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7. Abstract

This document provides the essential characterization data for Double-Shell Tank AW-105

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Tank Characterization Report for Double-Shell Tank 241-AP-101

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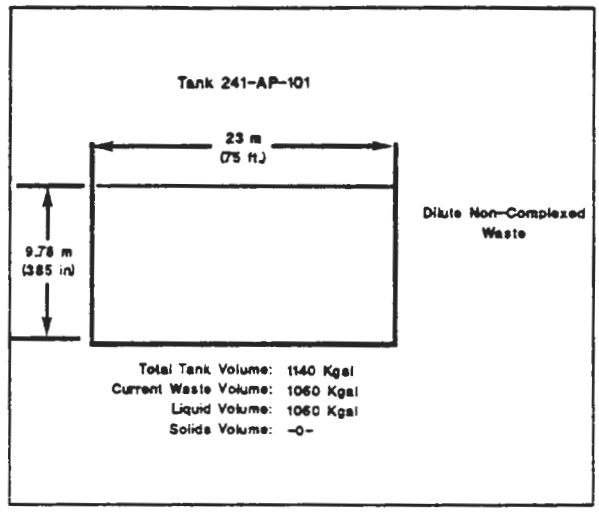
EXECUTIVE SUMMARY

Double Shell Tank 241-AP-101 is a radioactive waste tank most recently sampled in July of 1993. Sampling and characterization of the waste in Tank 241-AP-101 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 as part of an overall waste volume reduction program.

Tank 241-AP-101, 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 1,060,000 gallons of dilute non-complexed waste. All of the waste is liquid. Waste has been removed periodically for processing and concentration through the 242-A Evaporator. Final disposal of the contents in Tank 241-AP-101 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-101 at this time.



The waste in Tank 241-AP-101 exists as an aqueous solution of metallic salts and radionuclides. There are no solid wastes present in the tank. The most prevalent soluble analytes include sodium, potassium, hydroxide, nitrate, nitrite, and ammonia. The calculated pH of 13 is above the *Resource Conservation and Recovery Act* established for corrosivity. The only radionuclides present in concentrations above their detection limits are ^{137}Cs, ^{90}Sr, and ^{3}H. Approximately 99% of the waste by weight is water. Comparisons to established limits of concern for 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)[1]. 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).

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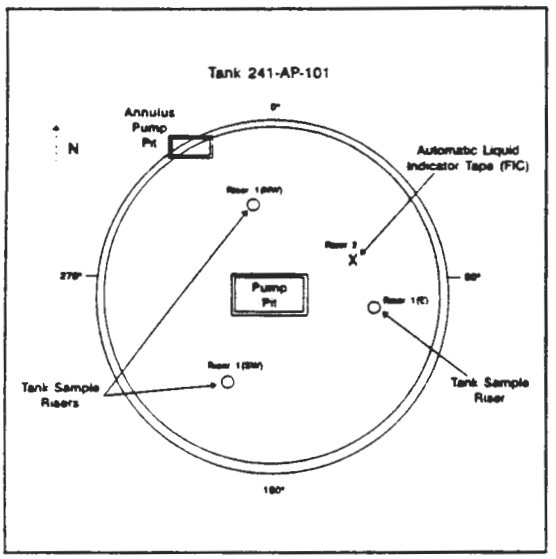
[1] Additional information has recently come to light regarding the potential processibility of this waste. This data is too recent to be properly addressed in this document now. However, as this information is reviewed, it will be incorporated into the revision updating this document.



TANK 241-AP-101	
TANK DESCRIPTION	
Type	Double-Shell
Constructed	1986
In Service	1986
Diameter	75' (23 m)
Usable Depth	35' (10.7 m)
Operating Capacity	1,140,000 gal (4,315,000 L)
Bottom Shape	Flat
Hanford Coordinates:	40.666° North 47.100° West
Ventilation:	Operating Exhauster
TANK STATUS: as of May 1994	
Contents:	Dilute Non-Complexed Waste
Total Waste:	1,060,000 gal (4,010,000 L)
Liquid Volume:	1,060,000 gal (4,010,000 L)
Drainable Interstitial Liquid	N/A
Manual Tape Surface Level:	385.0 inches
FIC Surface Level:	385.4 inches
Integrity Category:	Sound
Watch List Status:	Not Listed
Annulus Status	In Compliance

Double-Shell Tank 241-AP-101 Concentrations and Inventories for Critical List Analytes (as of May 1994)		
Total Tank Volume	1,140,000 gallons (4,315,000 L)	
Total Waste Volume	1,060,000 gallons (4,010,000 L) 3,950,000 kg	
Liquid Volume	1,060,000 gallons (4,010,000 L) 3,950,000 kg	
Physical Properties		
Specific Gravity	0.986	
H_2O	~ 98.8 wt% ~ 3,870,000 kg	
Temperature	59°F	
pH	13.0	
Heat Load	< 1.30 W	
Chemical Constituents	**Average Concentration**	**Bulk Inventory**
Na (Sodium)	0.46 wt%	18,100 kg
NH_3 (Ammonia)	0.20 wt%	7,860 kg
OH^- (Hydroxide)	0.18 wt%	7,310 kg
NO_3^- (Nitrate)	0.16 wt%	6,330 kg
NO_2^- (Nitrite)	0.11 wt%	4,450 kg
Total Organic Carbon	2.4E-03 wt%	95.0 kg
Total Inorganic Carbon	0.019 wt%	762 kg
Radionuclides		
Total Uranium	2.15 E-05 wt%	0.85 kg
^{137}Cs	3.26 μCi/L	13.1 Ci
^{90}Sr	0.563 μCi/L	2.26 Ci
^{3}H	2.10 μCi/L	8.42 Ci

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LIST OF TERMS

AA	atomic absorption
AEA	alpha energy analysis
APC	alpha proportional counting
BPC	beta proportional counting
CFR	*Code of Federal Regulations*
CVAA	cold vapor atomic absorption
DM	direct measurement
DN	dilute non-complexed
DNFSB	Defense Nuclear Facilities Safety Board
DOE	United States Department of Energy
DSC	differential scanning calorimetry
EPA	United States Environmental Protection Agency
FAA	flame atomic absorption
FIC	Food Instrument Corporation
GEA	gamma energy analysis
GHAA	gaseous hydride atomic absorption
IC	Ion Chromatography
ICP	Inductively Coupled Plasma Atomic Emission Spectrometry
ISE	ion selective electrode
KTN	Kjeldahl's Total Nitrogen
LEPS	Low Energy Photon Spectroscopy
LF	laser fluorimetry
LSC	Liquid Scintillation Counting
MDL	method detection limit
MS	mass spectrometry
ND	not detected
NDi	not dispersive
PC	proportional counting
PNL	Pacific Northwest Laboratory
PUREX	Plutonium-Uranium Extraction Plant
RPD	relative percent difference
SpG	specific gravity
SOW	statement of work
SST	Single-Shell Tank
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 July 1993, Double-Shell Tank 241-AP-101 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. It also addresses expected concentration and inventory data for the waste contents based on this latest sampling data and background tank information. Finally, this report makes recommendations and conclusions regarding operational safety.

1.1 PURPOSE

The purpose of this report is to describe and characterize the waste in Double-Shell Tank 241-AP-101 (hereafter, Tank 241-AP-101) based on information given from various sources. This report summarizes the available information regarding the waste in Tank 241-AP-101, and using the historical information to place the analytical data in context, arranges this information in a useful format for making management and technical decisions concerning this waste tank. In addition, conclusions and recommendations are given based on safety issues and further characterization needs.

Specific objectives reached by the sampling and characterization of the waste in Tank 241-AP-101 are:

- Contribute towards 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 and DOE, 1993).

- Complete safety screening of the contents of Tank 241-AP-101 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*, Rev. 1 (Bell, 1994).

1.2 SCOPE

A broad description of the tank and its historical background are presented first. This allows a detailed estimation of the contents of Tank 241-AP-101 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 statistically. The information obtained from historical sources is then compared 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-101. This Tank Characterization Report incorporates all available previous sampling, characterization, and transfer data concerning Tank 241-AP-101. 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. Based on the statistical determination, presented in Section 7.0, that the tank waste is homogenous, and given that the analytical data is valid and defensible, this report is therefore the definitive characterization of the contents of Tank 241-AP-101.

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 as the basis for the analytical section of this report, Section 5.0. The historical characterization of this tank, Section 2.0, is based on the available "historical results" prior to the 1993 sampling.

Tank 241-AP-101 remains in active service for waste management operations. Although the future contents of the tank will likely change, the characterization of Tank 241-AP-101 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-101 based on historical tank information, and to use this information to predict the constituents of the tank waste and their 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-101 based on historical information. The final part details the surveillance data taken on the tank.

2.1 TANK HISTORY

Tank 241-AP-101 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 for storing 1.16 million gallons of waste; however, safety considerations require a maximum operating capacity of 1.14 million gallons. Instruments access Tank 241-AP-101 through risers and monitor the pressure, temperature, liquid level, and other bulk tank characteristics (Bell, 1994). A detailed diagram of a double-shell tank is presented in Figure 2-1 (Hanlon, 1994).

Tank 241-AP-101 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 located 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 northwest corner of the AP Tank Farm.

Tank 241-AP-101 is used to store dilute non-complexed waste from several sources. The two primary sources are the PUREX Ammonia Scrubber and supernate from Tank 241-AP-103 (the transfers between these two tanks are detailed in section 2.4). Other minor waste sources include PUREX Decladding Supernate and flush water from various sources. Portions of the tank waste have been periodically removed for evaporation and concentration in the 242-A Evaporator.

2.2 TANK STATUS

Tank 241-AP-101 presently contains 1,060,000 gallons of liquid waste (Hanlon, 1994). No slurry, sludge, or salt cake exists; therefore, no interstitial liquid exists. Since Tank 241-AP-101 has an operational capacity of 1,140,000 gallons, it is 93% full with 80,000 gallons of reserve capacity. Tank 241-AP-101 is still in service. The "in service" designation allows these tanks to continue receiving waste in conjunction with production and/or waste processing. The tank integrity is classified as sound and it currently is not on a Watch List. There are no Unreviewed Safety Questions associated with Tank 241-AP-101 at this time.

Tank 241-AP-101 is equipped with both a manual tape and an automated liquid indicator device for surface level readings; both are operable. The waste occupies approximately the bottom 385 inches of the tank. All tank monitoring instruments, with the exception of the Leak Detection Pit radiation readings, are in monitoring compliance (Hanlon, 1994).

