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7. Abstract

This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in tank 241-AW-101. This report supports the requirements of Tri-Party Agreement Milestone M-44-08.

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

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EXECUTIVE SUMMARY

This tank characterization report summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in underground double-shell storage Tank 241-AW-101. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-08.[1]

Tank 241-AW-101 is located in the AW Tank Farm in the 200 East Area of the Hanford Site. The tank went into service in 1980 and had an active transfer history until 1986. The major waste types received by the tank were Plutonium-Uranium Extraction (PUREX) process miscellaneous waste and water. The tank was also a receiver of concentrated waste from the 242-A Evaporator. In 1986, the tank was nearly emptied in preparation for Evaporator Campaign 86-5. The two receipts of double-shell slurry feed from this evaporator run were the last transfers received by the tank and raised the volume of waste in the tank to its current level. Tank 241-AW-101 remains in active service. However, it is on the Flammable Gas Watch List, and an accompanying unreviewed safety question regarding the potential accumulation of flammable mixtures of hydrogen and nitrous oxide gas under a crust is still associated with it. The tank likely will not experience any transfer activity until all safety issues surrounding it are resolved.

[1]Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

A description and status of Tank 241-AW-101 are summarized in Tables ES-1 and ES-2 and Figures ES-1 and ES-2[2]. The tank, which has an operational capacity of 4,320 kiloliters (kL) (1,140 kilogallons [kgal]), currently contains 4,255 kL (1,124 kgal) of waste, 3,937 kL (1,040 kgal) existing as supernate and 318 kL (84 kgal) as a heel and a crust[3]. These levels have remained constant since 1986. A crust layer of indeterminate thickness also is present in the tank.

This report summarizes three sampling and analysis events. Crust composition is based on three auger samples acquired in 1995 to address the crust burn safety issue. The samples were obtained and analyzed in accordance with the crust burn data quality objective (DQO)[4]. Supernate composition is based on grab samples taken in 1990 in support of the Hanford Grout Disposal Program. Because the supernate samples were taken before the existence of DQOs, the sampling and analysis may not comply with the safety screening DQO.[5] An assessment was still made with the results from this sampling event and the safety screening DQO decision criteria. A 1987 core sample from the heel of Tank 241-AW-101 was used as historical information and aided in the assessment of the tank waste profile.

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[2]Welsh, T. L., 1991, *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-055, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[3]Hanlon, B. M., 1995, *Waste Tank Summary for Month Ending February 28, 1995*, WHC-EP-0182-83, Westinghouse Hanford Company, Richland, Washington.

[4]Johnson, G. D., 1994, *Data Requirements Developed Through the Data Quality Objectives Process for the Crust Burn Issue Associated with Flammable Gas Tanks*, WHC-SD-WM-DQO-003, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[5]Babad, H., and K. S. Redus, 1994, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table ES-1. Concentrations and Inventories for Major Analytes and Analytes of Concern in Tank 241-AW-101 Supernate Based on 1990 Samples[1].

Physical properties	Supernate results	
Density	1.56 g/mL	
Percent water	43.6%	
Heat load	9,760 W (33,300 Btu/h)	
Chemical constituents	**Supernate concentration**	**Supernate inventory**
Metals	**μg/mL**	**kg**
Al	27,900	1.10E+05
Cr	161	632
K	41,800	1.64E+05
Na	2.30E+05	9.06E+05
U	224	880
Ions	**μg/mL**	**kg**
NH_3	247	971
CO_3^{2-}	12,300	48,500
Cl^-	5,180	20,400
OH^-	86,200	3.40E+05
NO_3^-	2.14E+05	8.44E+05
NO_2^-	1.02E+05	4.01E+05
PO_4^{3-}	2,110	8,300
SO_4^{2-}	1,030	4,060
Radionuclides	**μCi/mL**	**Ci**
^{134}Cs	1.53	6,010
^{137}Cs	520	2.05E+06
$^{89/90}Sr$	1.09	4,270
Total carbon	**μg/mL**	**kg**
Total organic carbon	2,460	9,690

Notes:
Btu/h = British thermal units per hour.
Ci = curie.
g/mL = grams per milliliter.
kg = kilogram.
μCi/mL = microcuries per milliliter.
μg/mL = micrograms per milliliter.
W = watt.
[1]Welsh, T. L., 1991, *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-055, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table ES-2. Description and Status Summary of Tank 241-AW-101.

Tank description	
Type:	Double-shell
Constructed:	1980
In-service:	1980
Diameter:	22.9 m (75 ft)
Usable depth:	10.5 m (34.5 ft)
Operating capacity:	4,320 kL (1,140 kgal)
Bottom shape:	Flat
Ventilation:	Operating exhauster
Tank status	
Total waste volume (03/95):	4,255 kL (1,124 kgal)
Heel and crust volume (03/95; *same at taking of 1995 augers and 1987 core*):	318 kL (84 kgal)
Supernate volume (03/95; *same at taking of 1990 grab samples*):	3,937 kL (1,040 kgal)
Manual tape level (05/31/95):	10.4 m (34.0 ft.)
Temperature (05/22/95):	25 °C to 42.2 °C (77 °F to 108 °F)
Integrity category:	Sound
Watch List:	Flammable gas
Service status	
Active	

Notes:
C = Celsius.
F = Fahrenheit.
ft = feet.
in. = inch.
kL = kiloliter.
kgal = kilogallon.
m = meter.

Figure ES-1. Tank 241-AW-101.

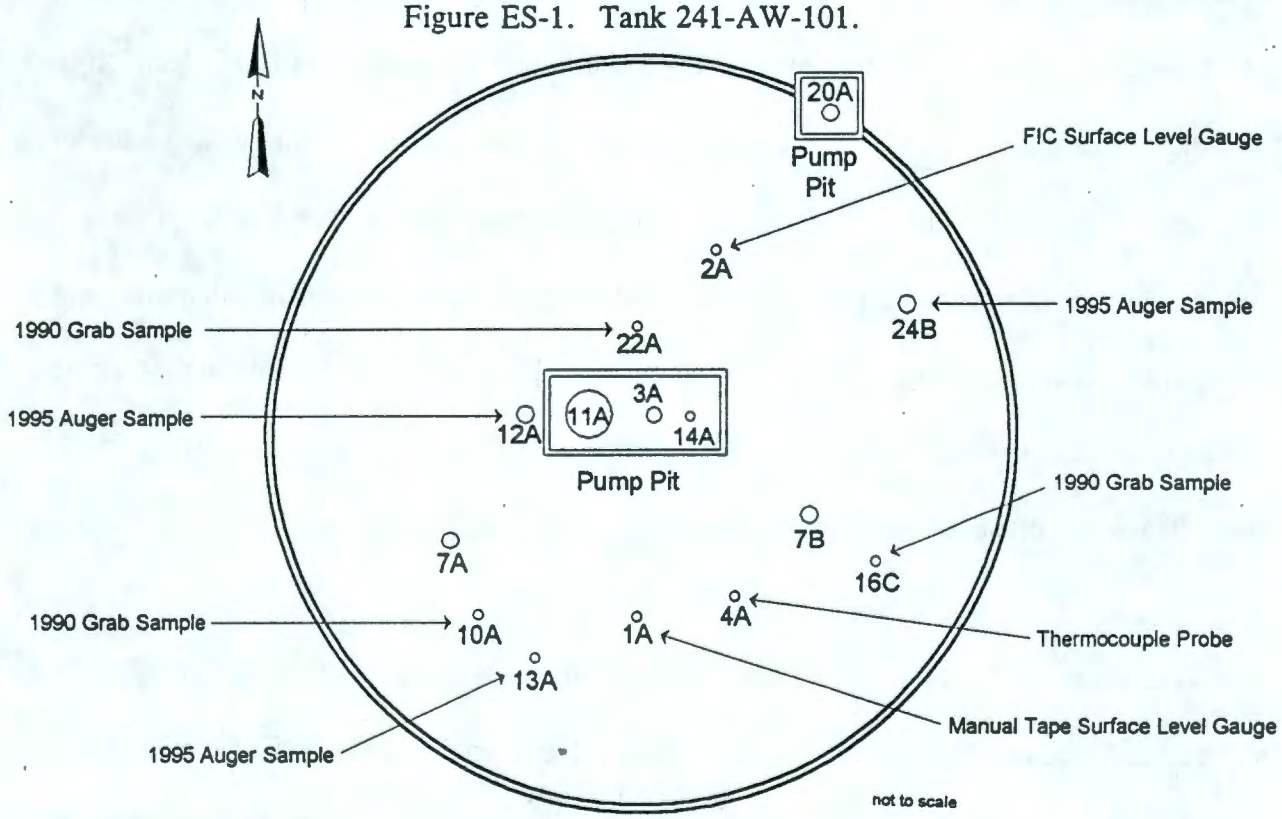
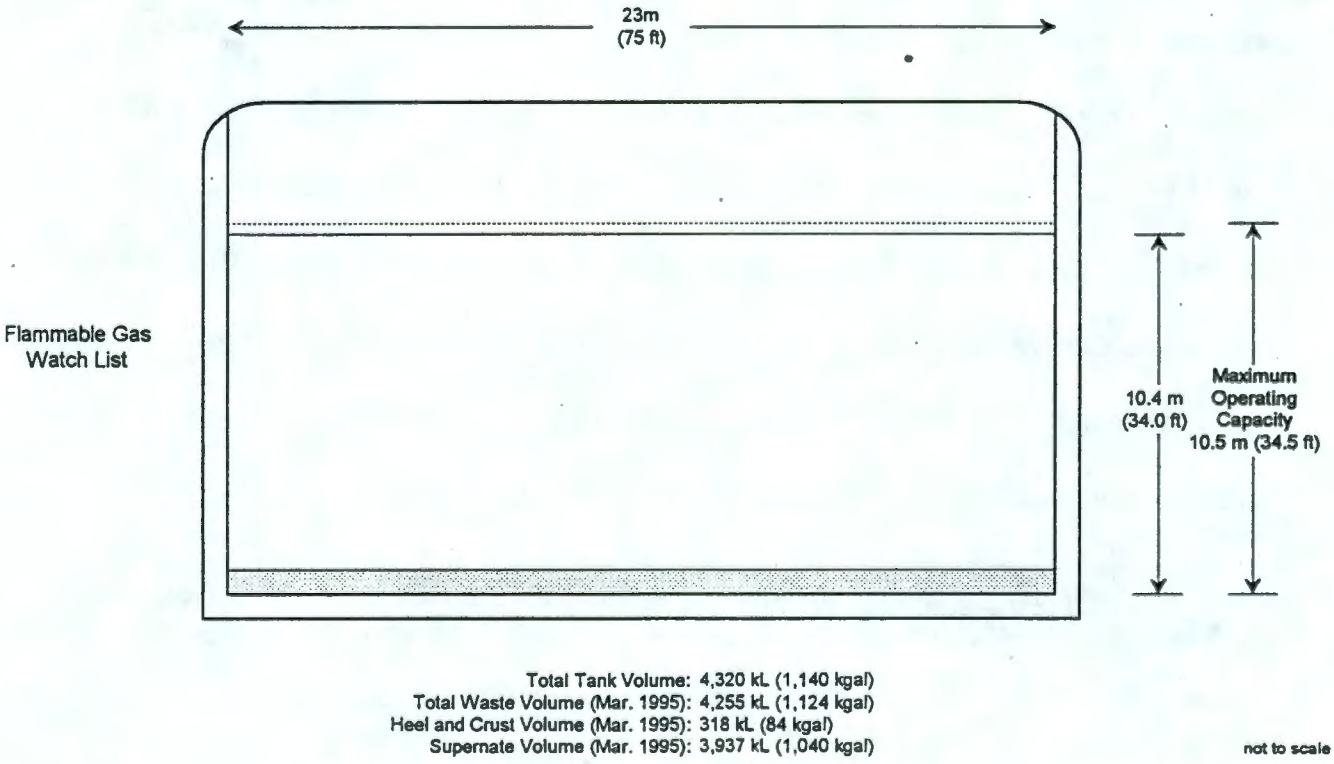


Figure ES-2. Waste Profile of Tank 241-AW-101.



The fuel content of the crust was measured by differential scanning calorimetry; exotherms were found in nearly every subsample but were less than the crust burn DQO decision limit. Although a similar analysis was not performed on the 1990 supernate samples, the presence of excessive fuel is unlikely when the total organic carbon, cyanide concentration, and process history of the tank are considered. The waste is about 93 percent supernate, and the crust moisture content ranged from 33.8 to 42.0 percent. The total organic carbon content in the auger samples ranged from 4,840 micrograms/gram (μg/g) to 11,800 μg/g. All results were below the crust burn DQO notification limit of 30,000 μg/g.

The heat generated by the radioactivity in the supernate is estimated to be 33,300 British thermal units/hour (Btu/h) (9,760 watts). This value is approaching half of the 70,000 Btu/h (22,500 watts) operating limit for tanks in the AW Tank Farm[6]. An analysis for ^{90}Sr and ^{137}Cs should be performed for the heel and crust when the tank is sampled again to provide a more accurate estimate of the overall tank heat load. Temperatures have been stable since 1989, ranging from 25 degrees Celsius (°C) (77 degrees Fahrenheit [°F]) to 43 °C (109 °F). The estimated level of $^{239/240}$Pu in the supernate, 0.00115 microcuries per milliliter (μCi/mL), is below the safety screening threshold of 61.5 μCi/mL.[7] Results from the 1987 core sample demonstrated that the heel was transuranic contaminated (> 100 nanocuries/gram total transuranic)[8]. This tank characterization report does not include any tank head space vapor sampling and analysis information for evaluation.

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[6]Harris, J.P., 1994, *Unclassified Operating Specifications for the 241-AN, -AP, -AW, -AY, -AZ, and -SY Tank Farms*, Rev. H-8, Westinghouse Hanford Company, Richland, Washington.

[7]Babad, H., and K. S. Redus, 1994, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[8]Weiss, R. L., 1987, *Results of Analysis of Tank 241-AW-101 Heel Samples* (Internal Memo 65453-87-105 to W. G. Richmond), Westinghouse Hanford Company, Richland, Washington.

