP-D	(1,060)				
	Sample 107-AP-E	(1,010)				

Table A-2. Tank 241-AP-107 Analytical Data: Nitrite

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
IC.NO ₂ ⁻	Sample 107-AP-A	(22,900)	1,070	22,800 to 25,300	23,500	98,400
	Sample 107-AP-B	(22,800)				
	Sample 107-AP-C	(22,800)				
	Sample 107-AP-D	(25,300)				
	Sample 107-AP-E	(23,600)				

Table A-2. Tank 241-AP-107 Analytical Data: Phosphate

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
IC.PO ₄ ⁻	Sample 107-AP-A	(< 10)	N/A	N/A	< 10	< 42
	Sample 107-AP-B	(< 10)				
	Sample 107-AP-C	(< 10)				
	Sample 107-AP-D	(< 10)				
	Sample 107-AP-E	(< 10)				

Table A-2. Tank 241-AP-107 Analytical Data: Sulfate

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Anion		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	.kg
IC. SO_4^{-2}	Sample 107-AP-A	(< 10)	N/A	N/A	203	851
	Sample 107-AP-B	(< 10)				
	Sample 107-AP-C	(203)				
	Sample 107-AP-D	(< 10)				
	Sample 107-AP-E	(< 10)				

Table A-3. Tank 241-AP-107 Analytical Data: Radionuclides

Analyte	Laboratory Sample Identification	Analytical Data Result	Projected Inventory
Radionuclide		$\mu\text{Ci/mL}$	Ci
AEA. ^{241}Am	Sample 107-AP-COM	(< 6.37E-04)	< 2.67
LSC. ^{14}C	Sample 107-AP-COM	3.18E-06	0.0133
GEA. $^{144}\text{Ce/Pr}$	Sample 107-AP-COM	< 3.40E-02	< 142
GEA. ^{134}Cs	Sample 107-AP-COM	< 5.80E-05	< 0.243
GEA. ^{137}Cs	Sample 107-AP-COM	(1.23E-04)	0.515
GEA. ^{60}Co	Sample 107-AP-COM	< 6.90E-05	< 0.289
AEA. $^{243/244}\text{Cm}$	Sample 107-AP-COM	(< 6.37E-04)	< 2.67
GEA. ^{154}Eu	Sample 107-AP-COM	< 1.92E-04	< 0.805
GEA. ^{155}Eu	Sample 107-AP-COM	< 1.29E-04	< 0.541
GEA. ^{129}I	Sample 107-AP-COM	(< 4.35E-05)	< 0.182
APC. ^{237}Np	Sample 107-AP-COM	(< 1.48E-05)	< 0.0620
GEA. ^{94}Nb	Sample 107-AP-COM	< 4.96E-05	< 0.208
AEA. ^{238}Pu	Sample 107-AP-COM	(< 6.51E-04)	< 2.73
AEA. $^{239/240}\text{Pu}$	Sample 107-AP-COM	(< 5.34E-04)	< 2.24
GEA. ^{226}Ra	Sample 107-AP-COM	< 1.19 E-03	< 4.99
GEA. $^{106}\text{Ru/Rh}$	Sample 107-AP-COM	< 9.50E-04	< 3.98
LSC. ^{79}Se	Sample 107-AP-COM	< 5.38E-06	N/A
BPC. ^{90}Sr	Sample 107-AP-COM	(1.18E-04)	0.494
LSC. ^{99}Tc	Sample 107-AP-COM	< 2.05E-05	< 0.0859
LSC. ^3H	Sample 107-AP-COM	0.0352	147
APC.Total Alpha	Sample 107-AP-COM	(< 1.96E-06)	< 0.00821
BPC.Total Beta	Sample 107-AP-COM	2.11E-04	0.884

Table A-4. Tank 241-AP-107 Analytical Data: Specific Gravity

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Physical Property						
SpG	Sample 107-AP-A	0.989	0.00158	0.987 to 0.991	0.989	N/A
	Sample 107-AP-B	0.990				
	Sample 107-AP-C	0.991				
	Sample 107-AP-D	0.988				
	Sample 107-AP-E	0.987				

Table A-4. Tank 241-AP-107 Analytical Data: Total Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Standard)	Range of Values	Evaluated Data Result	Projected Inventory
Physical Property		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
NDIR. TC	Sample R3620	(350)	22.7	345 to 405	359	1,500
	Sample R3622	(355)				
	Sample R3624	(345)				
	Sample R3626	(350)				
	Sample R3628	(350)				
	Sample R3629	(405)				

Table A-4. Tank 241-AP-107 Analytical Data: Total Inorganic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Physical Property		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
Coul.TIC	107-AP-A	(257)	51.2	247 to 400	295	1,240
	107-AP-B	(373)				
	107-AP-C	(274)				
	107-AP-D	(247)				
	107-AP-E	(250)				
NDIR.TIC	R3620	280				
	R3622	300				
	R3624	325				
	R3626	285				
	R3628	255				
	R3629	400				

Note: Sample Nos. 107-AP-A,B,C,D are from 222-S. R3620-R3629 are from PNL.