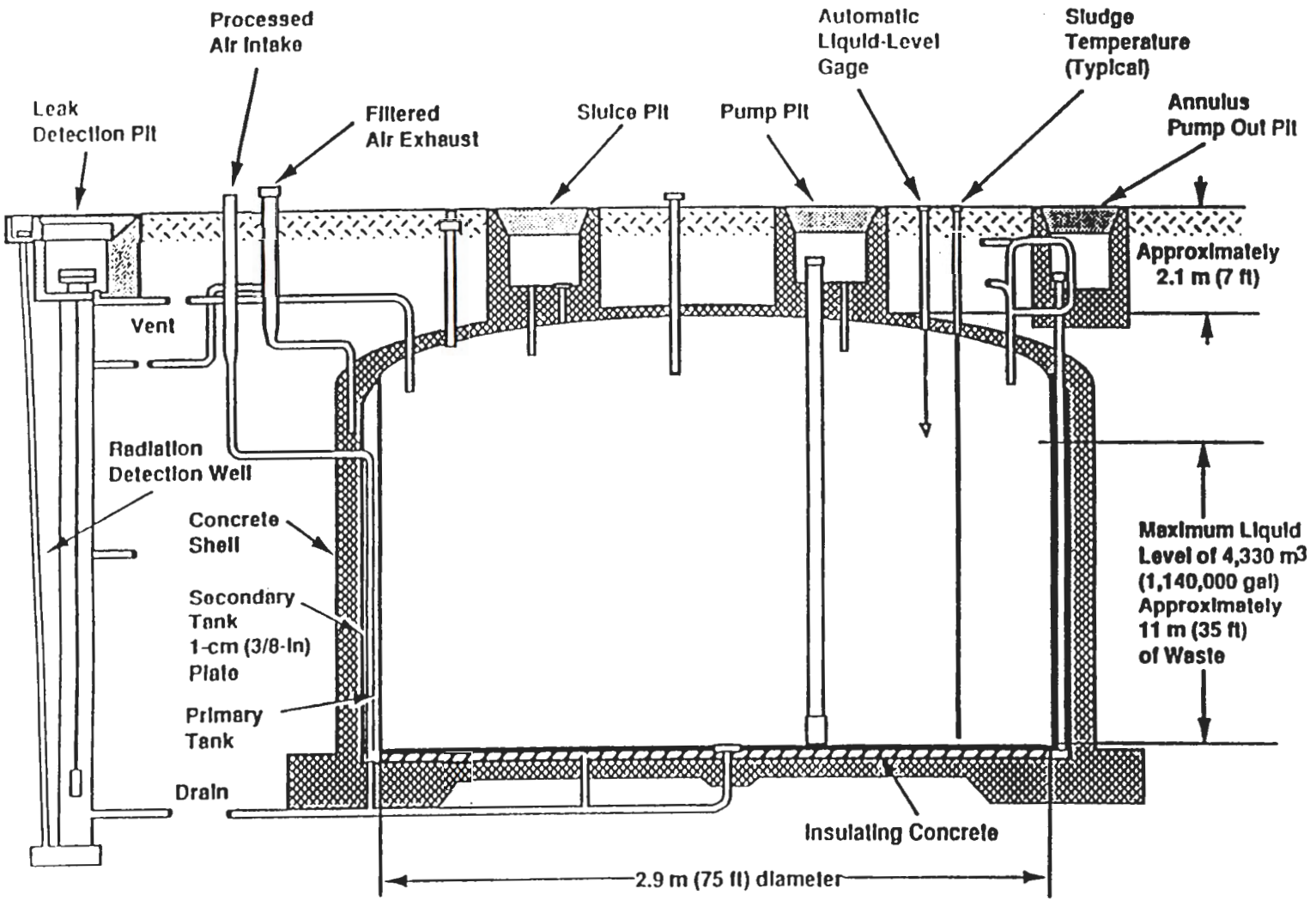
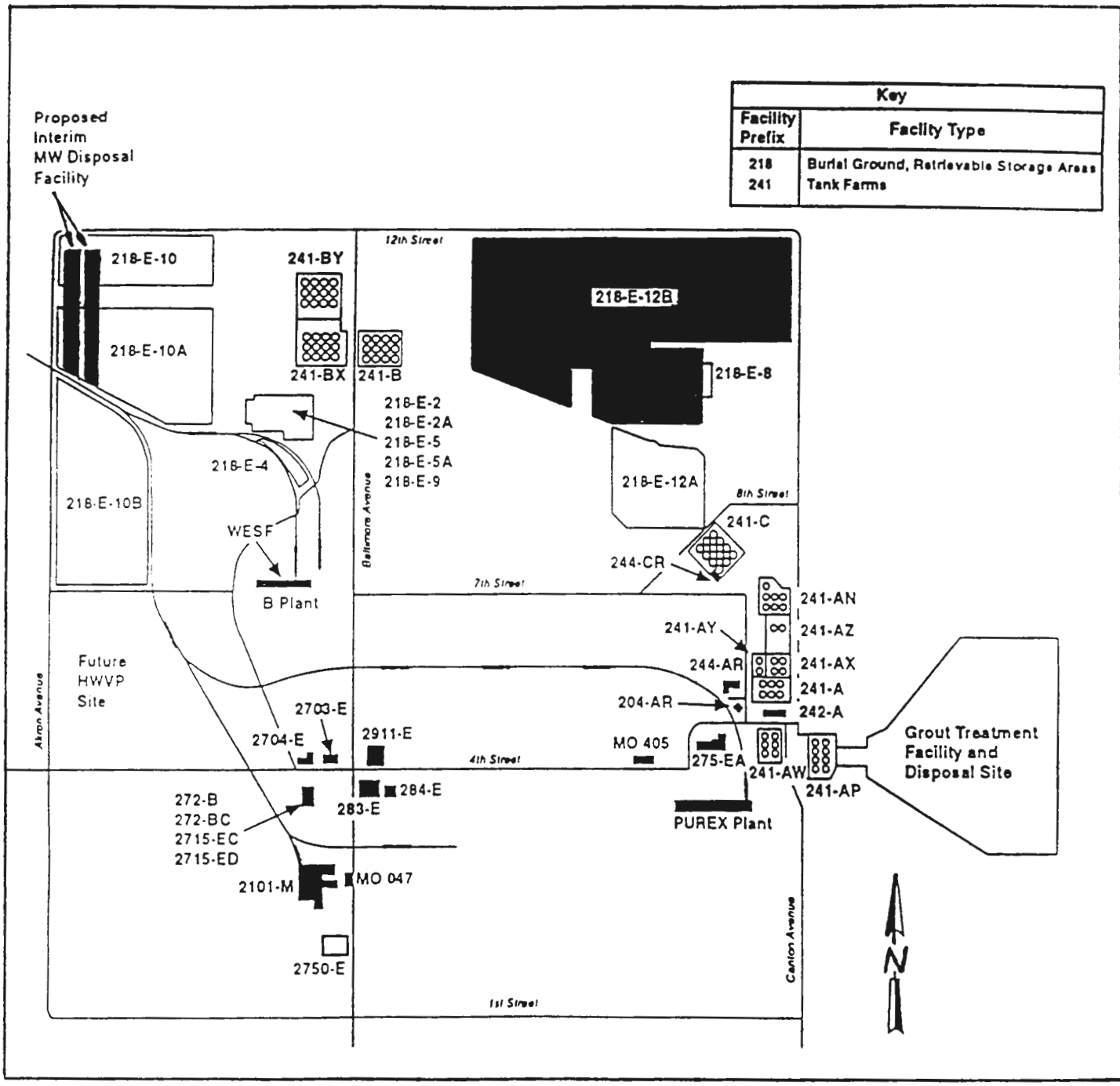


Figure 2-1. Double-Shell Tank Configuration.

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



Active ventilation is used to keep the tank contents cool and to minimize the potential for release of airborne contaminates to the environment (Husa et al., 1993). Temperatures within the tank are stable (Husa et al., 1993), with 56°F reported on May 31, 1994.

Approximately 58% (616,000 gallons) of the current volume of Tank 241-AP-101 was transferred from Tank 241-AP-103 in the fourth quarter 1989. The 382,000 gallons of dilute non-complexed (DN) supernate in Tank 241-AP-101 before the transfer was waste from the PUREX Ammonia Scrubber and PUREX Decladding Supernate, along with flush water. After the transfer, 64,000 gallons of DN waste from the PUREX Ammonia Scrubber and a small amount of flush water were added to arrive at the current volume.

2.3 PROCESS KNOWLEDGE

Figure 2-3 depicts the fill history of Tank 241-AP-101 from when it became operational in August 1986, to the end of 1993, the last entry in the *Waste Volume Projection Historical Database* (Koreski, 1994). A detailed description of the waste transfers into and out of the tank follows. All of the volume data were taken from Koreski (1994).

Tank 241-AP-101 was brought into service with a transfer of 19,000 gallons of flush water from miscellaneous sources in August 1986. A relatively small quantity (only 1,000 gallons) of dilute non-complexed (DN) waste of PUREX Decladding Supernate was added in August 1987. In July 1988, Tank 241-AP-101 received its first transfer of DN waste from the PUREX Ammonia Scrubber. Successive transfers from the PUREX Ammonia Scrubber increased the liquid volume until it reached its maximum of 1,344,000 gallons. Although it appears that the tank had overfilled its capacity of 1.14 million gallons, it in fact had not. These numbers were taken from a database which does not track the exact days of the gains and transfers. Instead it shows the gains beginning on the first of the month and extending through the end of the month, while transfers were shown beginning on the 15th of the month. In actuality, the gains and transfers were staggered to prevent overfilling the tank. Transfers of waste from Tank 241-AP-101 into Tank 241-AW-102 for processing through the evaporator, or Tank 241-AP-103 storage, resulted in a volume of 374,000 gallons at the end of the fourth quarter 1988.

This volume remained relatively stable until the fourth quarter 1989, when Tank 241-AP-101 received approximately 58% of its final volume through a 616,000 gallon transfer of dilute non-complexed supernate from Tank 241-AP-103. The contents of this waste were very similar to the contents already in Tank 241-AP-101 before the transfer. This is because previously, in the fourth quarter 1988, 578,000 gallons of DN supernate were transferred from Tank 241-AP-101 to Tank 241-AP-103. Only 60,000 gallons of supernate were present in Tank 241-AP-103 at the time, so this transfer composed approximately 91% of Tank 241-AP-103's volume. In addition, all 60,000 gallons of supernate in Tank 241-AP-103 consisted of either DN waste from the PUREX Ammonia Scrubber or flush water, similar to the same components of Tank 241-AP-101 waste. The waste in Tank 241-AP-103 remained virtually unchanged until its transfer back into Tank 241-AP-101, gaining only 3,000 gallons of flush water. Therefore, the contents of Tank 241-AP-103 and Tank 241-AP-101 were essentially identical.

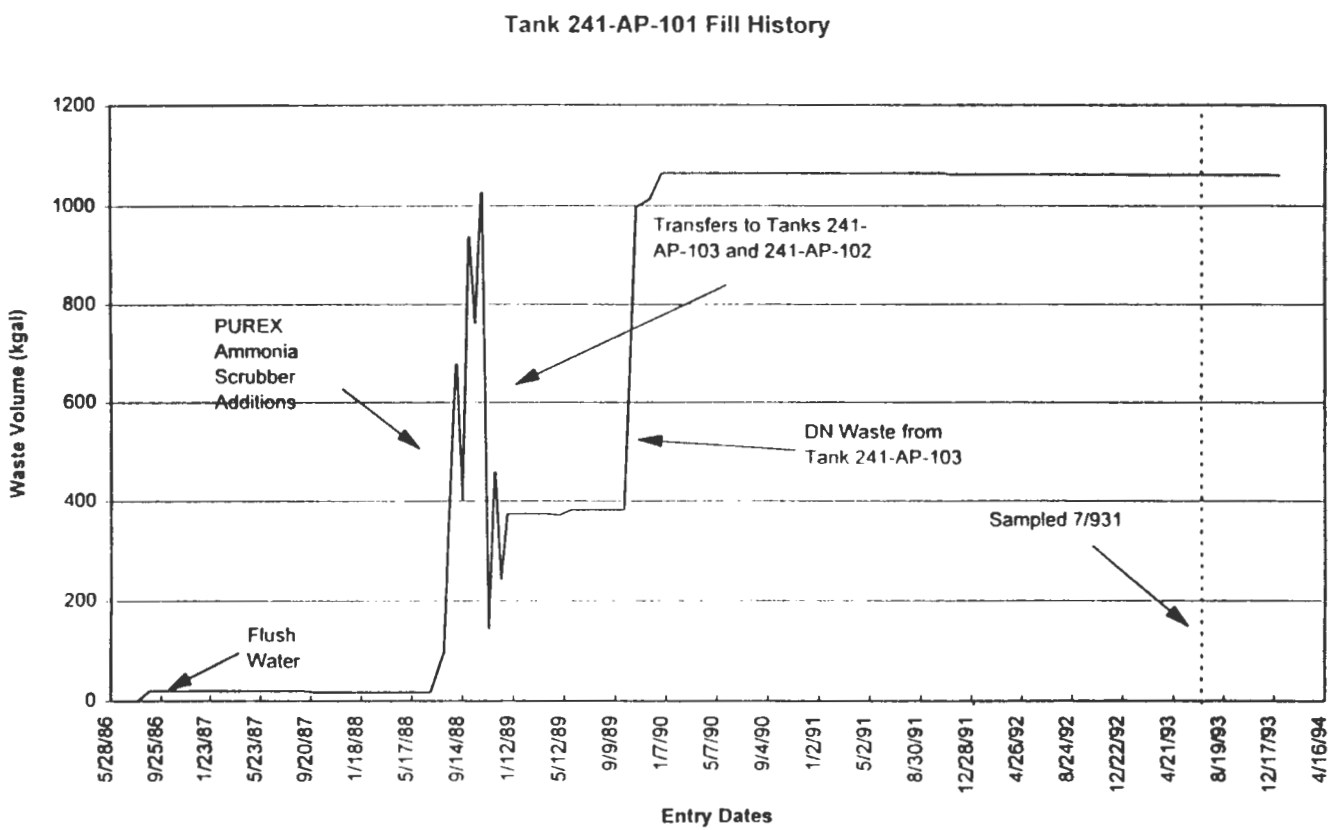


Figure 2-3. Waste Volume History of Tank 241-AP-101.