The concentration and tank inventory for the major constituents and analytes of concern in the supernate are summarized in Table ES-1. No estimates of the chemical concentrations of the heel were determined in any of the sampling events. The supernate contained high concentrations of Al, Na, K, CO_3^{2-}, Cl^-, OH^-, NO_3^-, NO_2^-, PO_4^{3-}, and SO_4^{2-}. The large amounts of Al, Na, NO_3^-, NO_2^-, CO_3^{2-}, and OH^- were expected in the PUREX process miscellaneous waste and other dilute miscellaneous waste which had been concentrated in the 242-A Evaporator. The organic carbon found in the crust and supernate is also characteristic of Plutonium-Uranium Extraction miscellaneous waste. The ^{137}Cs was the only radionuclide expected from the process history to be present in substantial quantities; 2.05E+06 curies were found in the supernate.

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LIST OF TERMS

AC	analytical chemistry
AL	analytical laboratory
ANOVA	analysis of variance
DN	dilute noncomplexed
DQO	data quality objective
DSC	differential scanning calorimetry
IC	ion chromatography
PUREX	Plutonium-Uranium Extraction
PXMSC	PUREX miscellaneous waste
RPD	relative percent difference
RSST	reactive system screening tool - adiabatic calorimetry
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TOC	total organic carbon
TRU	transuranic
USQ	unreviewed safety question

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1.0 INTRODUCTION

This report presents an overview of double-shell Tank 241-AW-101 and its waste contents. It provides estimated concentrations and inventories for the waste components based on the latest sampling and analysis activities and background tank information. This tank characterization report for Tank 241-AW-101 describes the results of three sampling events. A core sample of the heel was taken in 1987 (Weiss 1987), and the supernate was grab sampled in 1990 (Welsh 1991) using the "bottle-on-a-string" technique (now referred to as grab sampling). The final sampling event constituted auger sampling of the crust (WHC 1995a; WHC 1995b). Tank 241-AW-101 is on the Flammable Gas Watch List and an unreviewed safety question is associated with it due to the potential for accumulation of flammable hydrogen and nitrous oxide gas mixtures. The tank remains in active service, although it has not received waste since 1986. Future activities such as supernate removal will change the inventory for tank waste. The concentration and inventory estimates reported in this document may not reflect the exact composition of the waste but do represent the best estimates based on the most recent and available data. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, Milestone M-44-08 (Ecology et al. 1994).

1.1 PURPOSE

The purpose of this report is to summarize information about the use and contents of Tank 241-AW-101. When possible, this information will be used to assess issues associated with safety, operation, environmental, and process development activities. This report also provides a reference point for more detailed information about Tank 241-AW-101.

1.2 SCOPE

The core sample of the heel taken in 1987 was used to assess the concentration of transuranic (TRU) isotopes in the tank waste. Significant TRU contamination of the supernate from the solids would render the supernate unsuitable for use as grout feed material (Weiss 1987). Radiochemical constituents were analyzed in the sludge and supernate; no other analyses were performed.

The supernatant grab samples obtained in 1990 were taken to characterize the tank waste in support of the Hanford Grout Disposal Program. Characterization was needed to prepare for the disposal of the tank supernate at the Hanford Grout Treatment Facility (Welsh 1991). Chemical and radiochemical components were measured for the supernate. Analyses for organic constituents were performed. Limited testing of physical properties was also conducted.

The auger samples acquired in 1995 were taken to resolve the crust burn safety issue for Tank 241-AW-101. Because the tank is on the Flammable Gas Watch List, a full characterization of the tank contents must be performed. Before this can occur, the potential for secondary ignition of organic-nitrate/nitrite mixtures in the crust layer initiated by the burning of flammable gases or by a mechanical in-tank energy source (such as friction during core sampling) must be assessed (Sathyanarayana 1994). To accomplish this assessment, analyses for total organic carbon (TOC) and total inorganic carbon (TIC) were performed. Thermodynamic properties also were evaluated by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The technical basis for the crust burn issue investigation is described in WHC-SD-WM-DQO-003, *Data Requirements Developed Through the Data Quality Objectives Process for the Crust Burn Issue Associated with Flammable Gas Tanks* (Johnson 1994). Sampling and analysis were performed as mandated in WHC-SD-WM-TP-229, *Tank 241-AW-101 Tank Characterization Plan* (Sathyanarayana 1994). Crust material was evaluated for the analytes discussed previously. No other analyses were performed.

2.0 HISTORICAL TANK INFORMATION

Tank 241-AW-101 is in active service and may have additional transfers that will alter the volume and composition of the tank once the safety issues surrounding the tank are resolved. The most current volume status of the tank is provided in routinely updated reports. Tank history includes tank status, tank design information, waste transfer history, and an estimate of the current contents based on the history of the tank. The final part, surveillance history, includes waste temperature and surface-level information as well as observations from in-tank photographs.

2.1 TANK STATUS

According to Hanlon (1995), Tank 241-AW-101 contains 4,255,000 liters (L) (1,124,000 gallons [gal]) of waste and is 98.6 percent full (see Section 2.2 for tank capacity). The supernate portion, 3,937,000 L (1,040,000 gal), accounts for 92.5 percent of the total waste volume (Hanlon 1995). The remaining waste is composed of a heel and a crust. Exact volumes of each of these waste phases is unknown. The existence of a crust is reported in Welsh (1991), but is not recognized in Hanlon (1995).

On May 22, 1995, the maximum recorded waste temperature in Tank 241-AW-101 is 42.2 degrees Celsius (°C) (108 degrees Fahrenheit [°F]), and the minimum temperature is 25 °C (77 °F). Liquid levels and tank temperatures are further discussed in Section 2.4.

The current classification of the tank's contents is double-shell slurry feed. The tank has an unreviewed safety question and is currently on the Flammable Gas Watch List because it has exhibited "burping" (gas release) activity (Sathyanarayana 1994). Tank 241-AW-101 is ventilated through an operating exhauster. A hydrogen monitor has been installed in the ventilation system to measure offgas (Wilkins 1995). The tank is considered sound and all monitoring systems are currently in compliance with established standards (Hanlon 1995).

2.2 TANK DESIGN AND BACKGROUND

Tank 241-AW-101 is a tank-in-tank design consisting of a heat-treated primary carbon steel liner inside a second steel liner. These liners are enclosed by a reinforced concrete shell. The top of the tank is a concrete dome. Tank 241-AW-101 has a design capacity for storing 4,390,000 L (1,160,000 gal) of waste; however, safety considerations require a maximum operating capacity of 4,320,000 L (1,140,000 gal). The tank has a diameter of 22.9 meters (m) (75 feet [ft]) and a usable depth of 10.5 m (34.5 ft). The bottom of the tank is flat. A diagram of Tank 241-AW-101 is shown in Figure 2-1. Instruments access Tank 241-AW-101 through risers and monitor the pressure, temperature, liquid level, sludge level, and other bulk tank characteristics. The locations of these risers are shown in Figure 2-2.

Figure 2-1. Basic Design of Tank 241-AW-101.

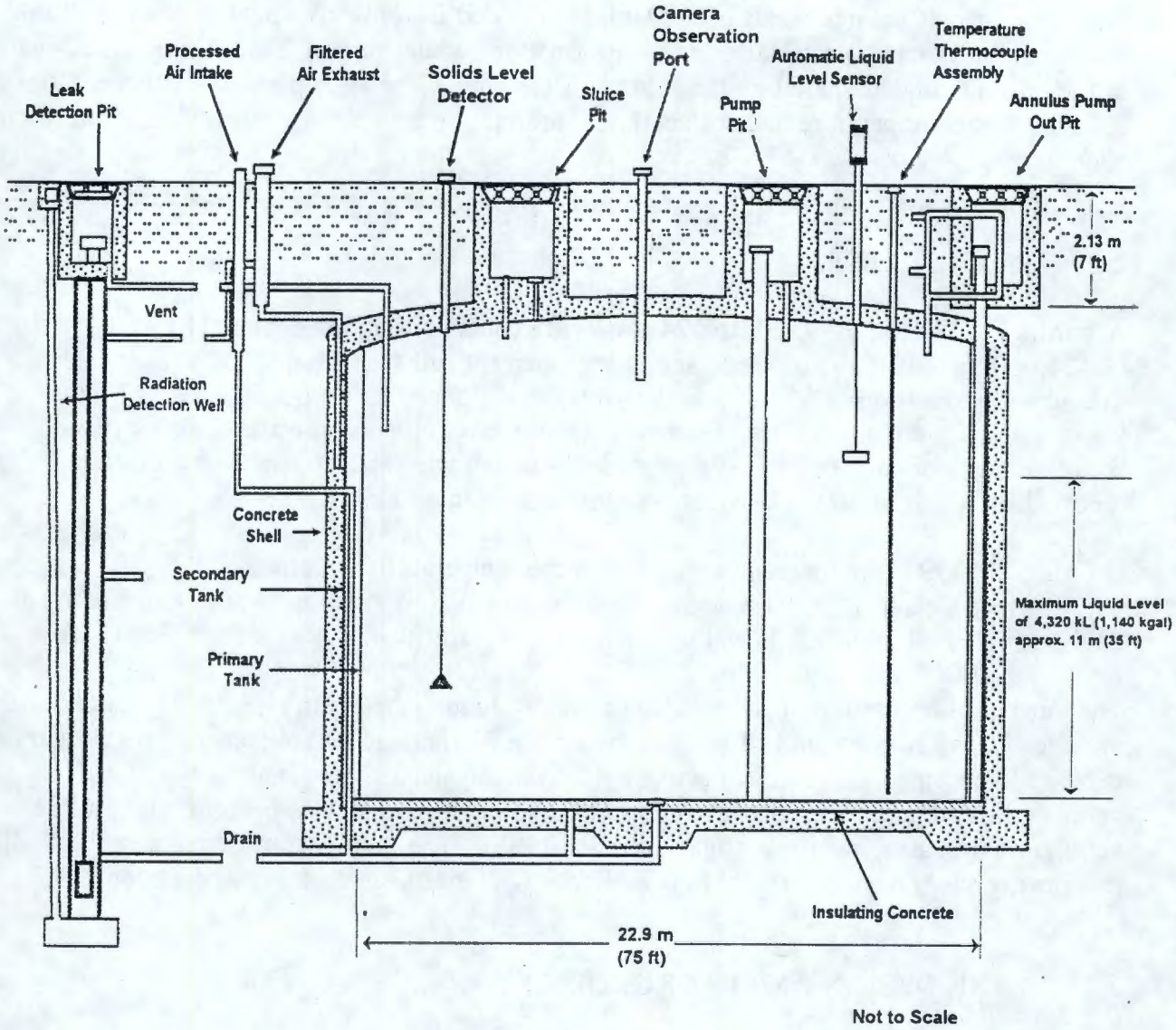

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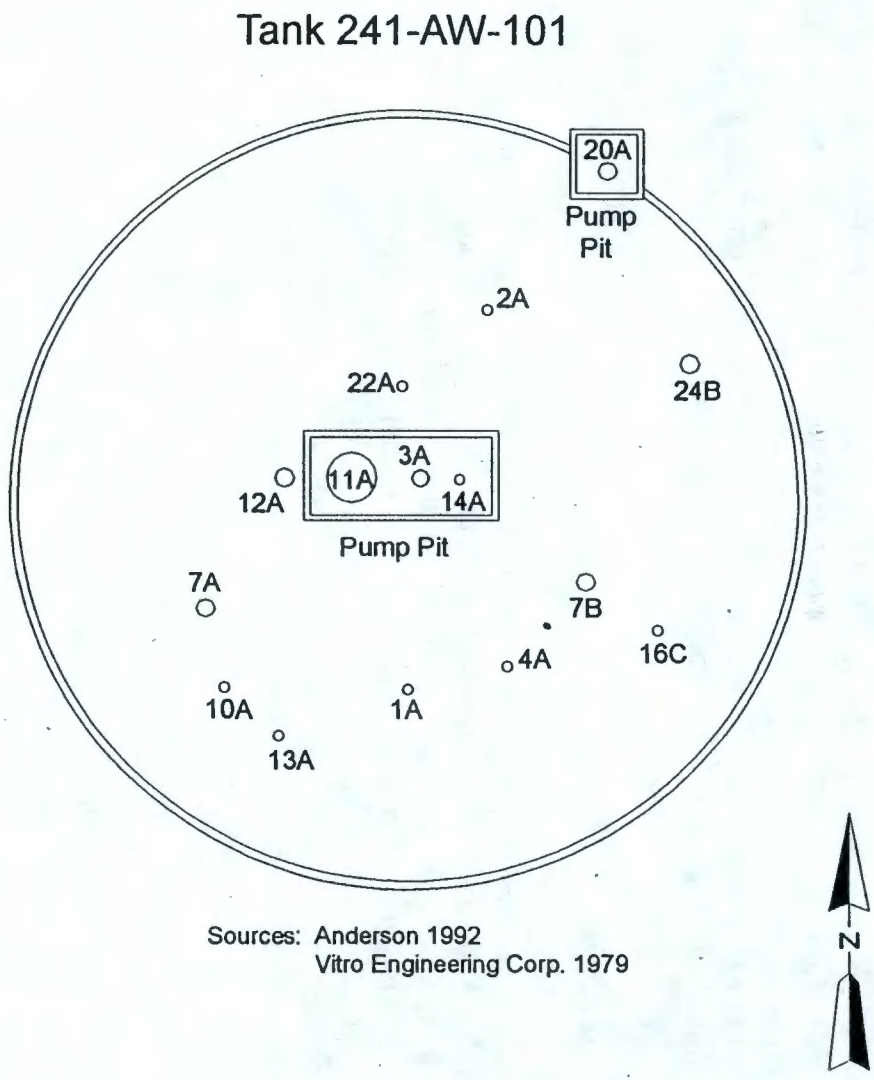
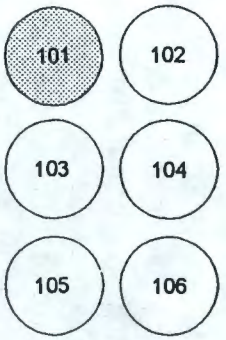
Figure 2-2. Riser Configuration of Tank 241-AW-101.