Table A-4. Tank 241-AP-107 Analytical Data: Total Organic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Physical Property		$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	$\mu\text{g/mL}$	kg
NDIR. TOC	Sample R3620	(70)	33	5.0 to 70	52	220
	Sample R3622	(55)				
	Sample R3624	(20)				
	Sample R3626	(65)				
	Sample R3628	(95)				
	Sample R3629	(5.0)				

Table A-5. Tank 241-AP-107 Analytical Data: Volatile Organic Compound

Analyte	Result µg/L	Analyte	Result µg/L
Chloromethane	ND	Trichloroethene	ND
Bromomethane	ND	Dibromochloromethane	ND
Vinyl Chloride	ND	1,1,2-Trichloroethane	ND
Chloroethane	ND	Benzene	ND
Methylene Chloride	ND	trans-1,3-Dichloropropene	ND
Acetone	ND	Bromoform	ND
Carbon Disulfide	ND	4-Methyl-2-Pentanone	ND
1,1-Dichloroethene	ND	2-Hexanone	ND
1,1-Dichloroethane	ND	Tetrachloroethene	ND
trans-1,2-Dichloroethene	ND	1,1,2,2-Tetrachlorethane	ND
cis-1,2-Dichloroethene	ND	Chlorobenzene	ND
Chloroform	ND	Ethylbenzene	ND
1,2-Dichloroethane	ND	Styrene	ND
2-Butanone	ND	m&p-Xylene	ND
1,1,1-Trichloroethane	ND	o-Xylene	ND
Carbon Tetrachloride	ND	Isopropylbenzene	ND
Vinyl Acetate	ND	1,3,5-Trimethylbenzene	ND
Bromodichloromethane	ND	1,2,4-Trimethylbenzene	ND
1,2-Dichloropropane	ND	Tetrahydrofuran	ND
cis-1,3-Dichloropropene	ND	1,2,3-Trimethylbenzene	ND

NOTE: All VOA data was rejected (R).

ND = Not Detected.

Table A-6. Tank 241-AP-107 Analytical Data: Semivolatile Organic Analysis

Analyte	Result µg/L	Analyte	Result µg/L
Phenol	ND	3-Nitroaniline	ND
bis(2-Chloroethyl)ether	ND	Acenaphthene	ND
2-Chlorophenol	ND	2,4-Dinitrophenol	ND
1,3-Dichlorobenzene	ND	4-Nitrophenol	ND
1,4-Dichlorobenzene	ND	Dibenzofuran	ND
Benzyl alcohol	ND	2,4-Dinitrotoluene	ND
1,2-Dichlorobenzene	ND	Diethylphthalate	ND
2-Methylphenol	ND	4-Chlorophenyl-phenylether	ND
bis(2-Chloroisopropyl) ether	ND	Fluorene	ND
4-Methylphenol	ND	4-Nitroaniline	ND
N-Nitroso-di-n-propylamine	ND	4,6-Dinitro-2-methylphenol	ND
Hexachloroethane	ND	N-Nitrosodiphenylamine (1)	ND
Nitrobenzene	ND	4-Bromophenyl-phenylether	ND
Isophorone	ND	Hexachlorobenzene	ND
2-Nitrophenol	ND	Pentachlorophenol	ND
2,4-Dimethylphenol	ND	Phenanthrene	ND
Benzoic acid	ND	Anthracene	ND
bis(2-Chloroethoxy)methane	ND	Di-n-butylphthalate	ND
2,4-Dichlorophenol	ND	Fluoranthene	ND
1,2,4-Trichlorobenzene	ND	Pyrene	ND
Naphthalene	ND	Butylbenzylphthalate	ND
4-Chloroaniline	ND	3,3'-Dichlorobenzidine	ND
Hexachlorobutadiene	ND	Benzo(a)anthracene	ND
4-Chloro-3-methylphenol	ND	Chrysene	ND
-Methylnaphthalene	ND	Bis(2-Ethylhexyl)phthalate	ND
Hexachlorocyclopentadiene	ND	Di-n-octylphthalate	ND
2,4,6-Trichlorophenol	ND	Benzo(b)fluoranthene	ND
2,4,5- Trichlorophenol	ND	Benzo(k)fluoranthene	ND
2-Chloronaphthalene	ND	Benzo(a)pyrene	ND
2-Nitroaniline	ND	Indeno(1,2,3-cd) pyrene	ND
Dimethylphthalate	ND	Dibenz(a,h)anthracene	ND
Acenaphthylene	ND	Benzo(g,h,i)perylene	ND
2,6-Dinitrotoluene	ND	2-Butoxyethanol	ND

Table A-6. Tank 241-AP-107 Analytical Data: 1-Butanol

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Semivolatile Organic		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
GC/MS. 1-Butanol	Sample R3620	(14,000)	5,300	2,000 to 15,000	9,900	41
	Sample R3622	(14,000)				
	Sample R3624	(15,000)				
	Sample R3626	(7,800)				
	Sample R3628	(6,400)				
	Sample R3631	(2,000)				

Table A-6. Tank 241-AP-107 Analytical Data: Phosphoric acid, Tributyl ester

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	Evaluated Data Result	Projected Inventory
Semivolatile Organic		$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	$\mu\text{g/L}$	kg
GC/MS. Tributyl Phosphate	Sample R3620	(3,200)	1,000	2,200 to 4,700	3,000	13
	Sample R3622	(2,200)				
	Sample R3624	(2,300)				
	Sample R3626	(4,700)				
	Sample R3628	(2,600)				