Following the transfer from Tank 241-AP-103, Tank 241-AP-101's fill activity was minimal. Sixty-four thousand gallons of DN waste from the PUREX Ammonia Scrubber and 2,000 gallons of water were added for a volume of 1,064,000 at the end of the fourth quarter 1989. The final volume for the tank was reported at 1,060,000 gallons of DN waste at the end of the fourth quarter 1993, following a loss of 4,000 gallons over four years due to unknown causes. The reasons for these losses were most likely evaporation or measurement inconsistencies, since an inch on the measuring tape is equivalent to approximately 2,750 gallons of waste (Hanlon, 1994).

2.4 HISTORICAL ESTIMATION OF THE CONTENTS OF TANK 241-AP-101

A preliminary estimate of the waste constituents in Tank 241-AP-101 can be generated by reviewing the historical characterization data for the tank. This estimate is compared with the most recent analytical data in Section 5.0.

Unfortunately, Tank 241-AP-101 had never been sampled and characterized before the July 1993 sampling date, so no historical analytical data exists. However, a rough estimate of the contents of the tank can be made by comparison to tanks with similar wastes and process histories. The best tank to use this comparison is Tank 241-AP-107.

The waste in Tank 241-AP-107 is considered to be the same as that in Tank 241-AP-101. The source of all 1,108,000 gallons of waste in Tank 241-AP-107 was the PUREX Ammonia Scrubber, with small amounts of flush water (Korenski, 1994). All but 1,000 of the 1,060,000 gallons in Tank 241-AP-101 either originated in the PUREX Ammonia Scrubber or was flush water (PUREX Decladding Supernate comprised the other 1,000 gallons). Some of the waste in Tank 241-AP-101 did come from Tank 241-AP-103, but as discussed above in Section 2.4, the wastes were virtually the same in composition; both had come from the PUREX Ammonia Scrubber.

This preliminary approximation of the contents of Tank 241-AP-101 from the characterization data of Tank 241-AP-107 makes use of several assumptions. The first is that all PUREX Ammonia Scrubber waste is alike in chemical composition. Secondly, in the case where an analyte was present at a value less than the instrument detection limit, the 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.

Table 2-1 summarizes the estimated waste composition of Tank 241-AP-101, based on the characterization data from Tank 241-AP-107 (WHC, 1994).

2.5 SURVEILLANCE DATA

2.5.1 Surface Level Readings

To determine the surface level of the waste, Tank 241-AP-101 is equipped with both an automatic gauge manufactured by the Food Instrument Corporation (FIC) and a manual tape. The manual tape readings are used when the FIC indicator is out of service. Both devices are currently operable. The most recent FIC liquid level measurement available was 385.4 inches on March 23, 1994 (Rios, 1994). The manual tape reading for the same date was 385 inches.

Table 2-1. Estimated Waste Composition of Tank 241-AP-101.

Analyte	Estimated Result (from Tank 241-AP-107)	Analyte	Estimated Result (from Tank 241-AP-107)
Metals	**(μg/L)**	**Radionuclides**	**(μCi/L)**
Al	1,060	^{241}Am	< 0.637
As	< 13	^{14}C	3.18E-03
Ba	18.1	$^{144}Ce/Pr$	< 34.0
Ca	20,100	^{134}Cs	< 0.058
Cd	< 20	^{137}Cs	0.123
Cr	55.2	^{60}Co	< 0.0690
Fe	< 55.0	$^{243/244}Cm$	< 0.637
Hg	< 3.00	^{154}Eu	< 0.192
Mg	1,550	^{155}Eu	< 0.129
Mn	< 77.3	^{3}H	35.2
Na	2.28E+06	^{129}I	< 0.0435
Pb	329	^{94}Nb	< 0.0496
Zn	990	^{237}Np	< 0.0148
Anions	**(μg/L)**	^{238}Pu	< 0.651
Cl^-	< 22,000	$^{239/240}Pu$	< 0.534
CN^-	579	^{226}Ra	< 1.19
F^-	< 142,000	$^{106}Ru/Rh$	< 0.950
OH^-	< 266,000	^{90}Sr	0.118
NH_3	< 80,000	^{99}Tc	< 0.0205
NO_2^-	1.11E+06		
NO_3^-	1.02E+06		
PO_4^{-3}	< 10,000		
SO_4^{-2}	203,000	Specific Gravity	0.989

The FIC indicator uses a conductivity electrode which is lowered by machine until electrical contact is established with the waste surface; it can be monitored automatically or manually (Husa, et al., 1993). When monitored automatically, the FIC gauge is electrically connected to a computer for data transmission, analysis, and reporting via the Computer Automated Surveillance System. The manual tape also uses a conductivity probe but must be lowered by hand crank.

2.5.2 Internal Tank Temperatures

Each double-shelled tank is equipped with approximately 100 thermocouples which measure the tank temperature. A probe with 18 thermocouples assembled in a pipe, called a thermocouple tree, is inserted into a waste tank and used to monitor the waste temperatures at various levels in the primary tank, usually every two feet. The temperature readings for Tank 241-AP-101 have been automatically recorded since the beginning of the third quarter 1989, by surveillance analysis computer systems. The maximum temperature readings from thermocouple tree one, which is located in the southwest quadrant of the primary tank at a midway radial position, are plotted in Figure 2-4. This graph, along with all of the temperature data, have been taken from Rios (1994). The last available temperature reading for Tank 241-AP-101 was 56°F, taken on May 31, 1994.

It is apparent from the plotted temperature graph in Figure 2-4 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). Usually the soil below this 10-foot zone attenuates the effects of changing ambient temperature. The bottom of the tank is 55 feet below the surface level (Husa et al., 1993), 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 Tank 241-AP-101's waste temperatures to fluctuate between a high of 69°F in the summer months to a low of 55°F in the winter months.

From the commencement of temperature readings in the third quarter 1989, to the end of the fourth quarter that same year, readings were only taken once a month. Beginning in 1990, Tank 241-AP-101 was monitored on approximately a weekly basis, excluding two periods in which the thermocouple equipment was out of service. The two periods with no thermocouple data are from the end of the fourth quarter 1990 to the second quarter 1991, and from the third quarter 1991 to the fourth quarter 1992. Interestingly, all eight tanks in the AP Tank Farm are lacking thermocouple data for these periods.

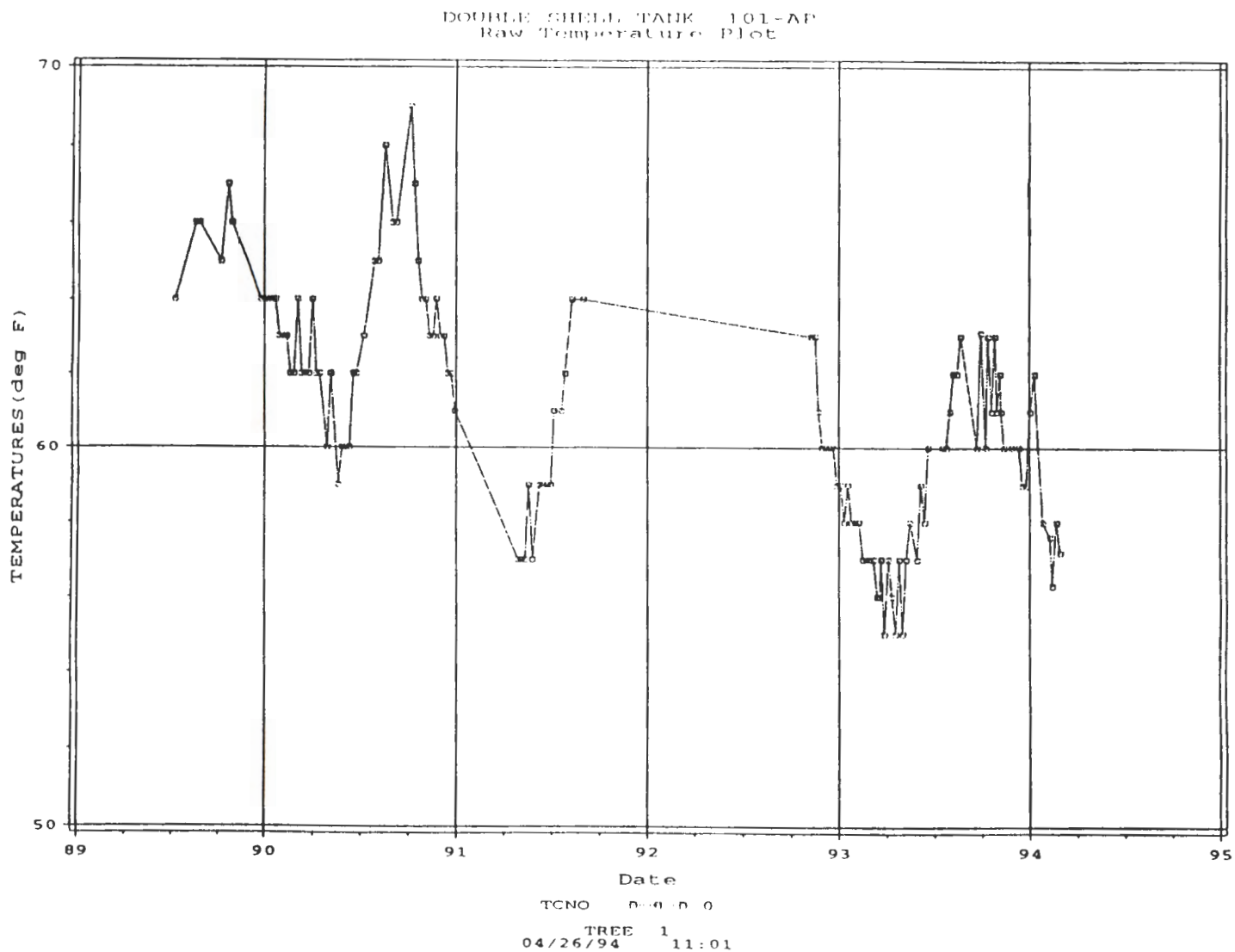


Figure 2-4. Tank 241-AP-101 Thermocouple Tree Raw Temperature Plot (Rios 1994).

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3.0 TANK SAMPLING OVERVIEW

The primary objective for Tank 241-AP-101 waste analyses is to evaluate the fitness of the waste to be safely processed through the evaporator. However, there are other benefits. First, this information will help to evaluate whether constituent concentrations are within safe operating limits by determining whether they are nonflammable and nonexplosive. Second, constituent concentrations relevant to functional limits can be determined. Finally, predictions regarding the types, amounts, and locations of environmentally hazardous wastes in the evaporator product stream can be made.

3.1 DESCRIPTION OF SAMPLING EVENT

Samples were collected on July 20, 1993 from three vertical risers within the tank [risers 1(NW), 1(E), and 1(SW)] (Miller, 1993). Figure 3-1 displays these sample locations. Two sample locations were selected at random depths within the tank from risers 1(NW) and 1(E). The fifth sample location was from within riser 1(SW). Duplicate samples were collected from each of the five sampling locations. The "bottle-on-a-string" method (ASTM, 1973) was used to collect the liquid samples from the tank. Each glass sample bottle collected approximately 100 milliliters of liquid. For a further description of sampling procedures, see the *Tank Characterization Reference Guide* (De Lorenzo, et al., 1994).