No.	Dia.	Description and Comments
1A	4"	Manual Tape
2A	4"	FIC Gauge
3A	12"	Supernate Pump
4A	4"	Thermocouple Probe
7A	12"	Tank Ventillation
7B	12"	Spare
10A	4"	Spare
11A	42"	Slurry Distributor
12A	12"	Observation Port - Spare
14A	4"	Dropleg Nozzle
13A	4"	Sludge Measurement Port
16C	4"	Sludge Measurement Port
20A	12"	Annulus Pump
22A	4"	Sludge Measurement Port
24B	12"	Spare



The 241-AW Tank Farm consists of six double-shell tanks built in 1980. The Tank Farm is located on the eastern side of the 200 East Area of the Hanford Site. Figure 2-3 details the 200 East Area and the location of the 241-AW Tank Farm. Tank 241-AW-101 is located in the northwest corner of the AW Tank Farm.

2.2.1 Flammable Gas Watch List

In March 1990, an unreviewed safety question was declared concerning a potential flammable condition developing beneath waste crusts in some Hanford Site waste tanks due to the presence of hydrogen and nitrous oxide mixtures. The existing safety analysis report at the time did include the issue of hydrogen generation, but did not specifically consider the hazard of a flammable mixture of hydrogen and nitrous oxide in the waste (McDuffie 1994). Due to this issue, an unreviewed safety question was declared. Although the unreviewed safety question was initially generated by a concern regarding the simultaneous generation of hydrogen and nitrous oxide, extensive analytical and experimental work conducted for Tank 241-SY-101 has also shown the need to consider other flammable gases such as ammonia and methane (McDuffie 1994).

The Flammable Gas Watch List includes tanks that have the potential for concentration of a gas or mixture of gases accumulating above the lower flammability limit. Tank 241-AW-101 was added to this list in 1993 (Hanlon 1994). The tank is being investigated through the 1995 auger sampling to determine if a potential exists for the burning of organic-nitrate/nitrite mixtures in the crust layer initiated by the burning of flammable gases or by a mechanical in-tank energy source (Johnson 1994).

2.3 PROCESS HISTORY

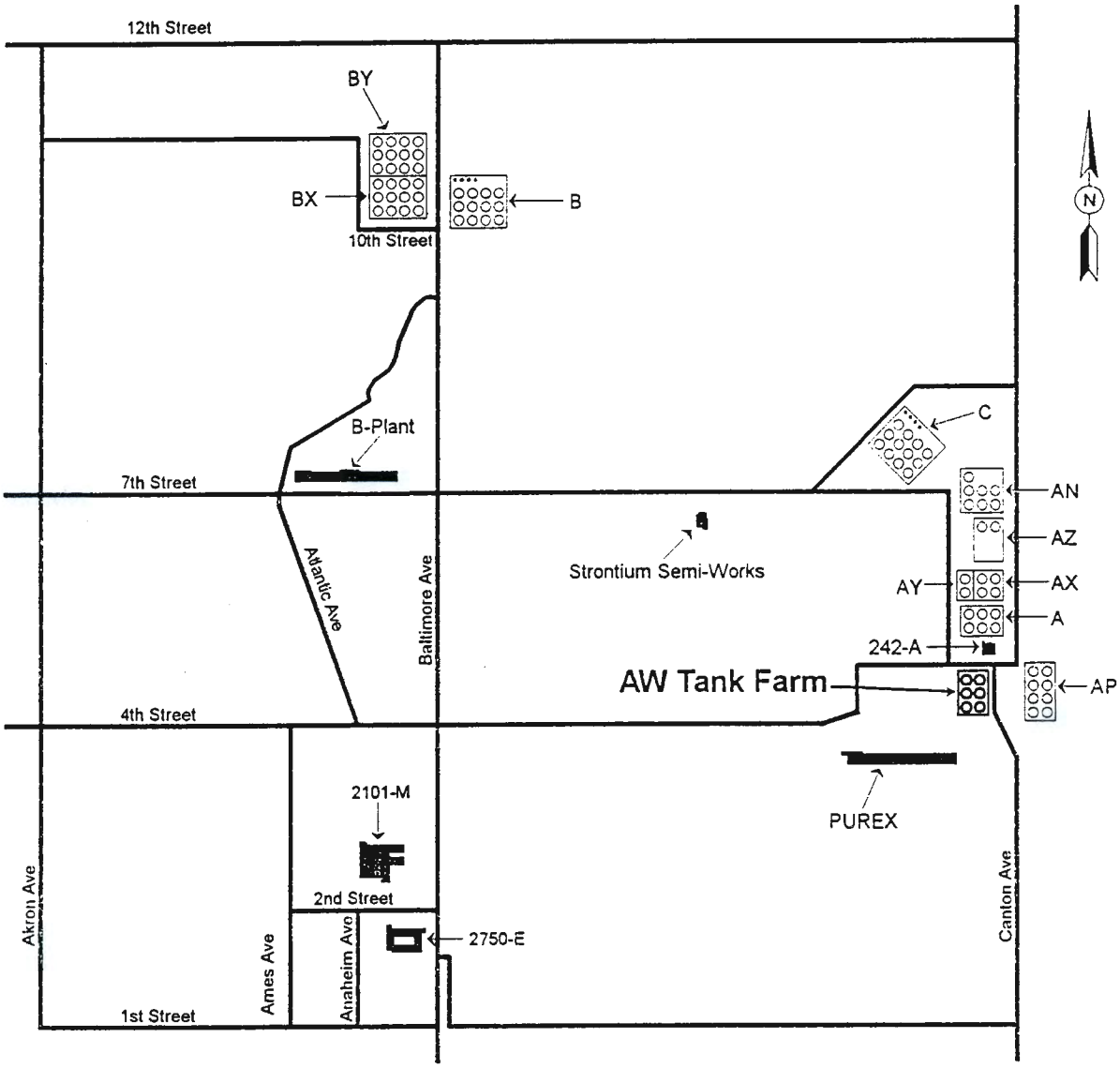
This section presents the transfer history of Tank 241-AW-101 and describes the process wastes that made up these transfers. The majority of the transfer history information is found in WHC-SD-WM-TI-689, *Waste Status and Transaction Record Summary for the Southeast Quadrant* (Agnew et al. 1995). This section also describes the characteristics of waste types that entered the tank and the conditions of their entry. Most of the information about waste type characteristics is taken from WHC-SD-WM-TI-309, *Waste Generation and Processing Rates with Waste Volume Reduction Factors, 1988* (Strode et al. 1989).

2.3.1 Waste Transfer History

Tank 241-AW-101 entered service in July 1980 when it received 34,100 L (9,000 gal) of dilute noncomplexed (DN) waste from an unrecorded source (Anderson 1990). Waste is considered DN if it is a low-activity liquid with a low content of organic carbon and organic complexants. Waste types that are typically DN include the following (Hanlon 1994):

- Supernate from the Plutonium Finishing Plant and B, T, and S Plants

Figure 2-3. Location of the 241-AW Tank Farm.



- Plutonium-Uranium Extraction (PUREX) decladding supernate and miscellaneous wastes
- Salt well liquid
- Waste from the 300 and 400 Areas
- Sulfate waste from the 100-N Area.

In 1981, Tank 241-AW-101 received a number of additions of PUREX miscellaneous wastes (PXMSC). These additions were usually accompanied with flush water additions. The PXMSC is a mixture of low-level PUREX waste streams including solvent recovery waste, ammonia scrubber feed, acid recovery/cell sump waste, and canyon cell sump waste. The major constituents of this dilute waste are nitrates and sodium. The PXMSC also contains a small amount of organic carbon. Flush water is expected to be mostly water with insignificant concentrations of radionuclides.

The combination of additions of PXMSC and flush water discussed above is a common trend in the process history of Tank 241-AW-101. Additions of PXMSC are scattered throughout the most active period of transfer activity for the tank (1981 to 1986). Additions of flush water from miscellaneous sources also persist throughout the transfer history of the tank. These transfers, however, tended to be of a smaller volume than the PXMSC additions.

In late 1981, Tank 241-AW-101 was the receiver tank for the 242-A Evaporator. Most of the concentrated waste received by Tank 241-AW-101 during this evaporator run originated from other tanks, but a portion originated from Tank 241-AW-101.

The additions of dilute phosphate waste from the 100-N Area and liquid from the United Nuclear Corporation Fuels Fabrication Facility in the first quarter of 1982 were each accomplished in single transactions. This is the only time the tank has received either of these types of waste. Dilute phosphate waste is produced during periodic decontamination of the 100-N Reactor. This waste has a high concentration of trisodium phosphate and also contains various complexants and inhibitors. Waste from the Fuels Fabrication Facility is considered DN and is comparatively high in nitrates and sodium.

Supernate from Tank 241-SY-102 was also transferred to Tank 241-AW-101 in early 1982. At that time, Tank 241-SY-102 had been receiving DN waste from T Plant and salt well liquid from 200 West Area single-shell tanks.

Sulfate waste from the 100-N Area was added to Tank 241-AW-101 in a series of three transactions in the second quarter of 1982. This waste is considered DN and comes from two different waste streams: ion-exchange regeneration waste and sand filter backwash waste. The sulfate waste was mostly water with a small amount of solids and a large collection of radionuclides present in small quantities. Ion-exchange regeneration waste was produced during regeneration of the ion-exchange resins used to remove radionuclides from

the 105-N spent fuel storage basin water. Sand filter backwash waste was generated before ion-exchange operations when fuel storage basin water was filtered to remove entrained solids, producing an inorganic sludge.

After being nearly emptied at the end of 1982, Tank 241-AW-101 was filled by a transfer from Tank 241-AW-105 in 1983. Much of this transfer probably consisted of complexed waste that Tank 241-AW-105 had received in 1980 (Anderson 1990). Later in 1983, more waste was transferred into Tank 241-AW-101 from Tank 241-AZ-102. At that time, Tank 241-AZ-102 held complexed waste that had just been concentrated in the 242-A Evaporator. This complexed waste was included in a two-pass concentration effort through the evaporator in 1984. Tank 241-AW-101 acted as a receiver tank for this evaporator run and cycled waste back through the feed tank, Tank 241-AW-102, for the two passes. After the evaporator run was completed, Tank 241-AW-101 was filled with the concentrated slurry. Most of this concentrated complexed waste was later transferred to Tank 241-AN-102 in 1984.

The small addition of laboratory wastes from the 300 and 400 Areas in the last quarter of 1984 is DN consisting mostly of water. Sodium, nitrates, and sulfates are present in the laboratory waste, but in small concentrations. The salt well liquid from 200 East Area single-shell tanks transferred into Tank 241-AW-101 in 1985 is also considered to be DN. Noncomplexed salt well liquid tends to be high in sodium and nitrate; salt well liquid may also be high in nitrite with a significant concentration of aluminate depending on the source of pH of the liquid.

A series of transfers to Tank 241-AW-102 in 1985 and 1986 emptied Tank 241-AW-101 down to 204 kiloliters (kL) (54 kilogallons [kgal]) in preparation of receiving concentrated waste from the 242-A Evaporator. The last recorded addition of evaporator waste to Tank 241-AW-101 occurred on July 21, 1986. Although no transfers of waste to the tank have occurred since 1986, the waste level has changed due to a series of gas accumulations under the crust followed by lancing (Agnew et al. 1995).

The process history of Tank 241-AW-101 is presented graphically in Figure 2-4. Table 2-1 presents an estimate of the total volumes of the specific waste types that were added to the tank.

2.3.2 Historical Estimation of Tank Contents

The historical tank content estimates based on the tank layer model, waste status and transaction record summary, and Hanford Defined Wastes Types developed by Los Alamos National Laboratory were not yet available for Tank 241-AW-101 when this report was compiled. This model has not been validated.

Figure 2-4. Waste Volume History of Tank 241-AW-101.

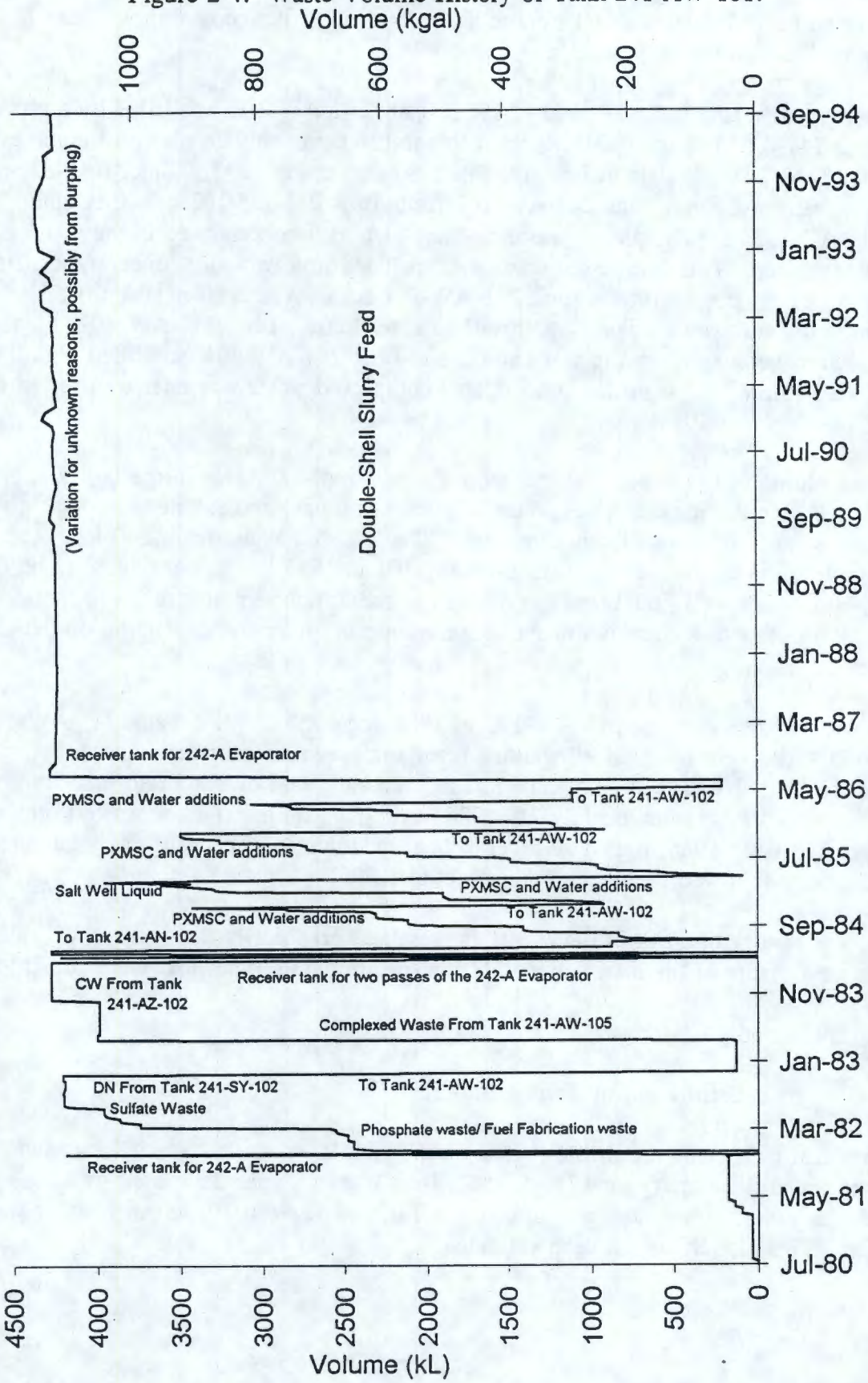


Table 2-1. Estimated Total and Current Volumes of Waste Types Received by Tank 241-AW-101.[1]

Waste type	Estimated volume[2] kL (kgal)	Years received
Unknown DN	34.1 (9)	1980
PXMSC	10,500 (2,764)	1981 - 1986
Flush water	1,680 (443)	1981 - 1986
LUNC	64.4 (17)	1982
NRPO4	34.1 (9)	1982
DN (Tank 241-SY-102)	1,150 (303)	1982
NRSO4	405 (107)	1982
CC (Tanks 241-AW-105 & 241-AZ-102)	4,141 (1,094)	1983
L3A4A	11.4 (3)	1984
Salt well liquid	273 (72)	1985
EVAP	19,100 (5,039)	1981, 1984, 1986

Notes:
[1]Source: Agnew, S. F., T. Duran, R. Corbin, K. Jurgensen, and B. Young, 1995, *Waste Status and Transaction Record Summary for the Southeast Quadrant*, WHC-SD-WM-TI-689, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[2]Total volume is >2,010,000 liters (530,000 gallons) because waste was routinely pumped from Tank 241-AW-101.

CC = Concentrated complexed waste from tanks 241-AW-105 and 241-AZ-102.
DN = Dilute, noncomplexed waste. Defined as waste with total organic carbon <1 wt percent (10 grams/liter).
EVAP = Waste that had been concentrated in the 242-A Evaporator before being transferred into the tank.
kgal = kilogallon.
kL = kiloliter.
L3A4A = DN laboratory wastes from 300 and 400 Areas.
LUNC = DN waste from United Nuclear Corporation Fuels Fabrication Facility.
NRPO4 = Dilute phosphate waste from the 100-N Area.
NRSO4 = DN sulfate waste from the 100-N Area.
PXMSC = DN from Plutonium-Uranium Extraction miscellaneous streams (from processing N Reactor fuel).

The two primary waste types received by Tank 241-AW-101 before 1986 were PUREX miscellaneous streams from processing N Reactor fuel, and concentrated 242-A Evaporator waste. The tank was selected to be the slurry receiver for 242-A Evaporator Campaign 86-5, and in preparation was emptied down to 204 kL (54 kgal). By the end of the evaporator run,

Tank 241-AW-101 was filled to its current level with double-shell slurry feed. This run concentrated PXMSC from Tank 241-AW-102, and other dilute miscellaneous wastes from tanks 241-AW-104 and 241-AW-106. The evaporated waste was added to tank-AW-101 in two transfers. These were the last transfers received by the tank.

The chemical composition of the double-shell slurry feed was analyzed from in-line samples taken after evaporation (Starr 1987). Sample R-9897 was taken July 6, 1986, and results from its analysis are included in Table 2-2. Double-shell slurry feed has been evaporated up to (but not beyond) the sodium aluminate phase boundary and separates into distinct supernate and solid layers when permitted to settle. The double-shell slurry feed has been designated the final interim waste type; further concentration is no longer desired until the waste is removed from the tank and treated for final disposal.

2.4 SURVEILLANCE DATA

2.4.1 Surface-Level Readings

To determine the surface level of the waste, Tank 241-AW-101 is equipped with an automatic gauge manufactured by the Food Instrument Corporation and a manual tape. The Food Instrument Corporation gauge uses a conductivity probe which is automatically lowered until an electric circuit is completed when the probe contacts the waste surface. Usually the measurement is automatically entered into the computer-automated surveillance system and the surveillance analysis computer system; however, the gauge is not currently transmitting data and must be read manually. The manual tape uses a similar conductivity probe, but it is lowered by a hand crank and read manually. A manual tape will have a small variance in length with temperature changes; however, the actual level change in a tank caused by seasonal temperature variations is negligible. It would take a 4.4 °C (40 °F) rise in liquid temperature to cause a 1 percent change in the liquid volume of the tank (Johnson 1994).

Surface-level readings are currently being taken daily. The most recent available Food Instrument Corporation surface-level reading recorded on May 31, 1995, was 1,038 centimeters (cm) (408.5 inches [in.]). The waste level in Tank 241-AW-101 has fluctuated somewhat even though no waste has been added since 1986. Gains and losses during this time have been attributed to changes in instrumentation, unknown causes, and "burping" of gas generated in the waste.

2.4.2 Internal Tank Temperatures

Local tank temperatures in Tank 241-AW-101 are monitored by a thermocouple tree (a probe with multiple thermocouples assembled in a pipe), mounted in Riser 4A. The thermocouple tree in this tank is an iron constantan Type J, which monitors the waste temperatures at various levels in the tank. The maximum variability for the Type J thermocouple is ± 6 °C (11 °F) (Scaief III 1991). Six of the thermocouples on the tree in Tank 241-AW-101 are in service.

Table 2-2. Chemical Composition of Slurry Sample from Evaporator Campaign 86-5 for Tank 241-AW-101 (2 sheets).*

Physical properties		
Sample date	7/4/86	
Sample ID number	R-9897	
Density (g/mL)	1.49	
Volume filtered solids	14%	
% H_2O	51.5	
TOC (g/L)	4.83	
Chemical constituents		
Analyte	**Slurry**	
Metals	**M**	**μg/mL**
Al	0.75	2.02E+04
Ca	0.00129	51.7
Cr	0.00274	143
K	0.60	2,350
Mg	2.43E-04	5.91
Na	5.77	1.32E+05
Si	0.003	84.3
P	0.02	18.6
Ions		
CO_3^{2-}	0.50	2.99E+04
Cl^-	0.13	4,610
F^-	0.16	3,040
NH_3	<0.02	<63.3
NO_2^-	1.36	4.37E+04
NO_3^-	4.05	1.95E+05
OH^-	5.20	8.84E+04
PO_4^{3-}	0.06	5,700
SO_4^{2-}	0.04	3.84E+04
Radionuclides	**μCi/mL**	
^{14}C	4.51E-04	
$^{89/90}Sr$	4.33	
^{99}Tc	0.273	

Table 2-2. Chemical Composition of Slurry Sample from Evaporator Campaign 86-5 for Tank 241-AW-101 (2 sheets).*

Radionuclides (continued)	μCi/mL
^{134}Cs	6.8
^{137}Cs	469
$^{239/240}Pu$	2.36E-05 (μg/mL)
^{241}Am	0.0126
^{147}Pm	0.013

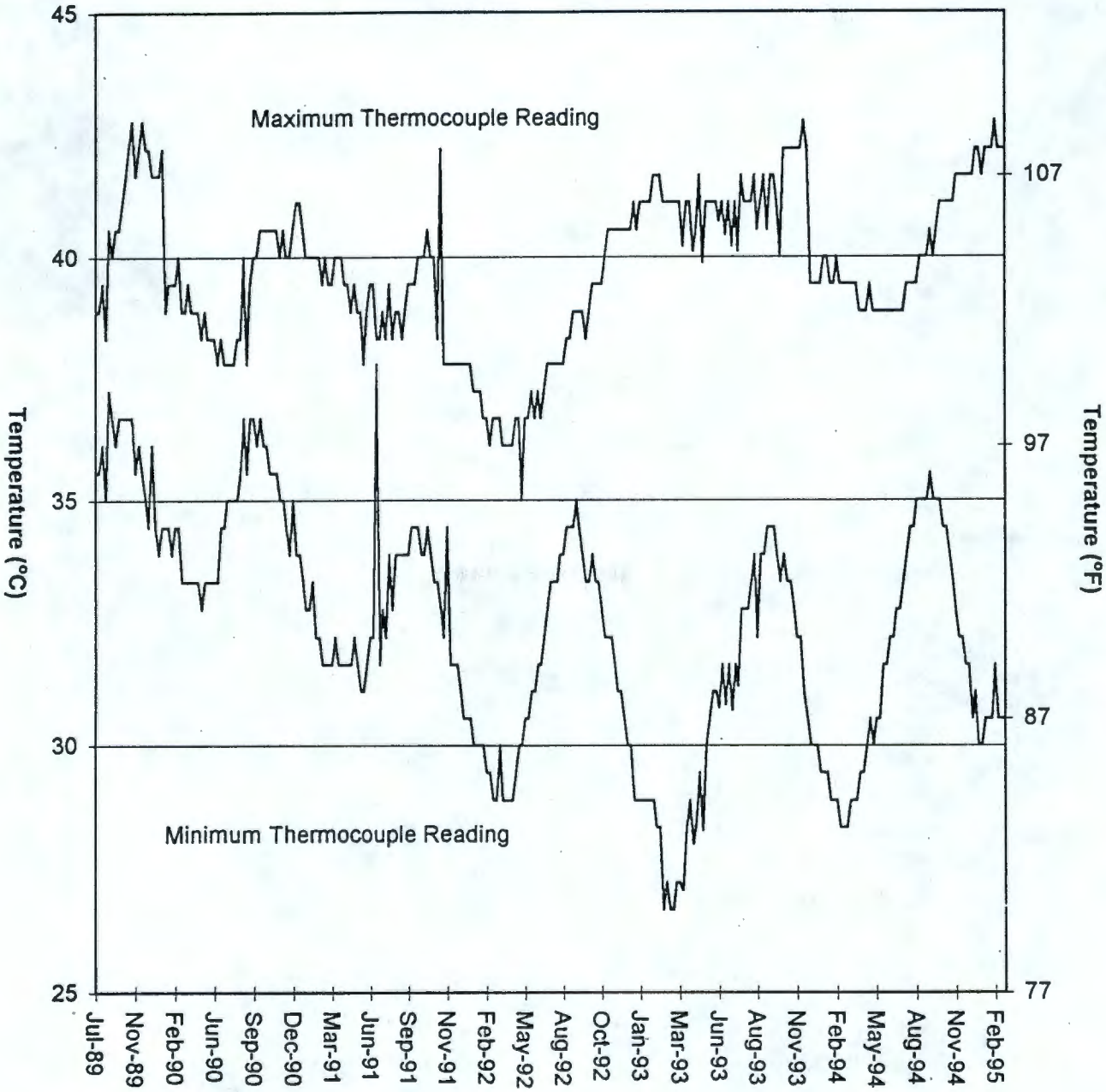
Notes:
*Starr, J. C., 1987, *242-A Evaporator/Crystallizer Fiscal Year 1986 Campaign Run 86-5 Post-Run Document*, WHC-SD-WM-PE-032, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
g/L = gram/liter.
g/mL = gram/milliliter.
ID = Identification.
M = moles/liter.
μg/mL = microgram/milliliter.
μCi/mL = microcurie/milliliter.
TOC = Total organic carbon.

Temperature readings for Tank 241-AW-101 since July 1989 are plotted in Figure 2-5. Both the maximum and the minimum temperature readings are plotted. The maximum temperature for Tank 241-AW-101 on May 22, 1995 was 42.2 °C (108 °F). The highest temperatures in the tank since July 1989 have been consistently recorded by thermocouples 3 and 4. The third and fourth thermocouples are at heights of 132 cm (52 in.) and 193 cm (76 in.) from the bottom of the tank, respectively (Tran 1993). Figure 2-5 illustrates that since 1989, temperatures have mostly remained between 25 °C (77 °F) and 43 °C (109 °F) and seasonal variations are observed.

2.4.3 Tank 241-AW-101 Photographs

Figure 2-6 presents a 1988 photo montage of Tank 241-AW-101. This montage should be a good representation of the current contents of this tank because little has changed since the photograph was taken in 1988. The montage shows the surface of the waste and an irregular crust layer, as well as tank risers. Equipment items are also easy to identify and include a temperature probe, three level probes, and a supernatant pump.

Figure 2-5. Tank 241-AW-101 Historical Temperature Data.