3.2 SAMPLE HANDLING PROCEDURES AND ANALYSES

To be consistent with safety procedures that help to limit personnel exposure to hazardous ionizing radiation, no attempt was made to completely fill the sample bottles; as a result, headspace may be present. For the same reason, samples were not preserved by refrigeration or acidification. These conditions are not expected to influence the analytical results or their interpretation.

After samples were collected, a Teflon cap was placed on top of the bottles. Duplicate field blanks were obtained by placing deionized water into sampling bottles and capping in the same manner. Each sampling location was sampled in duplicate; therefore one complete set of samples was available to both the WHC 222-S Process and Analytical Chemistry Laboratory and to Battelle's Pacific Northwest Laboratory (PNL). An additional sample was collected from the surface of the tank waste and provided to PNL for a Total Organic Carbon analysis.

After samples were retrieved, they were taken to the laboratory receiving doors in small radiation shielding casks by the B-Plant sample truck. Chain-of-custody forms were generated by the sample collector, and all samples were received between July 20, 1993 and July 21, 1993.

All of the waste analyses were performed at the WHC 222-S Laboratory except for the organic analyses, which were performed by PNL. The WHC sample numbers are presented in Table 3-1, while the PNL sample numbers are shown in Table 3-2. A list of analytes requested for evaluation by each laboratory is displayed in Table 3-3.

Figure 3-1. Tank 241-AP-101 Sample Locations.

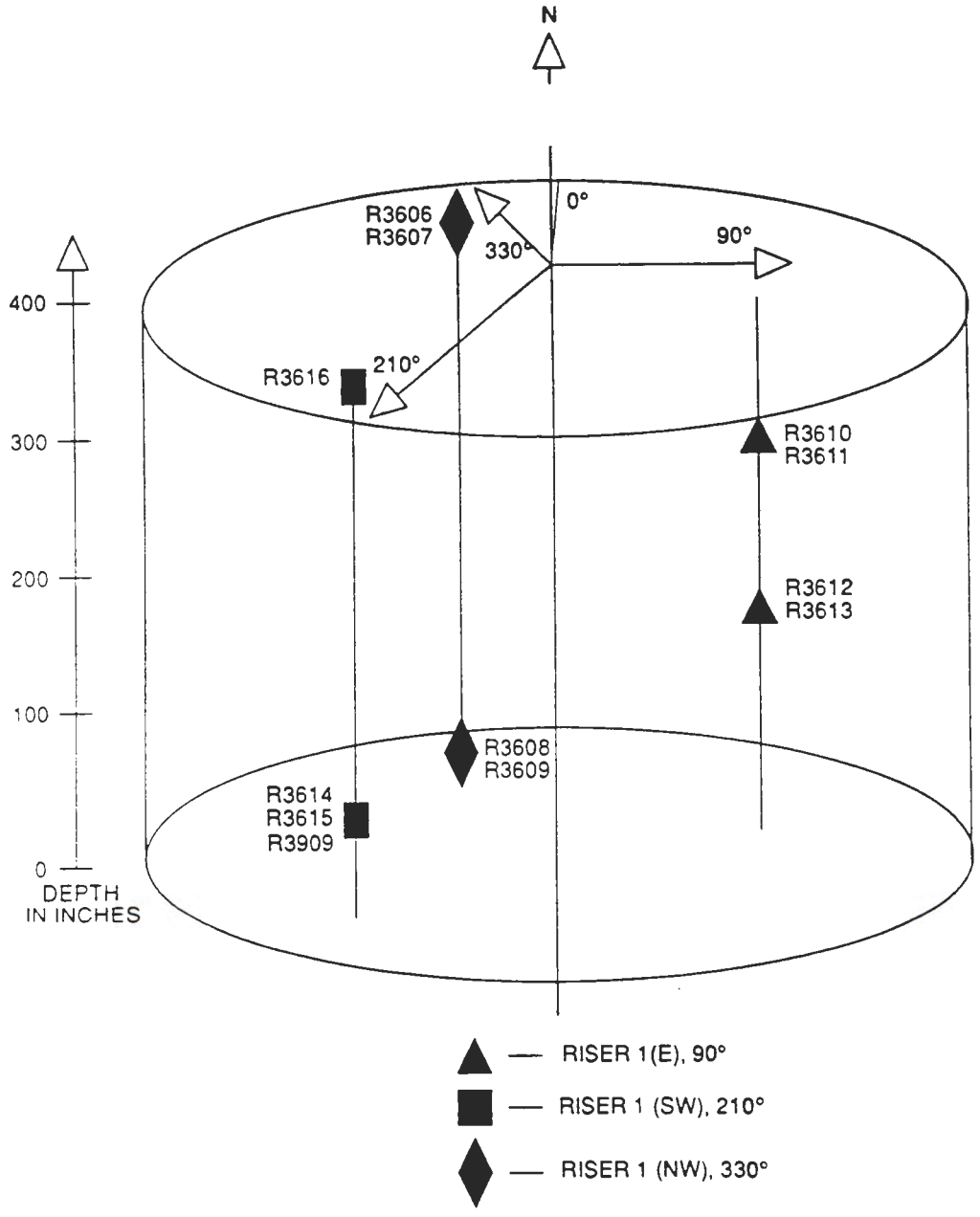

Table 3-1. WHC Sample Numbers (Tank 241-AP-101) (Miller, 1993).

Riser, Angle	Depth (from tank bottom)	Shipping Sample Number	Laboratory Sample Number
1 (E), 90°	276 Inches 180 Inches	R3610 R3612	V7 V8
1 (SW), 210°	84 Inches 84 Inches	R3614 R3909	V9
1 (NW), 330°	372 Inches 36 Inches	R3606 R3608	V3 V4
Field Blank		R3617	V12
Composite		R3606 R3608 R3610 R3612 R3614	V15

Table 3-2. PNL Sample Numbers (Tank 241-AP-101) (Miller, 1993).

Riser, Angle	Depth (from tank bottom)	Shipping sample number	PNL Laboratory sample number
1 (E), 90°	276 Inches 180 Inches	R3611 R3613	93-08646 93-08647
1 (SW), 210°	84 Inches 386 Inches (surface)	R3615 R3616	93-08648 93-08649
1 (NW), 330°	372 Inches 36 Inches	R3607 R3609	93-08644 93-08645
Field Blank		R3618	93-08650PB

Table 3-3. Tank 241-AP-101 Samples and Requested Analytes (Miller, 1993).

Shipping sample numbers	Laboratory sample numbers	Laboratory	Requested Analytes
R3606 R3608 R3610 R3612 R3617	V3, V4, V7, V8, V9, V12	222-S Laboratory	Al, As, Ba, Ca, Cd, Cr, Fe, Hg, Mg, Mn, Na, Pb, Se, Ag, U, Zn, F^-, Cl^-, CN-, OH^-, NH_3, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, TIC
R3617 Composite	V12, V15	222-S Laboratory	^{241}Am, ^{134}Cs, ^{137}Cs, ^{60}Co, $^{144}Ce/Pr$, ^{154}Eu, ^{155}Eu, ^{226}Ra, ^{103}Ru, $^{106}Ru/Rh$, ^{94}Nb
Composite	V15	222-S Laboratory	^{3}H, ^{14}C, ^{79}Se, ^{99}Tc, ^{90}Sr, ^{129}I, $^{239/240}Pu$, ^{238}Pu, ^{241}Am, $^{243/244}Cm$, ^{237}Np, Alpha, Beta
R3606 R3608 R3610 R3612	V3, V4, V7, V8, V9	222-S Laboratory	Specific Gravity
R3607 R3609 R3611 R3613 R3615 R3616 R3618	93-08644 93-08645 93-08646 93-08647 93-08648 93-08649 93-08650PB	PNL	Total Organic Carbon (TC, TOC, TIC) Volatile Organic Semivolatile Organic

4.0 SAMPLE HANDLING AND ANALYTICAL SCHEME

4.1 WASTE DESCRIPTION

The samples collected from Tank 241-AP-101 were all similar in appearance. All samples were colorless clear liquids containing no visible solids or phases. Visual observations indicated that all of the samples were homogeneous and did not require heating or dilution to maintain solubility (Miller, 1993).

4.2 HOLD TIME CONSIDERATIONS

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

4.2.1 WHC - 222-S Laboratory

Tank 241-AP-101 was sampled on July 20, 1993. The samples were delivered to WHC 222-S Laboratory between July 20, 1993 and July 21, 1993. No preservation of samples (acidification or refrigeration) was undertaken at the time of sampling and no attempt was made to preserve samples while they were in the laboratory because of high pH, potential radiation hazard, and the small initial sample volume.

If SW-846 (EPA, 1986) protocol were required, samples would be preserved at the time of collection. However preservation of the samples is not considered necessary for maintenance of sample integrity with respect to this type of waste. As can be seen from Table 4-1 (Miller, 1993), the only analyte for which the maximum holding time was exceeded was nitrate.

Table 4-1. Holding Time Excursions.

Procedure	Analyte(s)	Maximum Allowable Holding Time (SW-846)	Samples Affected
Ion Chromatography	NO_3^-	48 hours	all

4.2.2 Pacific Northwest Laboratory - 325 Laboratory

The volatile organics analysis (VOA) and semivolatile organics analysis (SVOA) samples were delivered to the 325-PNL Laboratory on July 23, 1993. The volatile organics analyses were completed on October 15, 1993 and the semivolatile organic analyses on September 2, 1993. Total Organic Carbon analyses were conducted on August 29, 1993.

Table 4-2 lists the analyses performed by the 325-PNL Laboratory on samples held in excess of the maximum allowable holding time (Miller, 1993).

Table 4-2. Holding Time Excursions.

Procedure	Analyte(s)	Maximum Allowable Holding Time (SW-846)	Samples Affected
VOA	VOA	14 days	all
SVOA	SVOA	7 days	all
Total Organic Carbon	Total Organic Carbon	28 days	all

The Volatile Organic hold time before analysis was 85 days, which grossly exceeded the 14-day EPA SW-846 hold time limit based on sample receipt by the laboratory. In addition, the samples were received at the laboratory at ambient temperature, with headspace in the sample containers. This resulted in the qualification of all Volatile Organics data as estimated (for detects) or unusable (for non-detects) (refer to Section 5.3 for further discussion).

The maximum holding times for both the semivolatile organic samples and the Total Organic Carbon analyses were exceeded for all samples. The violation of recommended holding times for these analyses were not expected to significantly affect the data quality, and therefore results were qualified as estimated (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* (DeLorenzo et al., 1994).

4.4 ANALYTICAL METHODS

This section briefly describes the analytical methods used to characterize the waste in Tank 241-AP-101.

4.4.1 Physical Tests

The only physical test performed was the determination of specific gravity. Specific gravity analyses were performed on direct samples using procedure/revision number LA-510-112/C-2. The specific gravity analysis may have a negative bias, as further discussed in Section 5.4.

4.4.2 Chemical and Radionuclide Constituent Analysis

This section briefly describes the analytical methods utilized by the laboratories to determine chemical and radionuclide constituents in the tank. Duplicate analyses were performed on every tank sample for every analyte. No reruns were performed when it appeared that a significant difference occurred between a sample and its duplicate because no rerun criterion was specified. Table 4-3 lists the analytical methods used (Miller, 1993).

Table 4-3. Analytical Methods.