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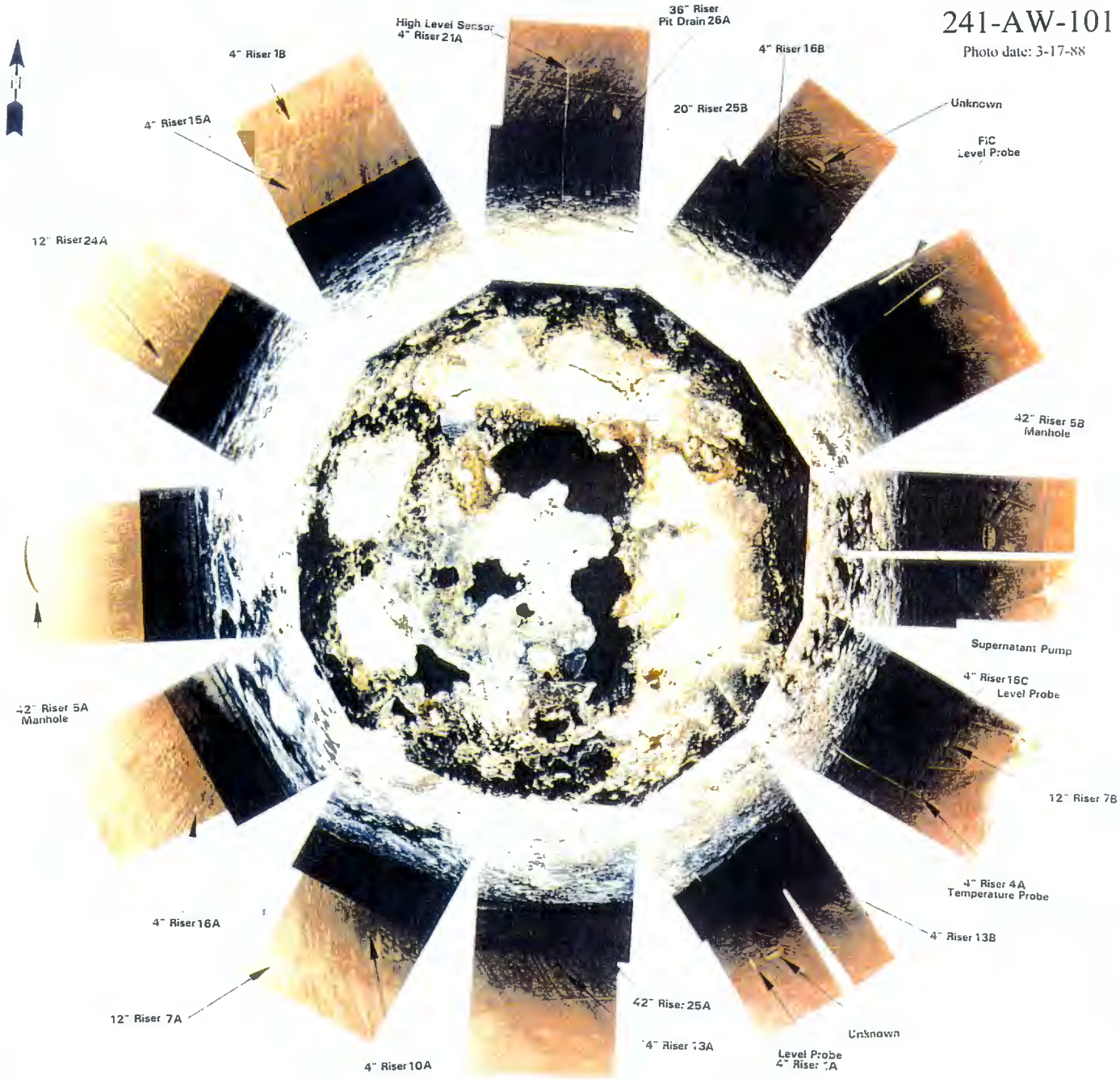

Figure 2-6. In-Tank Photo Montage of Tank 241-AW-101.

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3.0 TANK SAMPLING OVERVIEW

This section describes the three latest sampling and analysis events for Tank 241-AW-101. Any sampling events conducted before 1986 are not applicable because the tank was nearly emptied in 1986. A core sample was taken in 1987 to assess the level of TRU contamination in the heel of the waste. In June 1990, 12 grab samples of supernate were acquired for characterization of the chemical and radiological constituents of the tank waste. The samples were taken to resolve waste preparation issues for the Hanford Grout Disposal Program and waste treatment and disposal concerns of the Hanford Grout Treatment Facility. In January 1995, three auger samples were obtained in order to resolve the crust burn flammable gas safety issue. A discussion of the procedures for tank waste sample and analysis may be found in WHC-SD-WM-TI-648, *Tank Characterization Reference Guide* (De Lorenzo et al. 1994).

3.1 DESCRIPTION OF 1987 SAMPLING EVENT

In July 1987, an analysis of the heel of the waste in Tank 241-AW-101 was requested to assess the level of TRU contamination. If significant levels of TRU develop in the supernate from the heel in the tank, the supernate would be rendered unsuitable for use as grout feed material. Classification of the supernate as TRU contaminated (>100 nCi/g total TRU) would also increase the cost of disposal.

One core sample, composed of two approximately 48-cm (19-in.) long segments, was obtained. The upper segment was approximately two-thirds liquid and one-third solid. The solid was composed of two distinct phases: half was grey "slush" and the other half was brown sludge. The lower segment was a uniform solid dark brown sludge.

The 1987 sampling and analysis of Tank 241-AW-101 was conducted under the management of Rockwell International. Information regarding the specific riser from which the core was obtained, the depths at which the segments were taken, and the percent recovery of each segment was not available. It is also unknown whether or not hydrostatic head fluid was used during sampling.

3.1.1 Sample Handling (1987)

The supernatant liquid from the first segment was decanted from the solid. The solids from each segment were blended into a homogenous mixture. After the supernatant liquid was separated from the solid fraction in the upper segment, solids precipitated in the liquid portion. To prepare the liquid for analysis, the sample was gently warmed and mixed with 50 percent deionized water to redissolve the solids. No further precipitation occurred. Preparation of the solid portions for analysis involved dissolving the sample with aqua regia/hydrofluoric acid at elevated temperature and pressure. Two dissolutions were made on portions of the upper segment composite and one on the lower segment composite.

During the preparation of the dissolutions, the majority of the solids readily dissolved in the reagent before the bomb (bomb calorimeter) was sealed and heated. An additional dissolution was performed on an upper segment fraction using a 5 M HCL solution, which served as a check on the initial dissolution procedure.

3.1.2 Sample Analysis (1987)

The prepared solutions were submitted to the 222-S Analytical Laboratories (AL) for analysis of the following constituents: plutonium, americium, neptunium, uranium, and gamma activity. Information regarding analytical procedures was not available. The results of these analyses are provided in Appendix A of this report. Based on these data, the supernate associated with the heel in Tank 241-AW-101 is most likely non-TRU. The upper segment results were below the TRU limit; the lower segment data exceeded the TRU limit of 100 nCi/g. However, these results are based on a single 2.5-cm (1-in.) diameter core sample from a 23-m (75-ft) diameter tank. Additional sampling and analysis from other areas of the tank must be performed if a more accurate classification is needed. The degree of heterogeneity of the waste in the tank is unknown (Weiss 1987) and difficult to evaluate from a single sample.

3.2 DESCRIPTION OF 1990 SAMPLING EVENT

In June 1990, 12 grab samples were taken to characterize the supernate portion of the tank waste in support of the Hanford Grout Disposal Program. The 12 sample locations were selected for Tank 241-AW-101 using a randomized sampling plan. Three out of eight available risers were selected using a random number generator. Sampling elevation was randomly selected from four horizontal sections (the horizontal sections were determined by dividing the liquid height of the tank by 4). The choice of only three risers was done to keep radiological exposures as low as reasonably achievable. The three risers chosen were 16C, 10A, and 22A, and the 12 sample locations are identified in Table 3-1. For a visual representation of the sample locations, refer to Figure 3-1.

Twelve 100-mL samples were collected on June 28, 1990, using the "bottle on a string" technique (now referred to as grab sampling). Samples were obtained by opening a riser and lowering a weighted glass bottle to the desired depth below the surface of the liquid. Because of the radioactivity of the samples, they were not preserved with nitric acid in the field. The only problems encountered during the sampling were in getting the bottles through the crust. Chain-of-custody records were completed for this sampling event, but the forms could not be located.

Table 3-1. Tank 241-AW-101 Grab Sample Locations.

Sample number	Riser number	Radius[1] m (ft)	Angle[2]	Depth[3] cm (in)
R4792	16C	8.5 (28)	120°	239 (94)
R4793		8.5 (28)	120°	351 (138)
R4794		8.5 (28)	120°	739 (291)
R4795		8.5 (28)	120°	982 (387)
R4796	10A	8.5 (28)	216°30'	140 (55)
R4797		8.5 (28)	216°30'	381 (150)
R4798		8.5 (28)	216°30'	612 (241)
R4799		8.5 (28)	216°30'	859 (338)
R4800	22A	3.1 (10)	0°	132 (52)
R4801		3.1 (10)	0°	432 (170)
R4802		3.1 (10)	0°	660 (260)
R4803		3.1 (10)	0°	932 (367)

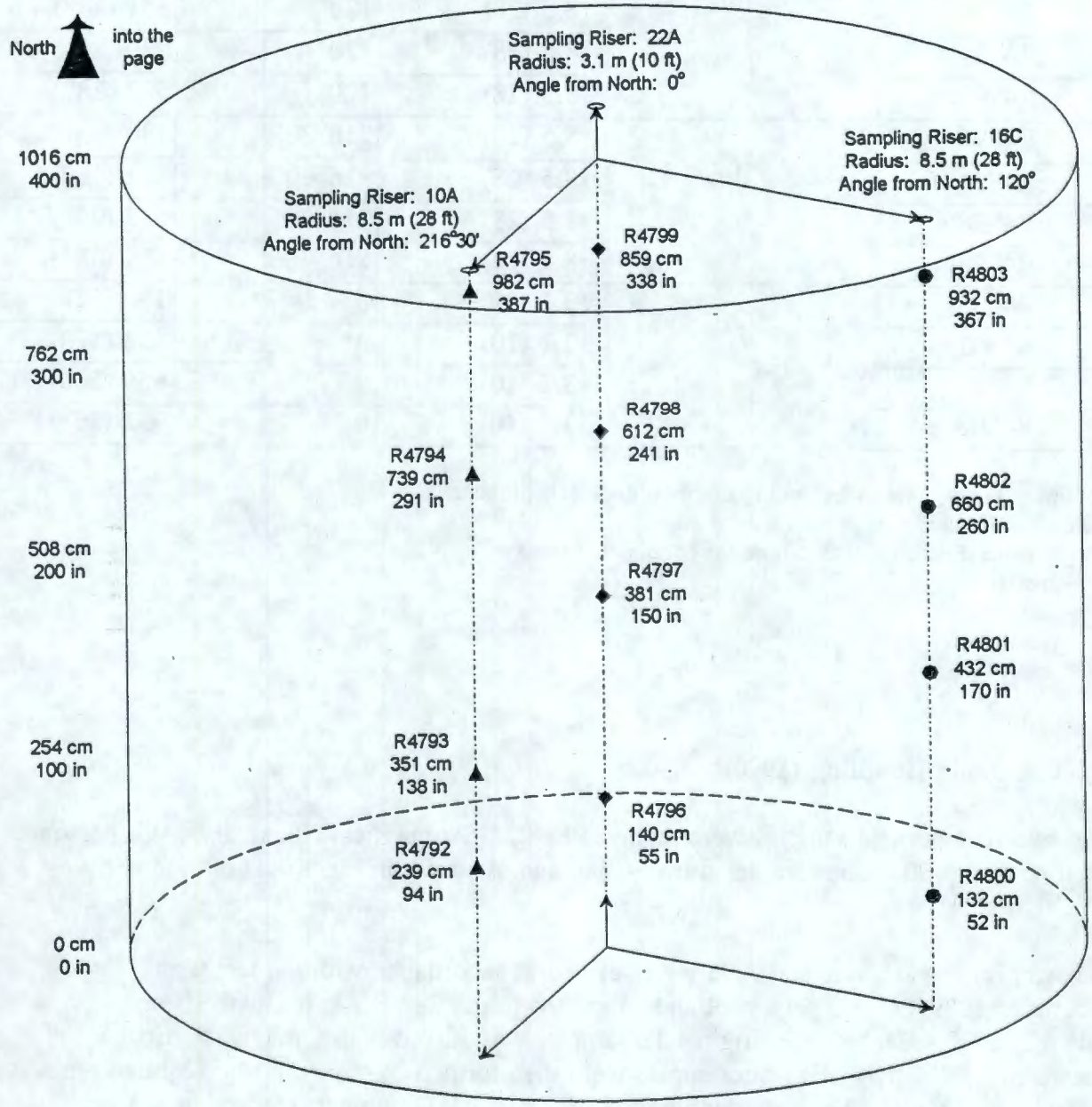
Notes:
[1]Radius is the distance in feet and inches from the center of the tank.
[2]Angle is the number of degrees from north.
[3]Depth is the number of inches from the bottom of the tank.
m = meter.
ft = feet.
cm = centimeter.
in = inch.

3.2.1 Sample Handling (1990)

The twelve supernate samples were received by 222-S Analytical Chemistry (AC) personnel on June 28, 1990. The samples were logged and assigned an identification number (Welsh 1991).

Subsamples of each waste sample were formed in accordance with the test plan (Hammitt 1989) by AC personnel and submitted to the 222-S AL for analysis on July 17, 1990. Each of the original 12 samples was stirred with a magnetic stir bar and heated to 40 °C (104 °F). Subsamples were then formed by pipetting the required amount of material into a vial. Each subsample identified by an AC number was assigned a new sample number by the AL. A composite sample also was prepared to determine the average waste composition as well as to test analytical procedures for making grout in the hot cell. Two water blanks were also submitted to the AL for analysis. The AL and AC sample numbers are summarized in Appendix B, Table B-1.

Figure 3-1. Sampling Locations for Tank 241-AW-101.



3.2.2 Individual Sample Analysis (1990)

The samples were analyzed for chemical and radiochemical constituents as well as for density and percent water. An analysis for phosphorus by ICP was requested but not completed due to instrument failure. Three additional analytes (carbonate, hydroxide, and mercury) were added to the list of requested analyses. The results of the analyses are presented in Appendixes C and D.