Analyte	Method	Procedure
F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}	Ion Chromatography	LA-533-105
NH_3	Kjeldahl[1]	LA-634-102
OH^-	Titration	LA-211-102
CN^-	Distillation/Spectrometric Analysis	LA-695-102
TIC	Acidification/CO_2 measured by Coulometry	LA-622-102
Total U	Laser Fluorimetry	LA-925-106
As Se	GHAA[2]	LA-355-131 LA-365-131
Hg	CVAA[3]	LA-325-104
Total Metals	ICP[4]	LA-505-151
^{241}Am, $^{144}Ce/Pr$, $^{134/137}Cs$, ^{60}Co, $^{154/155}Eu$, ^{94}Nb, ^{226}Ra, ^{103}Ru, $^{106}Ru/Rh$	Gamma Energy Analysis	LA-548-121
^{3}H ^{14}C	Liquid Scintillation	LA-218-114 LA-348-104
^{79}Se ^{99}Tc	Liquid Scintillation	LA-365-132 LA-438-101
^{90}Sr	separation/Beta[5]	LA-220-101
^{129}I	Low Energy Gamma Analysis	LA-378-103
^{237}Np	Alpha Proportional Counting	LA-933-141
$^{238/239/240}Pu$, ^{241}Am, $^{243/244}Cm$	separation/Alpha/AEA[6]	LA-503-156
Specific Gravity	Direct	LA-510-112
Total Alpha Total Beta	Proportional Counting	LA-508-101

[1]Ammonia analysis by caustic addition, distillation, and capture in a boric acid solution
[2]Gaseous Hydride Atomic Absorption Spectrometry
[3]Cold Vapor Atomic Absorption Spectrometry
[4]Inductively Coupled Plasma Emission Spectroscopy
[5]Chemical separation along with Total Beta Proportional Counting
[6]Chemical separation along with Alpha Proportional Counting and Alpha Energy Analysis.

4.4.3 Volatile and Semivolatile Organic Constituent Analysis

Samples of waste from Tank 241-AP-101 were analyzed for volatile and semivolatile constituents by Batelle's Pacific Northwest Laboratory (PNL). The samples were tested using the following methods:

Volatile Organics - Rapid screening by Headspace/Gas Chromatography to establish laboratory dilution requirements. PNL procedure PNL-ALO-331 is a modified version of EPA Method 3810, SW-846 (EPA, 1986).

Extracting the non-polar organics into Hexane or Isoctane followed by Gas Chromatography for volatile component analysis. PNL procedure PNL-ALO-335 follows the EPA Contract Laboratory Program Statement of Work (EPA, 1991).

Semivolatile Organics - Gas Chromatograph Mass Spectrometry for semivolatile component analysis. PNL procedure PNL-ALO-345 follows the EPA Contract Laboratory Program Statement of Work protocol (EPA, 1991). Quality assurance techniques of EPA methods cited were followed as closely as technically feasible.

4.5 MODULE SPECIFIC ANALYSES

The characterization program for Tank 241-AP-101 was intended to satisfy criteria set by the Tank Waste Remediation System (TWRS). The TWRS sample characterization objectives are to provide adequate description 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 to provide sufficient information to confidently determine whether constituent concentrations are within safe operating limits were performed. In addition these analyses were used to determine functional limits such as solids formation for operation of the evaporator. Characterization of Tank 241-AP-101 also provides data to predict the types and amounts of environmentally hazardous waste 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-101 are presented within this document as indicated in Table 5-1. The samples from which these results were derived were collected on July 20, 1993. This sampling event was the most recent regarding Tank 241-AP-101 and reflects the most accurate characterization of the tank waste available at the present time. A discussion of the sampling process was presented in Section 3.

Table 5-1. Tank 241-AP-101 Analytical Data Presentation Tables.

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

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 vise-versa, only single positive results 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 or "Evaluated Data Result" for each analyte was included with the Appendix A tables. 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. Furthermore, analytical results rejected on the basis of validation guidelines were not included in any statistical calculations.

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 4.01E+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 Elemental Constituents

The following analytes were evaluated by ICP (Inductively Coupled Plasma Atomic Emission Spectroscopy): Ag, Al, Ba, Ca, Cd, Cr, Fe, Mg, Mn, Na, Pb, and Zn. Several samples pertaining to the ICP analysis were reevaluated after a corresponding digestion standard indicated that the results were flawed. With regard to these samples, only values from the second set of data were considered for the determination of tank concentrations. Arsenic and selenium were analyzed by Gaseous Hydride Atomic Absorption Spectroscopy, and mercury was determined 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-101; however, the calculation of a charge balance indicates that the reported sodium concentration may be low. In fact, the "Tank Characterization Report Result" recorded for sodium in Table 5-5 was derived from the charge balance and provides a worst case estimate or upper limit value. This is further discussed in Section 7.1. The laboratory data pertaining to sodium is included in Appendix A and Table 5-2.

The following analytes were also detected in the waste, but their concentrations were less than 1 ppm: Al, Ba, Cd, Cr, Fe, Pb, Mg, Se, U, and Zn. Calcium was detected in concentrations between 1 and 10 ppm, but the laboratory results were rejected according to the validation report which accompanied the data. The calcium results are reported in Appendix A, but a historically derived value is listed in Table 5-5 since it offers a more conservative estimate. This treatment of the data should not adversely affect most Hanford programs due to the low calcium concentration.

With respect to the aluminum values, an attempt to statistically eliminate the least concentrated sample from the data was unsuccessful since an application of the Q-test at the 90% confidence limit would not allow its rejection. All of the initial uranium data were rejected due to an anomalous spike recovery, and the reported result was derived from the reanalysis of a single sample.

The sample analysis of Tank 241-AP-101 determined that As, Mn, Hg, P, and Ag were not present in detectable concentrations. The absence of phosphorous in the tank was confirmed by the ion chromatographic phosphate analysis. The silver results pertaining to the tank were rejected according to the data validation report on the basis of extremely low spike recoveries; therefore, a value for silver does not appear in Table 5-5. The data, however, is presented in Appendix A for informational purposes. A comparison of the laboratory data and available historical estimates is presented in Table 5-2.

5.1.2 Anions

The following anions were evaluated by ion chromatography: fluoride, chloride, nitrite, nitrate, sulfate, and phosphate. An unidentified peak initially obstructed the integration of the fluoride peak, but the interference was eliminated upon sample dilution. All of the above mentioned anions were detected in the waste except chloride and phosphate.

Table 5-2. Comparison of Analytical and Historical Estimates of Metal Constituents in Tank 241-AP-101.

Analyte	Laboratory Result (µg/L)	Historical Estimate (µg/L)	Relative Percent Difference
Al	667	1,060	46%
As	< 13.0	< 13	N/A
Ba	226	18.1	170%
Cd	143	< 20	N/A
Cr	39.3	55.2	33%
Fe	281	< 55.0	N/A
Pb	445	329	30%
Mg	657	1,550	81%
Mn	< 15.0	77.3	N/A
Hg	< 5.00	< 3.00	N/A
Na	1.29E+06	2.28E+06	55%
Zn	494	990	100%

A reasonable charge balance, discussed in Section 7.1, could only be calculated by assuming that the historical nitrite value was more accurate than the analytical value; therefore, the representative tank concentration for nitrite was determined to be 1.11E+06 µg/L. Furthermore, inspection of the data package indicated that a calculation associated with the nitrite analysis was in error by a factor of 10.

Ammonia was analyzed by the Kjeldahl method. No major problems were encountered during the analyses, but the results may exhibit a low bias since maximum allowable holding time specifications were exceeded. However, the reported ammonia result greatly exceeds the historical estimate; therefore, the potential low bias in the analytical value is of negligible concern.

Hydroxide was analyzed by titration, and cyanide was evaluated spectrophotometrically after samples were initially distilled. The reported carbonate value was derived from the total inorganic carbon analysis. A comparison of the laboratory data and historical estimates for ammonia and the anionic constituents is presented in Table 5-3.

Table 5-3. Comparison of Analytical and Historical Estimates of Anionic Constituents in Tank 241-AP-101.

Analyte	Laboratory Result (μg/L)	Historical Estimate (μg/L)	Relative Percent Difference
Ammonia	1.96E+06	< 80,000	N/A
Chloride	< 22,000	< 22,000	N/A
Cyanide	340	579	52%
Fluoride	68,600	< 142,000	N/A
Hydroxide	1.82E+06	< 266,000	N/A
Nitrate	1.58E+06	1.02E+06	43%
Nitrite	1.34E+07	1.11E+06	170%
Phosphate	< 10,000	< 10,000	N/A
Sulfate	86,200	203,000	81%

5.2 RADIOLOGICAL DETERMINATIONS

The maximum radioactive constituents in the waste were ^{137}Cs, ^{90}Sr, and ^{3}H. None of the alpha emitting isotopes demonstrated detectable activities during sample analysis, but the total alpha activity was 5.94E-03 μCi/L. The analytical and historical results are compared in Table 5-4, but do not demonstrate good agreement.

Table 5-4. Comparison of Analytical and Historical Isotopic Results for Tank 241-AP-101.

Analyte	Laboratory Result (μCi/L)	Historical Estimate (μCi/L)	Relative Percent Difference
^{137}Cs	3.26	0.123	185%
^{90}Sr	0.563	0.118	130%
^{3}H	2.10	35.2	177%

5.3 ORGANIC CONSTITUENTS

None of the target analytes associated with the volatile and semivolatile organic analyses were detected, as indicated by Tables A-5 and A-6, during the evaluation of samples from Tank 241-AP-101. Because of their volatile nature and relatively small contribution to the waste as indicated by the historical records, the appearance of these compounds was not expected.

With regard to the semivolatile organic analyses, cyclohexene was reported as a tentatively identified compound in the method blank and in nearly every sample. Since the methylene chloride utilized during the extraction process contained cyclohexene, the detection of cyclohexene in the samples was attributed to contamination. As a result, cyclohexene was not considered to be indigenous to the tank.

Since volatile and semivolatile organic compounds were not detected, the organic carbon in Tank 241-AP-101 is attributed to the presence of complexants, either intact molecules or decomposition products. Historical estimates for total organic carbon were unavailable for comparison with the analytical data.

5.4 PHYSICAL PROPERTIES

5.4.1 Specific Gravity and pH

The specific gravity of the waste was determined to be 0.986. This value is supported by the low dissolved salts content of the tank waste (~ 98.8 wt% water). In addition, the temperature of the waste at the time of the specific gravity measurement was greater than 4.0°C, the point at which the density of water is the greatest. Therefore, the specific gravity reading for the waste would be expected to be less than 1.0. A low bias in the analytical method is also a contributing factor.

The pH of the waste in Tank 241-AP-101 was calculated from the hydroxide concentration. It was determined to be 13.0.

5.4.2 Rheology

Rheological studies were not performed on samples associated with Tank 241-AP-101; therefore, the viscosity of the waste was estimated. The specific gravity of the waste is 0.986 and the tank is approximately 99% water, by weight. Since a 1%, by weight, aqueous solution of ammonia has a specific gravity of 0.995, its corresponding viscosity of 1.02 centipoise (0.000685 lbs/ft-s) was estimated to be the viscosity of the waste.

5.4.3 Energetics

There were no energetics tests performed on the samples taken from Tank 241-AP-101. Energetics were not analyzed as part of the test suite of assays because the high water content of the double-shell tank waste makes them unlikely candidates for an exothermic reaction under present tank operating conditions.

5.5 DATA PRESENTATION

The Tank Characterization Report Results recorded in Table 5-5 are the final constituent estimated for this document. The values are equal to the "Evaluated Data Result" 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 Report Result was, if possible, derived from historical data.

Table 5-5. Tank Characterization Report Data for Double-Shell Tank 241-AP-101. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Metals	(µg/L)	(µg/L)	(µg/g)	(kg)
Aluminum (Al)	1,060	**667**	**0.676**	2.68
Antimony (Sb)	---	---	---	---
Arsenic (As)	< 13	**< 13.0**	**< 0.0132**	< 0.052
Barium (Ba)	18.1	**226**	**0.229**	0.906
Beryllium (Be)	---	---	---	---
Bismuth (Bi)	---	---	---	---
Boron (B)	---	---	---	---
Cadmium (Cd)	< 20	**143**	**1.01**	0.573
Calcium (Ca)	20,100	**20,100**	**20.4**	80.6
Chromium (Cr)	55.2	**39.3**	**0.0399**	0.158
Copper (Cu)	---	---	---	---
Iron (Fe)	< 55.0	**281**	**0.285**	1.13
Lead (Pb)	329	**445**	**0.451**	1.78
Magnesium (Mg)	1,550	**657**	**0.666**	2.63
Manganese (Mn)	77.3	**< 15.0**	**< 0.0152**	< 0.060
Mercury (Hg)	< 3.00	**< 5.00**	**< 5.07E-03**	< 0.020
Molybdenum (Mo)	---	---	---	---
Neptunium (Np)	---	---	---	---
Nickel (Ni)	---	---	---	---
Phosphorus (P)	---	**< 3,790**	**< 3.84**	< 15.2
Potassium (K)	---	---	---	---
Selenium (Se)	---	**14.0**	**1.42E-05**	0.052
Silicon (Si)	---	---	---	---
Silver (Ag)	---	---	---	---
Sodium (Na)	2.28E+06	**4.46E+06**	**4,520**	18,100
Titanium (Ti)	---	---	---	---
Uranium (U)	---	**212**	**0.215**	0.85
Zinc (Zn)	990	**494**	**0.501**	1.98
Zirconium (Zr)	---	---	---	---

Table 5-5. Tank Characterization Report Data for Double-Shell Tank 241-AP-101. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Ions	(μg/L)	(μg/L)	(μg/g)	(kg)
Ammonia (NH_3)	< 80,000	1.96E+06	1,990	7,860
Carbonate (CO_3^{2-})		950,000	963	3,810
Chloride (Cl^-)	< 22,000	< 22,000	< 22.3	< 88.2
Cyanide (CN^-)	579	340	0.345	1.36
Fluoride (F^-)	< 142,000	68,600	69.6	275
Hydroxide (OH^-)	< 266,000	1.82E+06	1,850	7,310
Nitrate (NO_3^-)	1.02E+06	1.58E+06	1,600	6,330
Nitrite (NO_2^-)	1.11E+06	1.11E+06	1,130	4,450
Phosphate (PO_4^{-3})	< 10,000	< 10,000	< 10.1	< 40.1
Sulfate (SO_4^{-2})	203,000	86,200	87.4	346
Radionuclides	(μCi/L)	(μCi/L)	(μCi/g)	(Ci)
^{241}Am GEA	---	< 1.36	< 1.38E-03	< 5.45
^{241}Am AEA	< 0.637	< 0.318	< 3.23E-04	< 1.28
^{14}C	3.18E-03	4.66E-03	< 4.73E-06	< 0.0187
^{144}Ce/Pr	< 34.0	< 21.2	< 0.0215	< 85.0
^{134}Cs	< 0.058	< 0.288	< 2.92E-04	< 1.15
^{137}Cs	0.123	3.26	3.31E-03	13.1
^{60}Co	< 0.0690	< 0.273	< 2.77E-04	< 1.09
^{243}Cm	< 0.637	< 0.318	< 3.23E-04	< 1.28
^{154}Eu	< 0.192	< 0.968	< 9.82E-04	< 3.88
^{155}Eu	< 0.129	< 0.653	< 6.62E-04	< 2.62
^{129}I	< 0.0435	< 0.0408	< 4.14E-05	< 0.164
^{237}Np	< 0.0496	< 0.047	< 4.77E-05	< 0.19
^{94}Nb	< 0.0148	< 0.249	< 2.46E-04	< 0.999
^{238}Pu	< 0.651	< 0.302	< 3.06E-04	< 1.21
$^{239/240}$Pu	< 0.534	< 0.213	< 2.16E-04	< 0.854
^{226}Ra	< 1.19	< 4.65	< 4.72E-03	< 18.6
^{104}Ru	---	< 0.235	< 2.38E-04	< 0.942
^{106}Ru/Rh	< 0.950	< 4.73	< 4.80E-03	< 19.0
^{79}Se	---	< 6.15E-03	< 6.24E-06	< 0.0247
^{90}Sr	0.118	0.563	5.71E-04	2.26
^{99}Tc	< 0.0205	< 0.0307	< 3.11E-05	< 0.123

Table 5-5. Tank Characterization Report Data for Double-Shell Tank 241-AP-101. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Radionuclides (continued)	(μCi/L)	(μCi/L)	(μCi/g)	(Ci)
Total alpha	---	**5.94E-03**	**6.02E-06**	0.0238
Total beta	---	**5.48**	**5.56E-03**	22.0
^{3}H	35.2	**2.10**	**2.13E-03**	8.42
Physical Properties				
pH	---	**13.0**	---	---
Specific Gravity	0.989	**0.986**	---	---
TOC	---	**23,700 μg/L**	**24.0 μg/g**	95.0 kg
TIC	---	**190,000 μg/L**	**193 μg/g**	762 kg
Weight Percent Water	---	**98.8%**	---	---

6.0 ANALYTICAL RESULT INTERPRETATION

6.1 TANK WASTE PROFILE

Examination of the analytical results reveals that the waste in Tank 241-AP-101 is primarily a dilute aqueous solution of inorganic salts. The most abundant constituents in the tank are sodium, ammonia, nitrite, nitrate, and hydroxide; carbonate, as indicated by the total inorganic carbon analysis, is also present at a relatively high concentration. The high ammonia concentration is consistent with the fact that waste from the PUREX Ammonia Scrubber was stored in Tank 241-AP-101. The only radionuclides which demonstrated an appreciable activity in the tank were ^{137}Cs, and ^{90}Sr, and ^{3}H. The tank is free of volatile and semivolatile organic constituents, but the total organic carbon data indicates that non-volatile and water soluble organic compounds may be present.

6.2 WASTE SUMMARY AND CONDITIONS

6.2.1 In-Tank Summary

Since the pH of Tank 241-AP-101 is approximately 13, the equilibrium describing the dissociation of ammonia in water will shift to the left. This is demonstrated by the following equations.

$$NH_3 + H_2O = NH_4^+ + OH^-$$

$$K_b = \frac{[NH_4^+]\,[OH^-]}{[NH_3]}$$

The dissociation constant, K_b, of ammonia is 1.76E-05, and the molar hydroxide concentration of the tank is 0.107. Substitution of these values into the above equation shows that the concentration of ammonia will be roughly 6,000 times greater than that of ammonium; therefore, the corresponding analytical data is reported only as ammonia.

6.2.2 Projected Tank Heat Load

The very low relative level of radionuclides in Tank 241-AP-101 is reflected in the low heat load. Only three of the radionuclides tested for were detected by the analytical methods used; thus the heat load is insignificant. Detection limits for the other analytes were included in the calculation in order to obtain the most conservative estimate possible. Table 6-1 outlines the heat produced by each radionuclide and the total tank heat load.

6.2.3 Regulatory Limits

The calculated pH of 13.0 is above the *Resource Conservation and Recovery Act* pH limit of 12.5 for corrosivity (EPA, 1990).

Table 6-1. Tank 241-AP-101 Radionuclide Inventory and Projected Heat Load.

Radionuclide	Ci	Watts
^{241}Am - GEA	< 5.45	< 0.179
^{241}Am - AEA	< 1.28	< 0.0420
^{144}Ce/Pr	< 85.0	< 0.681
^{134}Cs	< 1.15	< 0.0117
^{137}Cs	13.17	0.0617
^{60}Co	13.1	< 0.0168
^{154}Eu	< 3.88	< 0.0350
^{155}Eu	< 2.62	< 1.90E-03
^{3}H	8.42	2.84E-04
^{129}I	< 0.164	< 7.67E-05
^{237}Np	< 0.190	< 5.47E-03
^{238}Pu	< 1.21	< 0.0394
$^{239/240}$Pu	< 0.854	< 0.0261
^{103}Ru	< 0.942	< 3.31E-03
^{106}Ru/Rh	< 19.0	< 0.183
^{90}Sr	2.26	0.0151
^{99}Tc	< 0.123	6.16E-05
Total Watts		< 1.30

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 process, and expressed in a series of program specific Data Quality Objective 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-101. 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-101, 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 6-2. Applicability of Characterization Information to the Data Needs of the TWRS Program Elements.

Data Quality Objective	Applicability to Characterization of Tank 241-AP-101
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 addressed
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

[1]The 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-101 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-101.

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.

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7.0 STATISTICAL INTERPRETATION

7.1 MASS AND CHARGE BALANCE

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. All of the values listed in Table 7-1 were calculated from the Tank Characterization Report Results recorded in Table 5-5.

Table 7-1. Mass and Charge Balance for Tank 241-AP-101.

	Mass µg/g	Charge µmol/g
Cations		
Calcium	20.4	1.02
Sodium	2,310	100
Anions		
Fluoride	69.6	3.66
Hydroxide	1,850	109
Nitrate	1,600	25.8
Nitrite	1,130	24.6
Sulfate	87.4	1.82
Carbonate (TIC)	963	32.2
Totals		
Cations	2,330	101
Anions	5,700	197
Ammonia	1,990	
Additional Sodium (Est.)	2,210	96
Water (Est.)	988,000	

A charge imbalance resulted 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-101 to be 4.46E+06 µg/L, approximately twice the historical estimate and 3.5 times the laboratory derived result. The sodium value recorded in the "Tank Characterization Report Result" column of Table 5-5 reflects the charge balance calculations.

Mass and charge balance results are reported in Table 7-1. The mass concentration, μg/g, resulting from the sum of the cations, anions, and ammonia 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-101 is 98.8%.

7.2 TANK HOMOGENEITY

Homogeneity of Tank 241-AP-101 was determined using two methods, the first being direct observation. Visual observations were taken and recorded, along with the dose rate. All five samples appeared exactly alike: colorless, clear liquids with no solids, one liquid phase, and a dose rate of < 2 mR. None of the samples required heating or dilution to maintain solubility. Visually, all of the samples were homogeneous (Miller, 1993).

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 (Miller, 1993).

Table 7-2. Comparison of RPD Data. (Miller, 1993).

Column 1 Analyte	Column 2 RPD Range	Column 3 Maximum RPD	Column 4 Comparative Precision
Specific Gravity	0.6	0.3	2.0
Fluoride	3.9	8.5	0.5
Nitrate	0.6	0.6	1.0
Nitrite	3.7	1.5	2.5
Sulfate	1.2	2.3	0.5
Ammonia	12.7	5.7	2.2
Hydroxide	18.0	6.8	2.6
Cyanide	31.3	55.6	0.6
Carbonate	6.7	1.6	4.2
Uranium	19.3	22.2	0.9

For all the analytes listed, the range of RPDs between individual samples was no greater than 4.2 times the maximum RPD between duplicate samples. The average value of Column 4 was 1.7, so the overall precision between the five samples had only 1.7 times the maximum deviation that existed between the samples and their duplicates. For example, the

only analyte which seems to show a strong spatial variability is cyanide, with an RPD range of 31.3 between concentrations at the sampling sites. This appears significant until compared with the maximum RPD between the samples and duplicates. The maximum RPD for cyanide duplicate samples was 55.6, much larger than 31.3, showing that experimental error probably caused a large amount of the concentration discrepancy. In fact, some of the cyanide samples were near the detection limit, which can lead to high RPD values. Because precision appears to be primarily a function of experimental error, heterogeneity in data likewise appears to be a function of experimental error and not indicative of heterogeneous tank contents. The RPD data thus demonstrate that the waste in Tank 241-AP-101 is reasonably homogeneous.

7.3 ANALYTICAL ERROR ESTIMATION

Several methods were employed to estimate analytical error in the sample analyses. RPDs between samples and their duplicates, RPDs 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 ± 20% except the following:

* Aluminum[1] (Al)	The RPD for the samples and duplicates ranged from 1.2 to 67.5%, with two samples exceeding the 20% criterion.
*Barium [2] (Ba)	The RPD for the samples and duplicates ranged from 2.2 to 37.3%, with just one sample exceeding the 20% criterion.
*Calcium[1] (Ca)	The RPD for the samples and duplicates ranged from 7.7 to 115%, with three of the samples exceeding the 20% criterion. All sample data were rejected due to contamination.
*Iron[1] (Fe)	The RPD for the samples and duplicates ranged from 17.3 to 159%, with six of the samples exceeding the 20% criterion.
*Lead[1,2] (Pb)	The RPD for the samples and duplicates were all below the detection limit, with the exception of one sample that had an RPD of 150. This high value is probably due to contamination.
*Magnesium[1] (Mg)	The RPD for the samples and duplicates ranged from 0.4 to 109%, with two of the samples exceeding the 20% criterion.
*Zinc[1] (Zn)	The RPD for the samples and duplicates ranged from 25.9 to 137%, with all of the samples exceeding the 20% criterion.
*Cyanide[2] (CN)	The RPD for the samples and duplicates ranged from 11.1 to 55.6%, with three of the samples exceeding the 20% criterion.