In general, the 12 individual sample analytical results indicated that Tank 241-AW-101 contents were homogenous (Welsh 1991). Procedures used for inorganic and radiological analyses are listed in Appendix E, Table E-1.

3.2.3 Composite Sample Analysis (1990)

The majority of the chemical and radiological constituents measured indicated that the tank contents were homogenous. A composite sample was prepared on February 4, 1991, by combining equal volumes of each of the 12 samples. The procedure called for each of the 12 samples to be stirred with a magnetic stir bar and heated to 40 °C (104 °F). Aliquots of 40 mL samples (in 10-mL increments) were pipetted from each of the 12 samples and transferred to a 1-L Erlenmeyer flask. Eight subsamples made from different dilutions of the composite sample were submitted to the AL for analysis on March 4, 1991. Dilutions were determined by the analysis requested. Nitrite analysis was performed by two different methods: spectrophotometric and ion chromatography. The AC numbers and the assigned AL sample numbers are listed in Appendix B, Table B-2.

The composite samples were analyzed for chemical and radiochemical constituents as well as for density. Additionally, volatile and semivolatile organic analyses were performed on a composite sample once it was discovered that total organic carbon in the tank exceeded 2 g/mL. The organic analyses were performed according to U.S. Environmental Protection Agency protocols with some exceptions. Radioactivity of the samples did not allow for the required preparation and preservation, and sample bottles could not be confirmed for zero headspace. Refrigeration of the sample was not possible, and because of hot cell handling requirements, holding times were exceeded. These deviations were not expected to have had a serious impact on the sample results because of the history of the waste.

3.3 DESCRIPTION OF 1995 SAMPLING EVENT

In January 1995, three auger samples were taken from Tank 241-AW-101 in accordance with the tank characterization plan (Sathyanarayana 1994). This characterization effort was focused on the resolution of the crust burn flammable gas safety issue. Flammable gas generation, retention, and release is a top priority waste tank safety issue at the Hanford Site.

To resolve these issues, characterization of the tank is necessary, including intrusive tank sampling (such as core sampling). Before core sampling can occur, the potential for secondary ignition of organic nitrate-nitrite mixtures in the crust layer, caused by friction during core sampling, must be assessed.

On January 25-27, 1995, three auger samples were taken from Tank 241-AW-101 using 10-inch augers. Eight inches of sample were expected to be recovered from each auger (Sathyanarayana 1994). Table 3-3 contains a description of the samples as well as information on the sampling events. The references in Table 3-3 and in other subsections of Section 3.0 to "auger flutes" pertain to the circular grooves on the auger shaft which entrap the waste sample at a point on the auger roughly corresponding to the depth of the waste. Flute #1 is the topmost circular groove on the auger when the auger is in the sampling position, and will generally contain material from the top of the waste column. The flute numbers increase with distance along the shaft. The flute with the highest number is located at the tip of the auger, and will generally contain material from the bottom of the waste column, or from the lowest portion of the waste column accessible to the auger in situations where the waste column has a greater length than the auger.

The samples were taken from widely spaced risers. Risers 12A, 13A, and 24B were used for this sampling event. Risers 12A and 24B are both 30 cm (12 in.) in diameter, while Riser 13A is 10 cm (4 in.) in diameter.

Waste Tank Sample Engineering did not take a field/trip blank for this sampling event because the data obtained from these analyses are not being used to make decisions regarding treatment or disposal of waste.

3.3.1 Sample Handling (1995)

The samples were received at the 222-S Laboratory on January 27, 1995, and extrusion took place on February 7 and 8, 1995 in accordance with the tank characterization plan (Sathyanarayana 1994). Drill string dose rates and sample descriptions are summarized in Table 3-2. After extrusion, the material was sampled from specific flutes of each auger as indicated in Table 3-3. Additionally, a composite sample was assembled from the material obtained from riser 13A. Waste from each auger was also collected in order to establish archive samples. Figure 3-2 is a flowchart of the steps taken by the 222-S Laboratory in the extrusion and analysis of the auger samples. Table 3-3 summarizes the sample designations, sample size, and assignments of laboratory numbers.

Table 3-2. 1995 Sample Data for Tank 241-AW-101.

	Riser 13A	Riser 12A	Riser 24B
Auger number	95-AUG-001	95-AUG-004	95-AUG-005
Date taken	01-25-95	01-26-95	01-27-95
Received by 222-S Laboratory	01-27-95	01-27-95	01-27-95
Date extruded	02-7-95	02-7-95	02-8-95
Cask serial number	SN-18G	SN-25G	SN-15-G
Drill string dose rate	750 mR/h	900 mR/h	700 mR/h
Weight recovery (g)	78	12	18
Estimated recovery	85%	60%	60%
Description of solids	Damp, dark brown sludge material, with crystalline crust dispersed throughout flutes 1-3	Damp, dark brown sludge material, no crust material observed	Damp, dark brown sludge material, no crust material observed

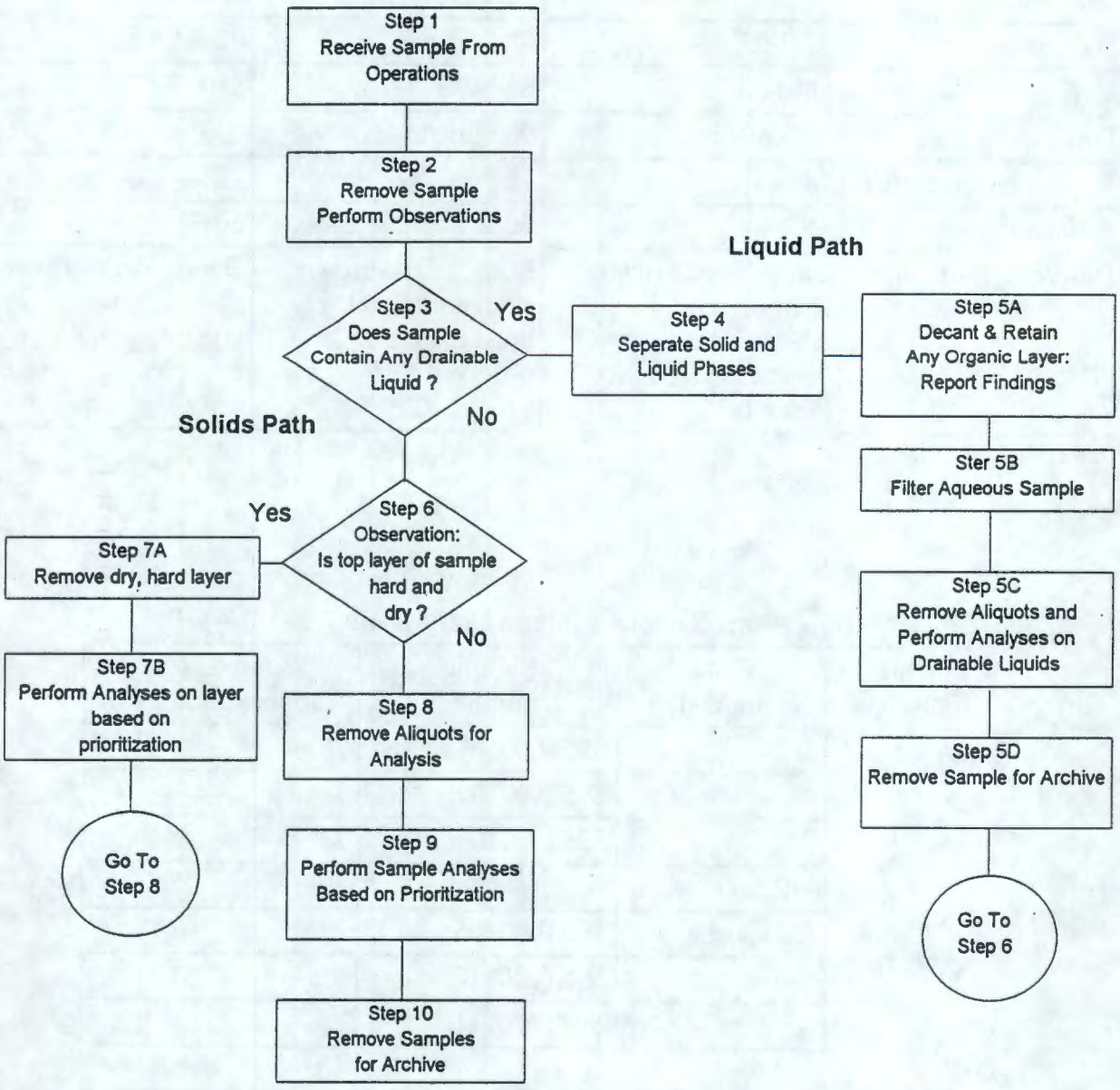
Notes:
mR/h = milliroentgens per hour.
g = gram.

Table 3-3. Auger Sampling Information for Tank 241-AW-101.

Riser number	Flute number	Sample number	Sample size (approximate) (g)
13A	1-3	S95T000107	26
	4	S95T000102	3
	9	S95T000103	2
	4-9	--	49
	Composite	S95T000106	--
12A	5-6	S95T000110	0.5
	9	S95T000111	2
	4-9	--	10
24B	6	S95T000113	1
	10	S95T000114	3
	6-10	--	15

Note:
g = gram.

Figure 3-2. Flowchart for 1995 Sample Analysis.



3.3.2 Sample Analysis (1995)

All three auger samples were analyzed in accordance with the general sampling and analysis scheme, which assumed that an adequate sample (including a dry crust layer) existed to perform all analyses. Before sample removal and breakdown began, a delegate of the Flammable Gas and Safety Program was present to observe the breakdown procedures and guide the laboratory in the case of an unusual sample. The primary purpose of this sampling event is to determine the maximum net exothermic energy in the crust samples. Therefore, the auger cask and liner must remain in the vertical position to preserve waste stratification and prevent interstitial liquid from coming into contact with a dry crust layer. The net exothermic energy is expected to be greatest in areas of low moisture content. The sample must remain unhomogenized to yield an accurate evaluation of the safety boundary. However, this can also result in greater scatter (decreased precision) of analytical results.

The Flammable Gas and Safety Program and the laboratories have decided that for the purposes of this sampling event the required precision and accuracy would be ± 20 percent. This is a reasonable level for the laboratories to achieve while being stringent enough to satisfy the purposes of the Program. These samples were analyzed to support the crust burn safety issue.

The 40-day initial report contains results for DSC and TGA (WHC 1995a) for all samples. Because the net exothermic energy was significantly below 140 calories/gram (cal/g) (586 joules/gram [J/g]), Reactive System Screening Tool - Adiabatic Calorimetry (RSST) and radiochemical analyses were not required, and the crust burn issue was closed.

The 136-day report contains results for TIC and TOC (WHC 1995b). All the samples met the accuracy and precision criteria set for this analysis scheme. There were no notification limits for this analysis. All results met the accuracy criteria set for this sampling scheme except for S95T000114 (95-AUG-005), which was slightly outside of the 20 percent precision range. No rerun was ordered because of the heterogenous nature of these samples (WHC 1995b). All results were well below the notification limit of 30,000 μg/g. The TGA and the DSC, TIC, and TOC analysis results are discussed in Section 4.0. See Appendix E, Table E-2 for a complete list of procedure numbers for these samples.

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4.0 ANALYTICAL RESULTS AND WASTE INVENTORY

4.1 OVERVIEW

The purpose of this section is to summarize the sampling and analytical results from each of the sampling events as reported in the appendixes. Table 4-1 summarizes the location of data in this document.

Table 4-1. Analytical Data Presentation Tables.

Analyte	Tabulated result location
Supernate chemical composition summary from the 1990 sampling event	Table 4-2
Crust chemical composition summary from the 1995 sampling event	Table 4-3
Analytical data results for the 1987 core sampling event	Appendix A
Analytical data summary for the 1990 sampling event	Appendix C
Analytical data results for the 1990 sampling event	Appendix D
Analytical data results for the 1995 total carbon analyses	Appendix F

4.2 DATA PRESENTATION

A summary of the data obtained from the analyses of the supernate samples derived from the 1990 sampling event is presented in Table 4-2. The 1990 supernate samples from Tank 241-AW-101 provided a full spectrum of chemical and radiochemical analyses. The data include analyses pertaining to metals, radionuclides, ions, organic carbon, organic complexants, and a limited amount of physical characterization. The individual sample and composite results associated with the 1990 supernate samples are located in Appendix D. Individual sample data were used for the evaluation of each analyte unless composite data were the only available data.

Table 4-2. Tank 241-AW-101 Chemical Composition Data Summary from Analysis of 1990 Supernate Samples (3 sheets).

Analyte	Mean concentration	Standard deviation (data)	Calculated mean concentration	Projected tank inventory
Metal	**M**	**M**	**μg/mL**	**kg**
Al	1.03	0.0350	27,900	1.10E+05
As	<1.33E-07	--	<0.00996	<0.0392
Ba	<6.80E-05	--	<9.32	<36.7
Bi	<5.79E-04	--	<121	<476
Cd	<1.08E-04	--	<1.21	<4.76
Ca	8.26E-04	7.05E-04	33.1	130
Cr	0.00309	0.00143	161	632
Cu	<3.81E-04	--	<24.2	<95.3
Fe	<7.86E-04	--	<43.9	<173
Pb	<0.00146	--	<302	<1,190
Mg	0.00216	0.00205	52.4	206
Mn	4.76E-04	6.54E-04	26.1	103
Hg	<0.157 mg/L	--	<0.157	<0.617
Mo	6.00E-04	4.04E-05	57.5	226
K	1.07	0.201	41,800	1.64E+05
Se	4.20E-07	1.38E-07	0.0331	0.131
Si	<0.00436	--	<123	<483
Ag	<3.09E-04	--	<33.4	<131
Na	10.0	0.310	2.30E+05	9.06E+05
Ti	<9.88E-05	--	<4.73	<18.6
U	9.39E-04	1.99E-04	224	880
Zn	<0.00484	--	<317	<1,250
Zr	<5.54E-04	--	<50.5	<199
Ions	**M**	**M**	**μg/mL**	**kg**
NH_3/NH_4^+	0.0145	0.00212	247	971
CO_3^{2-}	0.205	0.0623	12,300	48,500
Cl^-	0.146	0.0114	5,180	20,400
CN^-	0.00103	2.83E-05	26.8	105

Table 4-2. Tank 241-AW-101 Chemical Composition Data Summary from Analysis of 1990 Supernate Samples (3 sheets).

Analyte	Mean concentration	Standard deviation (data)	Calculated mean concentration	Projected tank inventory
Ions (continued)	M	M	μg/mL	kg
OH^-	5.07	0.115	86,200	3.40E+05
F^-	<0.00402	--	<76.3	<300
NO_3^-	3.46	0.119	2.14E+05	8.44E+05
NO_2^- (IC)	2.21	0.104	1.02E+05	4.01E+05
NO_2^- (spec)	2.16	0.0560	99,500	3.92E+05
PO_4^{3}	0.0222	0.0152	2,110	8,300
SO_4^{2-}	0.0107	0.00448	1,030	4,060
Radionuclides	μCi/L	μCi/L	μCi/mL	Ci
^{241}Am	1.20	0.376	0.00120	4.74
$^{243/244}Cm$	0.107	0.00919	1.07E-04	0.421
^{14}C	0.370	0.0113	3.70E-04	1.47
^{134}Cs	1,530	49.0	1.53	6,010
^{137}Cs	5.20E+05	17,400	520	2.05E+06
^{60}Co	<29.6	--	<0.0296	<117
^{129}I	0.303	0.0750	3.03E-04	1.19
^{94}Nb	<68.2	--	<0.0682	<269
^{237}Np	<0.00306 g/L	--	<3.06 μg/mL	<12.0 kg
$^{239/240}Pu$	1.15	0.149	0.00115	4.51
$^{106}Ru/Rh$	<3,700	--	<3.70	<14,600
^{79}Sr	0.480	0.0226	4.80E-04	1.89
$^{89/90}Sr$	1,090	77.8	1.09	4,270
^{99}Tc	152	33.9	0.152	598
Tritium[1]	7.07	0.410	0.00707	27.8
Physical properties				
Percent water	43.6%	1.98%		
Density	1.56 g/mL	0.0240 g/mL		

Table 4-2. Tank 241-AW-101 Chemical Composition Data Summary from Analysis of 1990 Supernate Samples (3 sheets).

Analyte	Mean concentration	Standard deviation (data)	Calculated mean concentration	Projected tank inventory
Carbon	g/L	g/L	μg C/mL	kg
Total organic carbon	2.46	0.0990	2,460	9,690

Notes:
Ci = curie.
g/L = gram/liter.
g/mL = gram/milliliter.
IC = Ion chromatography.
kg = kilogram.
M = moles/liter.
mg/L = milligram/liter.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.
μg C/mL = microgram carbon/milliliter.
μg/mL = microgram/milliliter.
[1]Standards were not within the statistical control limits for the analytical methods.

The mean concentration and the corresponding standard deviation of the data are listed, in units of molarity, in the second and third columns following the name of the analyte being examined. These values were statistically derived by Westinghouse Hanford Company personnel and may be found in WHC-SD-WM-TRP-055, *Tank 241-AW-101 Characterization Results* (Welsh 1991). The data are listed in standard notation for values >0.001 and <100,000. Values outside these limits are listed in scientific notation. Numbers that are preceded by a less than (<) symbol indicate that the analyte was noted, but was below the analytical instrument's calibrated detection limit. The fourth column lists a calculated mean, which is a conversion of the molarity value to units of microgram/milliliter (μg/mL) or microcurie/milliliter (μCi/mL). The converted numbers are included for ease of comprehension and further conversions to projected tank inventories. The final column lists a calculated projected inventory. This value is a product of the concentration of the analyte and the volume of the supernate in the tank (3,937 kL or 1,040 kgal).

The 1995 auger samples were obtained based on the data quality objective (DQO) process. The DQO that governs the sampling and subsequent sample analysis is WHC-SD-WM-DQO-003, *Data Requirements Developed Through the Data Quality Objectives Process for the Crust Burn Issue Associated with Flammable Gas Tanks* (Johnson 1994). The DQO stipulates that thermodynamic analyses (TGA and DSC) and an evaluation of total carbon (organic and inorganic carbon) content be examined. The thermodynamic data are discussed in Section 4.3.2 of this report. The total carbon data associated with the 1995 sampling event are tabulated in Appendix F of this report and summarized in Table 4-3.

Table 4-3. Tank 241-AW-101 Crust (1995) Total Carbon Data Summary.

Analyte	Sample Type and Location	Sample Number	Riser/Flute Numbers	Result (μg/g)
TOC	Composite	S95T000106	13A/All	6,520
	Crust	S95T000107	13A/1-3	4,840
	Material from lower half of auger	S95T000111	12A/9	7,140
	Material from lower half of auger	S95T000114	24B/10	11,800
TIC	Composite	S95T000106	13A/All	8,400
	Crust	S95T000107	13A/1-3	8,640
	Material from lower half of auger	S95T000111	12A/9	4,840
	Material from lower half of auger	S95T000114	24B/10	3,100

Notes:
μg/g = microgram/gram.
TOC = total organic carbon.
TIC = total inorganic carbon.

In Table 4-3, the first column lists the analyte. The second, third, and fourth columns provide sample information such as sample, riser, and flute numbers as well as sample type and location. The last column is the specific concentration of the analyte, determined at the different sampling points. As specified in the Tank Characterization Plan (Sathyanarayana 1995), only one aliquot from each auger was taken for the TIC and TOC analyses. An additional aliquot was taken from the crust material.

4.3 PHYSICAL MEASUREMENTS AND THERMODYNAMIC ANALYSES

This report uses the data obtained from the June 28, 1990, sampling event for the density measurements. Twelve samples obtained from three risers and a composite sample were analyzed.

In addition to the 1990 samples, three auger samples from Tank 241-AW-101 were analyzed to support the crust burn safety issue in 1995 and used for the thermodynamic characterization of the waste in Tank 241-AW-101. These samples were analyzed for percent water by TGA and for total energy content by DSC. The following discussion describes the results of these analyses.

4.3.1 Density

The density measurements were obtained from the 1990 supernate samples. Table 4-4 displays a summary of the density analytical results obtained during this sampling event. A presentation of the individual sample results may be seen in Appendix D.

Table 4-4. Tank 241-AW-101 Density Results from the 1990 Supernate Sample.

Sample location	Analytical result	Estimated mean
Density	g/mL	g/mL
Composite	1.54	1.54
Riser 16C sample analysis	1.56	1.56
Riser 10A sample analysis	1.58	
Riser 22A sample analysis	1.56	

Notes:
g/mL = gram/milliliter.

4.3.2 Thermodynamic Analyses

Thermogravimetric analysis and DSC were performed on the Tank 241-AW-101 auger samples. The TGA and DSC determine the thermal stability or reactivity of a material. The TGA measures the mass of a sample while the temperature of the sample is increased at a constant rate. Air is passed over the sample during heating. Any decrease in the weight of a sample represents a loss of gaseous matter from the sample either through evaporation or through a reaction that forms gas phase products.

The percent water by TGA was performed on a Mettler Model 20 thermogravimetric analyzer, using procedure LA-560-112, Rev. A-2, with an air purge. All the 1995 samples for the safety screen met the accuracy and precision criteria of 20 percent (further discussed in Section 5.1.2). The results were all within the range of 31.81 to 42.46 percent water. Table 4-5 shows the TGA results. A typical TGA scan for a Tank 241-AW-101 sample is shown in Figure G-1 of Appendix G.

In DSC analysis, heat absorbed or emitted by a substance is measured while the substance is exposed to a linear increase in temperature. While the substance is being heated, air is passed over the waste material to remove any gases being released. The onset temperature for an endothermic or exothermic event is determined graphically.

The DSC analysis for the 1995 crust burn investigation was performed using procedure LA-514-113, Rev. B-1, and a Mettler Model 20 differential scanning calorimeter under an air purge. No results exceeded the exotherm notification exotherm limit of -586 J/g. One sample, S95T000107, exceeded the precision limit of 20 percent. This sample was from the upper portion of the auger retrieved from Riser 13A. The initial sample result was -86.4 J/g and the duplicate was 0 J/g. A third sample was run giving a result of -111.3 J/g. The duplicate had a second endotherm at 300 °C (572 °F) that did not appear in the other two analyses. No further reruns were requested due to the small exotherm, the dose rate, and the heterogeneous nature of this sample. All samples met the accuracy criterion of 20 percent. The results for the DSC analyses are reported in Table 4-6. By convention, exotherms are assigned a negative value. A typical DSC scan for a Tank 241-AW-101 sample is shown in Figure G-2 of Appendix G.

Table 4-5. Thermogravimetric Analysis Results for Tank 241-AW-101.

Analyte	Laboratory sample number	Sample location	Sample description	Result (a)	Duplicate (b)	Mean	RPD (%)
		Riser:flute		%	%	%	%
% H_2O TGA	S95T000107	13A:1-3	Crust	41.33	41.01	41.17	0.78
	S95T000102	13A:4	upper ½ of auger	38.82	37.24	38.03	4.15
	S95T000103	13A:9	lower ½ of auger	39.94	40.62	40.28	1.69
	S95T000110	12A:5-6	upper ½ of auger	41.90	42.13	42.02	0.547
	S95T000111	12A:9	lower ½ of auger	39.21	38.75	38.98	1.18
	S95T000113	24B:6	upper ½ of auger	31.81	35.80	33.80	11.8
	S95T000114	24B:10	lower ½ of auger	42.46	38.13	40.30	10.7

Notes:
Data derived from WHC, 1995a, *Tank Characterization 40-Day Crust Burn Report for Double-Shell Tank 241-AW-101*, WHC-SD-WM-DP-097, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
TGA = Thermogravimetric analysis.
RPD = Relative Percent Difference = The absolute difference of a and b, divided by their mean.

Table 4-6. Differential Scanning Calorimetry Results for Tank 241-AW-101.

Sample number	Run	Transition 1		Transition 2		Transition 3		Transition 4	
		Peak °C	ΔH	Peak °C	ΔH	Peak °C	ΔH	Peak °C	ΔH
S95T000107	1	133	1,280	400	-86.4	--	--	--	--
	2	124	614	302	91.1	--	--	--	--
	3	133	1,080	326	-111	--	--	--	--
S95T000102	1	130	1,130	241	-14.7	316	-30.5	432	-77.7
	2	131	984	239	-13.1	318	-24.2	422	-62.3
S95T000110	1	135	1,090	316	-114	--	--	--	--
	2	141	993	231	5.9	322	-129	--	--
S95T000103	1	132	842	251	-102	--	--	--	--
	2	124	623	203	35.2	260	-112	--	--
S95T000111	1	137	979	233	20.5	320	-72.4	--	--
	2	135	962	233	31.0	318	-69.8	--	--
S95T000113	1	135	977	322	-169	--	--	--	--
	2	132	1,040	322	-173	--	--	--	--
S95T000114	1	130	957	235	18.0	326	-102	--	--
	2	137	877	235	23.0	324	-100	--	--

Notes:
Data derived from WHC, 1995a, *Tank Characterization 40-Day Crust Burn Report for Double-Shell Tank 241-AW-101*, WHC-SD-WM-DP-097, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
ΔH = change in enthalpy.
C = Celsius.

The dry weight calculations for the exothermic energy were calculated using the sum of measured exotherms within an individual sample run. The dry weight was calculated using the initial percent water value reported for the sample. Because of the heterogeneous nature of these samples, this method of calculation may introduce additional precision and accuracy errors because two different TGA values are used in the calculation. This is exemplified in sample S95T000102 by the increase in the relative percent difference (RPD) between the sample and duplicate. The RPD for the exothermic energy based on wet weight for this sample was 20.9 percent, while the RPD for the calculated dry weight was 23.3 percent.

Table 4-7 presents the total energy for the DSC results from Tank 241-AW-101 requested by the Flammable Gas and Safety Program cognizant scientist. The first column gives the sample and run numbers. The second column shows the sum of the exothermic energy values of all transitions observed for the first run of each sample. The third column lists the results calculated by dividing the values from the second column by the solids fraction of the sample (i.e., 1 - average water weight fraction as determined by TGA). The fourth column shows the sum of the endothermic energy values of all transitions observed for the first run of each sample. The fifth column is the sum of the second and fourth columns.

Table 4-7. Total Energy for Tank 241-AW-101.

Sample Number/Run	Total Exothermic Energy (Wet)	Total Exothermic Energy (Dry)	Total Endothermic Energy (Wet)	Net Energy (Wet)
	J/g	J/g	J/g	J/g
S95T000107/1	-86.4	-147	1,280	1,190
S95T000102/1	-123	-201	1,130	1,010
S95T000110/1	-114	-190	1,090	976
S95T000103/1	-102	-175	842	740
S95T000111/1	-72.4	-119	1,000	928
S95T000113/1	-169	-248	977	808
S95T000114/1	-102	-177	975	873

Notes:
Source: WHC, 1995a, *Tank Characterization 40-Day Crust Burn Report for Double-Shell Tank 241-AW-101*, WHC-SD-WM-DP-097, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
J/g = Joules/gram.

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

This section evaluates sampling and analysis factors that may impact interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify any limitations in its use.

5.1.1 Field Observations

Observations from each of the three sampling events described in this report (1987, 1990, and 1995) may impact the use and/or interpretation of the data.

In the 1987 sampling event, only one core of the heel was taken, so the representativeness of the sample is uncertain. Also, solids were observed to precipitate out of the decanted supernate sample. The fact that this sample was from the supernatant/sludge interface within the tank is worth mentioning, and may have an influence on the amount of solids that precipitated and the resulting estimated analyte concentrations. Solids formed because the liquid is saturated with salts. The temperature of the sample decreases when it is removed from the tank, which causes additional salts to precipitate. This effect is minimized by reheating and diluting subsamples with additional water. It may be possible that some precipitation reactions are not totally reversible and, therefore, the analysis may not exactly reflect the analyte concentration as it exists in the tank.