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

*Calcium[1] (Ca)	The RPD for the spike and spike duplicate was unacceptable at 41.2%.
*Silver[1] (Ag)	The RPD for the spike and spike duplicate was unacceptable at 62.8%. All sample data were rejected due to contamination.
*^{14}C[2]	The RPD for the spike and spike duplicate was unacceptable at 58.0%.

[1]High RPDs possibly due to contamination during sample preparation.

[2]High RPDs possibly due to sample concentration near the detection limit.

Sample standard deviations for each analyte are listed in the Appendix A tables. Although several analytes had relatively high standard deviations, in most cases that was due to either some of the sample data being qualified as estimated, or the analyte concentration being near the detection limit. For all other analytes, only magnesium had a standard deviation larger than 10% of the analyte concentration.

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. Data which failed to satisfy the established quality objectives were qualified as reported in Miller (1993).

The processes of data validation and statistical analyses confirm the accuracy of the characterization results for Tank 241-AP-101. Historical analytical data were not available and percent water (for mass balance calculation) was not analyzed. Therefore, historical estimates and mass balance are only useful as a baseline for comparison. Most of the differences between the predicted constituent concentrations and the analytical data are within the analytical error limits of each laboratory procedure. With few exceptions, the data met all of the data quality goals of the *TWRS Tank Waste Analysis Plan* (Bell, 1994). Questionable data which were not supported by proper quality control analyses as noted by the validation process are discussed throughout Section 5.

8.0 RECOMMENDATIONS

8.1 SAFETY ISSUES

Characterization of Double-Shell Tank 241-AP-101 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-101 is within established operating safety requirements, as defined by applicable Data Quality Objectives.

Tank 241-AP-101 is considered sound and non-leaking (Hanlon, 1994), and examination of the waste volume history supports this conclusion (Koreski, 1994). Thermocouple data indicate that no self heating occurs in the waste, and that all variations in waste temperature are due to seasonal fluctuations. Therefore, 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-101 for waste management and storage functions poses no unreasonable risk to personnel, the public, or the environment.

8.2 FURTHER CHARACTERIZATION NEEDS

Characterization of the liquid contents of Tank 241-AP-101 has been performed in this report. Specifically, it has been determined that the waste contents are comprised of a very dilute aqueous liquid solution containing limited amounts of inorganic salts. Further sampling and analysis of the contents of Tank 241-AP-101 is suggested for the following waste properties:

- Sampling of the contents of the tank vapor space would allow final resolution of any safety concerns regarding the presence of flammable or noxious vapors.

- The waste in Tank 241-AP-101 is designated as eventual feed for the evaporator. Phosphate was not detected in the tank waste, and the worst case sodium concentrations estimate of 0.19 M is much less than the 8 M limit defining a high salt content tank (O'Rourke, 1993). Therefore, further chemical characterization of the waste prior to evaporation would yield little useful information.

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9.0 REFERENCES

ASTM, 1973. "Weighted Bottle Method," *American Society for Testing Materials*, ASTM E-300-73, Philadelphia, Pennsylvania.

Babad, H., 1994. *Tank Safety Screening Data Quality Objective,* WHC-SD-WM-004, Westinghouse Hanford Company, Richland, WA.

Bell, K.E., 1994. *Tank Waste Remediation System Tank Waste Analysis Plan,* WHC-SD-WM-PLN-077, Rev. 0, Westinghouse Hanford Company, Richland, WA.

Conway, J.T., 1993. *DNFSB Recommendation 93-5 to the Secretary of Energy*, (letter 9400070 to H.R. O'Leary, DOE, July 19) Defense Nuclear Facilities Safety Board, Washington, D.C.

DeLorenzo, D.S., J.H. Rutherford, D.J. Smith, D.B. Hiller, and K.W. Johnson, 1994. *Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Los Alamos Technical Associates, Inc., Richland, WA.

Ecology, 1991. *Dangerous Waste Regulations*, Chapter 170-303, Washington State Department of Ecology, Olympia, WA.

Ecology, EPA, and DOE, 1994. *Hanford Federal Facility Agreement and Consent Order,* Fourth Amendment, Washington State Department of Ecology, United States Environmental Protection Agency, and the United States Department of Energy, Richland, WA.

EPA, 1986. *Test Methods for Evaluating Solid Waste,* SW-846, 3rd Edition, United States Environmental Protection Agency, Washington, D.C.

EPA, 1990. "Identification and Listing of Hazardous Wastes," *40CFR261*, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991. *Contract Laboratory Program Statement of Work*, United States Environmental Protection Agency, Washington D.C.

Freeze, R.A., and J.A. Cherry, 1979. *Groundwater,* "Groundwater and Thermal Processes", Prentice-Hall, Inc., Englewood Cliffs, N.J.

Hanlon, B.L., 1994. *Tank Farm Surveillance and Waste Status Summary Report for March 1994,* WHC-EP-0182-72, Westinghouse Hanford Company, Richland, WA.

Husa, E.I., R.E. Raymond, R.K. Welty, S.M. Griffith, B.M. Hanlon, R.R. Rios, and N.J. Vermeulen, 1993. *Hanford Site Waste Storage Tank Information Notebook,* WHC-EP-0625, Westinghouse Hanford Company, Richland, WA.

Koreski, G.M., 1994. *Waste Volume Projections Historical Database,* Westinghouse Hanford Company, Richland, WA.

Miller, G.L., 1993. *222-S Validation Summary for Double-Shell Tank 241-AP-101,* WHC-SD-WM-DP-051, Addendum 1, Rev. 0, Westinghouse Hanford Company, Richland, WA.

O'Rourke, J.F., 1994. *Process Control Plan for 242-A Evaporator Campaign 94-1*, WHC-SD-WM-PCP-008, Rev. 1, Westinghouse Hanford Company, Richland, WA.

Rios, R.R., 1994. *Computer Automated Surveillance System,* Westinghouse Hanford Company, Richland, WA.

WHC, 1994. *Validation Summary for Tank 241-AP-107, Westinghouse 222-S Laboratory*, WHC-SD-WM-DP-053, Addendum A, Rev. 0, Westinghouse Hanford Company, Richland, WA.

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APPENDIX A

ANALYTICAL RESULTS

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A.1 INTRODUCTION

A.1.1 Appendix A presents the chemical and radiological characteristics of Tank 241-AP-101 in a tabular form, in terms of the specific concentrations of anions, metals, physical properties, and radionuclides.

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. The data are listed in standard notation for values >.001 and <100,000. Values outside these limits are listed in scientific notation.

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
	FAA - Flame Atomic Absorption
Anions:	IC - Ion Chromatography
Radionuclides:	GEA - Gamma Energy Analysis
	AEA - Alpha Energy Analysis
	APC - Alpha Proportional Counting
	BPC - Beta Proportional Counting
	LSC - Liquid Scintillation Counting
Physical Properties:	DM - Direct Measurement
	DSC - Differential Scanning Calorimetry
	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 - potassium hydroxide fusion followed by acid digestion.

The analyte and method are presented as follows: "method.analyte," or, (in the case of a metal) "method.digestion.analyte." For example, the specific concentration of ^{90}Sr was measured with a beta proportional counter and is listed "BPC.^{90}Sr." The specific concentration of Pb was determined by the inductively coupled plasma method 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; this 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-101 data package (Miller, 1993). Data which was qualified as estimated (denoted by "J" or "UJ" in the data package) will be enclosed in parentheses, i.e., (395) μg/ml. Unusable data (denoted by "R" in the data package) will be entered with a strikeout, i.e., ~~395~~ μg/ml. Unqualified data will be entered in standard form.

A.3.4 "Standard Deviation" is computed for those results greater than the detection limit. Unusable or rejected data will not be used to compute standard deviation.

A.3.5 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 (MDL), and all results are less than the MDL, no range is given. However, if the MDL changes, (i.e., due to radiation background variations in radiochemistry) a range of detection limit values is given.

A.3.6 Column 6 "Evaluated Data Result" is derived according to the discussion on page 5-1. As in the case of the standard deviation column, no unusable or rejected data will be used for computation.

A.3.7 Column 7, "Projected Inventory," is the product of the concentration of the analyte and the volume of the waste in the tank. (1.06 million gallons or 4.01×10^6L, as of the sampling date: May 1993).

LIST OF TABLES FOR APPENDIX A

Table A-1. Tank 241-AP-101 Analytical Data:
- Aluminum A-4
- Arsenic A-4
- Barium A-5
- Calcium A-5
- Cadmium A-6
- Chromium A-6
- Iron A-7
- Lead A-7
- Mercury A-8
- Magnesium A-8
- Manganese A-9
- Selenium A-9
- Silver A-10
- Sodium A-10
- Total Uranium A-11
- Zinc A-11

Table A-2. Tank 241-AP-101 Analytical Data:
- Ammonia A-12
- Chloride A-12
- Cyanide A-13
- Fluoride A-13
- Hydroxide A-14
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Table A-1. Tank 241-AP-101 Analytical Data: Aluminum

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Al	Sample V3	(960)	277	217 to 960	**667**	2.68
	Sample V4	(217)				
	Sample V7	(641)				
	Sample V8	771				
	Sample V9	748				

Table A-1. Tank 241-AP-101 Analytical Data: Arsenic

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
AA.a.As	Sample V3	< 0.0130	N/A	N/A	< 0.013	< 0.052
	Sample V4	< 0.0130				
	Sample V7	< 0.0130				
	Sample V8	< 0.0130				
	Sample V9	< 0.0130				

Table A-1. Tank 241-AP-101 Analytical Data: Barium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Ba	Sample V3	< 15.0	N/A	212 to 240	**226**	0.906
	Sample V4	< 15.0				
	Sample V7	212				
	Sample V8	240				
	Sample V9	< 15.0				

Note: The results for sample numbers V7, V8, and V9 are from the sample reruns. The original results were rejected.

Table A-1. Tank 241-AP-101 Analytical Data: Calcium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Ca	Sample V3	~~9,990~~	N/A	N/A	**< 10,000**	N/A
	Sample V3	~~2,980~~				
	Sample V7	~~9,680~~				
	Sample V8	~~6,400~~				
	Sample V9	~~6,810~~				

Note: All Data Rejected

Table A-1. Tank 241-AP-101 Analytical Data: Cadmium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Cd	Sample V3	169	98.0	34.3 to 225	**143**	0.573
	Sample V4	34.3				
	Sample V7	225				
	Sample V8	< 20.0				
	Sample V9	< 20.0				

Note: The results for sample numbers V7, V8, and V9 are from reruns. The original results were rejected.

Table A-1. Tank 241-AP-101 Analytical Data: Chromium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Cr	Sample V3	< 30	1.27	37.8 to 40.1	**39.3**	0.158
	Sample V4	< 30				
	Sample V7	40.1				
	Sample V8	37.8				
	Sample V9	39.9				

Note: Results for sample numbers V7, V8, and V9 are from reruns. The original data were rejected.

Table A-1. Tank 241-AP-101 Analytical Data: Iron

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Fe	Sample V3	376	79	191 to 376	**281**	1.13
	Sample V4	(308)				
	Sample V7	249				
	Sample V8	(191)				
	Sample V9	~~1470~~				

Note: Results for sample numbers V7, V8, and V9 are from reruns.

Table A-1. Tank 241-AP-101 Analytical Data: Lead

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Pb	Sample V3	(816)	325	215 to 816	**445**	1.78
	Sample V4	(302)				
	Sample V7	(< 190)				
	Sample V8	(< 190)				
	Sample V9	(215)				

Note: The results for sample numbers V7, V8, and V9 are from reruns. The original data were rejected.

Table A-1. Tank 241-AP-101 Analytical Data: Mercury

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
CVAA.d. Hg	Sample V3	< 0.005	N/A	N/A	**< 0.005**	< 0.020
	Sample V4	< 0.005				
	Sample V7	< 0.005				
	Sample V8	< 0.005				
	Sample V9	< 0.005				

Table A-1. Tank 241-AP-101 Analytical Data: Magnesium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Mg	Sample V3	674	136	475 to 805	**657**	2.63
	Sample V4	475				
	Sample V7	672				
	Sample V8	805				
	Sample V9	~~464~~				

Note: The results for sample numbers V7, V8, and V9 are from reruns.

Table A-1. Tank 241-AP-101 Analytical Data: Manganese

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Mn	Sample V3	< 15.0	N/A	N/A	**< 15.0**	< 0.060
	Sample V4	< 15.0				
	Sample V7	< 15.0				
	Sample V8	< 15.0				
	Sample V9	< 15.0				

Note: The results for sample numbers V7, V8, and V9 are from reruns. The original data were rejected.

Table A-1. Tank 241-AP-101 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
GHAA.a.Se	Sample V3	< 0.013	N/A	N/A	**0.014**	0.052
	Sample V4	< 0.013				
	Sample V7	< 0.013				
	Sample V8	< 0.013				
	Sample V9	0.014				

Table A-1. Tank 241-AP-101 Analytical Data: Silver

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Ag	Sample V3	~~<30~~	N/A	N/A	**N/A**	N/A
	Sample V4	~~<30~~				
	Sample V7	~~<30~~				
	Sample V8	~~<30~~				
	Sample V9	~~<30~~				

Note: All Data Were Rejected

Table A-1. Tank 241-AP-101 Analytical Data: Sodium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Metal		µg/L	µg/L	µg/L	**µg/L**	kg
ICP.a.Na	Sample V3	(1.40E+06)	1.07E+05	1.11E+06 to 1.40E+06	**1.29E+06**	5,170
	Sample V4	(1.11E+06)				
	Sample V7	1.31E+06				
	Sample V8	1.32E+06				
	Sample V9	1.30E+06				

Note: The results for sample numbers V7, V8, and V9 were rejected. The data given are from reruns.

Table A-1. Tank 241-AP-101 Analytical Data: Total Uranium

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	**Projected Inventory**
Metal		µg/mL	µg/mL	µg/mL	**µg/mL**	**kg**
LF.d.U(tot)	Sample V3	~~0.455~~	N/A	N/A	**0.212**	**0.85**
	Sample V4	~~0.421~~				
	Sample V7	~~0.490~~				
	Sample V8	~~0.511~~				
	Sample V9	~~0.486~~				
	Sample V3 rerun	0.212				

Note: Sample V3 results (estimated) are the only nonrejected data for Total Uranium.

Table A-1. Tank 241-AP-101 Analytical Data: Zinc

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	**Projected Inventory**
Metal		µg/L	µg/L	µg/L	**µg/L**	**kg**
ICP.a.Zn	Sample V3	(1,430)	644	66.9 to 1,430	**494**	**1.98**
	Sample V4	(408)				
	Sample V7	(69.9)				
	Sample V8	(66.9)				
	Sample V9	~~184~~				

Note: The results from sample numbers V7, V8, and V9 are from reruns. The original data were rejected.

Table A-2. Tank 241-AP-101 Analytical Data: Ammonia

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Cation		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
KTN.d.NH_3	Sample V3	1,850	91.5	1,850 to 2,100	**1,960**	7,860
	Sample V4	1,920				
	Sample V7	(2,100)				
	Sample V8	(1,970)				
	Sample V9	(1,950)				

Table A-2. Tank 241-AP-101 Analytical Data: Chloride

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
IC.Cl^-	Sample V3	< 22.0	N/A	N/A	**< 22.0**	< 88.2
	Sample V4	< 22.0				
	Sample V7	< 22.0				
	Sample V8	< 22.0				
	Sample V9	< 22.0				

Table A-2. Tank 241-AP-101 Analytical Data: Cyanide

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
Spec.d.CN^-	Sample V3	(0.27)	0.041	0.27 to 0.37	**0.34**	1.36
	Sample V4	(0.37)				
	Sample V7	(0.36)				
	Sample V8	(0.36)				
	Sample V9	(0.33)				

Table A-2. Tank 241-AP-101 Analytical Data: Fluoride

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
IC.F^-	Sample V3	67.0	1.01	67.0 to 69.7	**68.6**	275
	Sample V4	68.3				
	Sample V7	68.9				
	Sample V8	69.7				
	Sample V9	69.0				

Table A-2. Tank 241-AP-101 Analytical Data: Hydroxide

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
Autotit.d. OH^-	Sample V3	(1,820)	121	1,620 to 1,940	**1,820**	7,310
	Sample V4	(1,940)				
	Sample V7	(1,850)				
	Sample V8	(1,880)				
	Sample V9	(1,620)				

Table A-2. Tank 241-AP-101 Analytical Data: Nitrate

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
IC.NO^-_3	Sample V3	1,580	4.47	1570 to 1580	**1580**	6,330
	Sample V4	1,580				
	Sample V7	1,570				
	Sample V8	1,580				
	Sample V9	1,580				

Table A-2. Tank 241-AP-101 Analytical Data: Nitrite

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
IC.NO_2^-	Sample V3	(13,400)	207	13,200 to 13,700	**13,400**	53,900
	Sample V4	(13,200)				
	Sample V7	(13,300)				
	Sample V8	(13,600)				
	Sample V9	(13,700)				

Table A-2. Tank 241-AP-101 Analytical Data: Phosphate

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	**µg/mL**	kg
IC.PO_4^{-3}	Sample V3	(< 10)	N/A	N/A	**< 10**	< 40.1
	Sample V4	(< 10)				
	Sample V7	(< 10)				
	Sample V8	(< 10)				
	Sample V9	(< 10)				

Table A-2. Tank 241-AP-101 Analytical Data: Sulfate

Analyte	Laboratory Sample Identification	Analytical Data Result	Standard Deviation (Sample)	Range of Values	**Evaluated Data Result**	Projected Inventory
Anion		µg/mL	µg/mL	µg/L	**µg/mL**	kg
$IC.SO_4^{-2}$	Sample V3	85.8	0.421	85.8 to 86.8	**86.2**	346
	Sample V4	86.8				
	Sample V7	85.9				
	Sample V8	86.5				
	Sample V9	86.1				

Table A-3. Tank 241-AP-101 Analytical Data: Radionuclides

Analyte	Laboratory Sample Identification	Analytical Data Result	Projected Inventory
Radionuclide		µCi/mL	Ci
AEA.^{241}Am	Sample V15	(< 3.18E-04)	< 1.28
GEA.^{241}Am	Sample V15	(< 1.36E-03)	< 5.45
LSC.^{4}C	Sample V15	< 4.66E-06	< 0.0187
GEA.^{144}Ce/Pr	Sample V15	(< 0.0212)	< 85.0
GEA.^{134}Cs	Sample V15	(< 2.88E-04)	< 1.15
GEA.^{137}Cs	Sample V15	(3.26E-03)	13.01
AEA.^{243}Cm	Sample V15	(< 3.18E-04)	< 1.28
GEA.^{60}Co	Sample V15	(< 2.73E-04)	< 1.09
GEA.^{154}Eu	Sample V15	(< 9.68E-04)	< 3.88
GEA.^{155}Eu	Sample V15	(< 6.53E-04)	< 2.62
LEPS.^{129}I	Sample V15	(<4.08E-05)	< 0.164
GEA.^{94}Nb	Sample V15	(< 2.49E-04)	< 0.999
APC.^{237}Np	Sample V15	(< 4.70E-05)	< 0.19
AEA.^{238}Pu	Sample V15	< 3.02E-04	< 1.21
AEA.^{239,240}Pu	Sample V15	< 2.13E-04	< 0.854
GEA.^{226}Ra	Sample V15	(< 4.65E-03)	< 18.6
GEA.^{103}Ru	Sample V15	(< 2.35E-04)	< 0.942
GEA.^{106}Ru/Rh	Sample V15	(< 4.73E-03)	< 19.0
LSC.^{79}Se	Sample V15	< 6.15E-06	< 0.0247
BPC.^{90}Sr	Sample V15	(5.63E-04)	2.26
LSC.^{99}Tc	Sample V15	(< 3.07E-05)	< 0.123
LSC.^{3}H	Sample V15	2.10E-03	8.42
PC.Total Alpha	Sample V15	(5.94E-06)	0.0238
PC.Total Beta	Sample V15	(5.48E-03)	22.0

Table A-4. Tank 241-AP-101 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		µg/mL	µg/mL	µg/mL	µg/mL	kg
TOC.NDIR	Sample 93-08644	< 10	15.1	13 to 41	**23.7**	95.0
	Sample 93-08645	< 10				
	Sample 93-08646	41				
	Sample 93-08647	17				
	Sample 93-08648	< 12.5				
	Sample 93-08649	13				

Table A-4. Tank 241-AP-101 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 V3	0.986	1.82E-03	0.983 to 0.988	**0.986**	N/A
	Sample V4	0.983				
	Sample V8	0.988				
	Sample V8	0.986				
	Sample V9	0.985				

Note: Bias low due to the analytical method which requires the pipetting of small volumes (200 µL) into preweighed vials.

Table A-4. Tank 241-AP-101 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		µg/mL	µg/mL	µg/mL	µg/mL	kg
TIC.NDIR	Sample V3	(195)	6.08	185 to 198	190	762
	Sample V4	(198)				
	Sample V7	(187)				
	Sample V8	(185)				
	Sample V9	(185)				

Table A-5. Tank 241-AP-101 Volatile Organic Compounds

Volatile Organic Compound	Result µg/L	Volatile Organic Compound	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
Toluene	ND		

Note: All results were less than the detection limit. However, hold times were grossly exceeded, sample containers had head space, and samples were held at ambient temperatures for extended periods of time. All results were qualified as unusable.

Table A-6. Tank 241-AP-101 Analytical Data: Semivolatile Organic Compounds.

Semivolatile Organic Compound	Result µg/L	Semivolatile Organic Compound	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-Nitroso-diphenylamine (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
2-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
1-Butanol	ND		

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L. K. Holton	P7-43	X
B. M. Johnson	K1-78	X
G. J. Lumetta	P7-25	X
B. D. McVeety	K6-63	X
I. C. McVeety	K7-22	X
P. J. Mellinger	P7-22	X
A. F. Noonan	B1-40	X
L. R. Pederson	K2-44	X

Westinghouse Hanford Company

H. Babad	S7-30	X
D. A. Barnes	R1-51	X
A. L. Boldt	H5-49	X
G. L. Borsheim	H5-27	X
D. R. Bratzel	S7-31	X
T. M. Brown	R2-12	X
T. H. Bushaw	T6-30	X
M. P. Campbell	R2-86	X
R. J. Cash	S7-15	X
G. M. Christensen	H4-21	X
W. L. Cowley	H4-61	X
M. L. Deffenbaugh	R2-06	X
C. DeFigh-Price	S7-30	X
R. A. Dodd	R2-70	X
G. L. Dunford	R2-50	X
S. J. Eberlein	S7-31	X
D. B. Engelman	R1-49	X
K. O. Fein	H4-63	X
J. S. Garfield	H5-49	X
K. D. Gibson	H4-61	X
C. E. Golberg	H5-49	X
J. M. Grigsby	H4-62	X
R. D. Gustavson	R1-51	X
C. S. Haller	R2-12	X
H. W. Heacock	S7-81	X
D. L. Herting	T6-09	X
B. A. Higley	H5-27	X
G. Jansen	H6-33	X
G. D. Johnson	S7-15	X
K. K. Kawabata	T6-50	X
N. W. Kirch	R2-11	X
M. J. Kupfer	H5-49	X
G. A. Meyer	S4-54	X
W. C. Miller	S4-55	X
W. C. Mills	S4-58	X
C. T. Narquis	T6-50	X
R. H. Palmer	R2-58	X
M. A. Payne	S7-14	X
S. H. Rifaey	S2-45	X
R. R. Rios	R1-80	X
D. A. Reynolds	R2-11	X
P. Sathyanarayana (2)	R2-12	X
F. A. Schmittroth	H0-35	X
J. S. Schofield	R1-67	X

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