In the 1990 sampling event, a situation occurred that was similar to the 1987 supernatant sampling. Solids that precipitated had to be dissolved back into solution before analysis. Measurements to obtain an accurate estimate of the amount of settled or dissolved solids were not made, thus their varying impact on the sample results from the 12 different locations is unknown. Photographs of the 12 samples in bottles showed varying amounts of precipitated solids, and colors ranging from yellowish to dark brown.

In the 1995 crust sampling event, eight inches of sample were expected to be recovered from each auger. Although the lengths of the recovered samples were not mentioned in WHC (1995a), the estimated recoveries ranged from 60 to 85 percent, and the recovery of the actual samples ranged from 12 to 78 g. Only one of the augers recovered material from flutes 1 through 3, and those flutes contained the only crystalline crust material found. With the other two augers, the heaviest accumulation of material was on the lowest two flutes. Because these augers were subsampled into upper and lower portions, the upper portions may have been subject to more drying, leading to inconsistency in the data and a possible low bias in the TGA results. All these issues may have an impact on the representativeness of the samples.

5.1.2 Quality Control Assessment

The appropriate blanks, duplicates, spikes, and standards for quality control measures were performed on the 1990 grab sample and 1995 auger sample analyses. No quality control information was provided with the 1987 sampling data package. Regarding the 1990 supernate grab samples, matrix spikes were not requested or required. None of the blanks conducted were detected at levels that would indicate contamination of the samples. All relative percent differences (RPDs) were within the specified limits except for several associated with the individual potassium results. Reruns were requested and all subsequent RPDs were acceptable; however, the rerun standards were slightly outside the criteria. The only other standard outside the limits was for the composite tritium results. Thus, generally speaking, the quality control information available with the 1990 supernate results indicate that the data was of high quality and reliable.

Regarding the 1995 sampling event, the tank characterization plan (Sathyanarayana 1994) established a criterion of $\pm$ 20 for the accuracy and precision of the data. The standard and spike results provide an estimate of the accuracy of the analysis. All the standard results were in the acceptable range and met the criteria. Spikes were only conducted on TIC and TOC, and both were within the limits. Blank values were above the detection limit for all the TIC and TOC analyses, but were <1 percent of the analytical results; thus, sample contamination was not a problem. Spike recoveries and method blanks are not applicable to the DSC/TGA methods. The relative percent difference (RPD) exceeded the 20 percent criterion for one of the TOC results (23.7 percent). A rerun was not requested because of the nonhomogeneous nature of the samples. None of the percent water analyses exceeded the RPD criterion, but one DSC sample exceeded the precision limits (RPD >20 percent). This sample was from the portion of Riser 13A that consisted of crust material mixed with sludge. The initial sample result was 86.4 J/g and the duplicate was 0 J/g. A third sample was run giving a result of 111.3 J/g. No further reruns were requested due to the small exotherm, the dose rate, and the heterogeneous nature of the samples.

5.1.3 Data Consistency Checks

Data consistency checks were only able to be performed for the supernate results. Lack of results for certain analyses limited this assessment to a comparison of individual and composite sample results for the grab samples and a mass and charge balance. Data consistency comparisons were not possible for the 1995 auger samples.

5.1.3.1 Comparison of Individual and Composite Sample Results. A statistical comparison between the mean calculated from the 12 individual sample results and the mean calculated from the composite sample results was conducted to determine whether the two results were consistent. Table 5-1 lists the calculated means for all analytes in which both the individual and the composite analyses were conducted. Statistical analysis was conducted only for those analytes which had all detected values. Significant differences were found between the two means for 7 of the analytes (indicated in column 5 as a "yes"), and no differences were found between the two means for 11 of the analytes (indicated in column 5 as a "no") (Welsh 1991).

Table 5-1. Estimated Mean Concentrations of Supernate Based on Individual Sampling Location and Composite Results (2 sheets).

Analyte	Units	Individual results concentration	Composite results concentration	Significant difference
Metals				
Al	M	1.03	1.29	Yes
Ba	M	<6.80E-05	<4.43E-06	--
Bi	M	<5.79E-04	<5.50E-05	--
Cd	M	<1.08E-05	<5.88E-05	--
Ca	M	8.25E-04	1.54E-03	No
Cr	M	3.09E-03	4.57E-03	No
Cu	M	<3.81E-04	<4.005E-05	--
Fe	M	<7.86E-04	1.46E-03	--
Pb	M	<1.46E-03	5.24E-04	--
Mg	M	2.16E-03	3.55E-04	No
Mn	M	4.76E-04	8.84E-04	No
Hg	mg/L	<0.157	<0.0217	--
Mo	M	6.00E-04	8.09E-04	Yes
K	M	1.07	1.26	No
Si	M	<4.36E-03	9.39E-03	--
Ag	M	<3.09E-04	<2.32E-05	--
Na	M	10.0	13.4	Yes
Ti	M	<9.88E-05	<2.35E-06	--
Zn	M	<4.84E-03	1.44E-04	--
Zr	M	<5.54E-04	<2.13E-05	--
Anions				
CO_3^{2-}	M	0.205	0.206	No
Cl^-	M	0.146	0.162	No
H^-	M	5.07	4.73	Yes
F^-	M	<4.02E-03	<1.06E-03	--
$^1NO_2^-$	M	2.16	2.28	Yes
$^2NO_2^-$	M	2.21	2.17	No
NO_3^-	M	3.46	3.62	No
PO_4^{3-}	M	0.0222	<2.13E-03	--
SO_4^{2-}	M	0.0107	0.0226	Yes

Table 5-1. Estimated Mean Concentrations of Supernate Based on Individual Sampling Location and Composite Results (2 sheets).

Analyte	Units	Individual results concentration	Composite results concentration	Significant difference
Physical properties				
Density	g/mL	1.56	1.54	No
Radionuclides				
^{134}Cs	μCi/L	1,530	1,090	Yes
^{137}Cs	μCi/L	5.20E+05	4.89E+05	No
^{60}Co	μCi/L	<29.6	<61.3	--
^{94}Nb	μCi/L	<68.2	<85.4	--
$^{106}RuRh$	μCi/L	<3,700	<4,560	--

Notes:
[1]Analyzed by spectrophotometry.
[2]Analyzed by ion chromatography.
M = moles/liter.
mg/L = milligram/liter.
g/mL = gram/milliliter.
μCi/L = microcuries/liter.

Because Tank 241-AW-101 contains a crust of solidified material, it was speculated that this may have caused the discrepancies in the data. Each of the 12 individual samples exhibited some solids, and some crystalline formations also were seen. If the samples were allowed to cool upon preparation of the composite, the saturated solutions would form solids which may have been entrained into the aliquots. If the aliquot from the original samples contained more (or less) solids than it should have, the composite sample result would be a higher (or lower) constituent concentration. It was also noted that after the composite sample was made, the metal analyte holding times were exceeded before the sample analysis. However, it is unlikely that this is responsible for the observed differences.

Even though there is a statistical difference between the means of the composite and individual results, this difference may not be large enough to impact the use of the data. Aluminum and sodium show the largest differences between the two results, but this could be associated with the solubility/solids issue. ^{134}Cs, molybdenum, and sulfate are minor or trace constituents, and the differences between the two means for hydroxide and spectrophotometric nitrite were significant, but small.

5.1.3.2 Mass and Charge Balance. The principal objective in performing a mass and charge balance is to determine if the measurements are self-consistent. In calculating the balances, only supernate analytes listed in Table 4-2 that were detected at a concentration of 1,000 μg/mL or greater were considered. Table 5-2 lists the cations used to calculate the mass and charge balance for Tank 241-AW-101.

Table 5-2. Cation Mass and Charge Data.

Analyte	Concentration (μg/mL)	Assumed species	Concentration of assumed species (μg/mL)	Charge (μeq/mL)
K	41,800	K^+	41,800	1,070
Na	2.30E+05	Na^+	2.30E+05	10,000
Totals			272,000 (174,000 μg/g)	11,100

Notes:
μg/mL = microgram/milliliter.
μeq/mL = microequivalent/milliliter.
μg/g = microgram/gram.

The anionic analytes listed in Table 5-3 were assumed to be present as sodium or potassium salts and were expected to balance the positive charge. The acetate data were derived from the TOC analysis. Aluminum was assumed to be present as the aluminate anion, AlO_2^-, which was calculated stoichiometrically from the inductively coupled plasma data for aluminum. There may be some argument whether or not the species in question are aluminate or tetrahydroxoaluminate, but the difference in their molecular weights has a minimal effect on the overall mass balance and no effect on the charge balance. Although smaller concentrations of other forms of aluminum are probably also present in the waste, they are not included in order to keep the mass-charge balance calculations simple and consistent. The concentrations of the cations in Table 5-2, of the anionic species in Table 5-3, and the percent water were ultimately used to calculate the mass balance, shown in Table 5-4.

The mass balance was calculated from the following formula. The factor 6.41E-05 is the conversion factor from μg/mL to weight percent, considering a density of 1.56 gram/milliliter (g/mL).

Mass balance = percent water + 6.41E-05 x {total analyte concentration}
= percent water + 6.41E-05 x $\{Na^+ + K^+ + C_2H_3O_2^- + CO_3^{2-} + AlO_2^- + Cl^- + OH^- + NO_3^- + NO_2^- + PO_4^{3-} + SO_4^{2-}\}$

The total analyte concentrations calculated from the above equation were 488,000 μg/g. The mean weight percent water reported in Table 5-4 is 43.6. The mass balance resulting from adding the percent water to the total analyte concentration is 92.4 percent. This is reasonable considering the uncertainty in estimating the correct analyte speciation and the error in analytical results.

Table 5-3. Anion Mass and Charge Data.

Analyte	Concentration (μg/mL)	Charge (μeq/mL)
Acetate (TOC)*	6,050 (2,460)	103
Carbonate	12,300	410
Aluminate	61,000	1,030
Chloride	5,180	146
Hydroxide	86,200	5,070
Nitrate	2.14E+05	3,450
Nitrite	1.02E+05	2,220
Phosphate	2,110	67
Sulfate	1,030	21
Totals	490,000 (314,000 μg/g)	12,500

Notes:
*The value in parentheses is from the TOC analytical result, and is used to derive the acetate value on the left.
μg/mL = microgram/milliliter.
μeq/mL = microequivalent/milliliter.
μg/g = microgram/gram.
TOC = Total organic carbon.

Table 5-4. Mass Balance Totals.

	Concentrations (μg/g)
Total from Table 5-2	174,000
Total from Table 5-3	314,000
Water	436,000
Total	924,000

Note:
μg/g = microgram/gram.

The charge balance is the ratio of total cations (microequivalents) to total anions (microequivalents) with respect to the following species, which were assumed to be water soluble.

Total cations (microequivalents) = $Na^+/23.0 + K^+/39.1$
The total cation charge, 11,100 microequivalents/milliliter, is calculated in Table 5-2.

Total anions (microequivalents) = $C_2H_3O_2^-/59.0 + CO_3^{2-}/30.0 + AlO_2^-/59.0 + Cl^-/35.5 + OH^-/17.0 + NO_3^-/62.0 + NO_2^-/46.0 + PO_4^{3-}/31.7 + SO_4^{2-}/48.0$
The total anion charge, 12,500 microequivalents/milliliter, is calculated in Table 5-3.

The ratio of microequivalents of total cations to microequivalents of total anions was 0.89, which is reasonable. A perfect charge balance would yield a ratio equivalent to 1.00.

5.2 COMPARISON OF RESULTS FROM DIFFERENT SAMPLING EVENTS

No direct, unbiased comparisons between the three sampling events were possible. The most logical comparison would have been the 1990 supernate samples and the 1987 supernate composite. This was not done because the 1987 supernate was taken from just above the sludge "heel" at the bottom of the tank, whereas the 1990 sampling included material throughout the entire supernate layer.

5.3 TANK WASTE INVENTORY PROFILE

Three waste layers are known to exist in Tank 241-AW-101: an upper supernatant layer composing approximately 93 percent of the tank contents (Hanlon 1995), a lower heel and a crust layer of indeterminate thickness on top or near the surface of the supernatant layer. Information gathered from the 1995 auger sampling was insufficient to quantify the thickness of the crust layer. Because of the limited amount of sample recovered and the fact that the samples were not homogenized, the data from the 1995 crust burn sampling event were not included in any attempt to establish a vertical trend in the tank waste. However, the 1990 supernate sampling event was extensive, and an analysis was conducted to determine if the contents of this waste layer were homogeneous.

Tank 241-AW-101 is not in a cascade series with any other tank; however, Riser 22A is closer to the tank waste inlet than the other two risers from which 1990 supernatant samples were taken. This may predispose the sample from this location to have higher analyte concentrations than at the other locations. However, the following statistical analysis did not find enough significant differences between the risers to conclude that waste concentrations at this riser were any higher than at the other risers.

Because twelve different sampling locations were chosen to characterize the tank waste, a fairly complete analysis of the supernatant waste disposition was possible. A one-way analysis of variance (ANOVA) was performed for each tank constituent reported as a detected value. The purpose of this statistical procedure was to determine whether the analyte concentrations were the same or different between the 12 different sampling locations. Photographs of the 12 supernatant samples did not reveal any clear visual trend between risers or segments. Precipitated solids and minor color variations were apparent in all samples, but did not correspond to any definable pattern.

The results of the ANOVA indicated that significant differences (at the $\alpha = 0.05$ level) did not exist between the 12 sample means for calcium, chromium, magnesium, molybdenum, chloride, hydroxide, nitrite (both methods), nitrate, sulfate, ^{134}Cs, ^{137}Cs, and density. Significant differences were found for aluminum, manganese, potassium, sodium, carbonate, and phosphate. A multiple comparison test known as Tukey's honestly significant difference was conducted to determine which sample means were different. The results did not find any consistent horizontal or vertical pattern to the differences in these sample means. In other words, it could not be said that there was a trend of increasing or decreasing concentration as a function of depth, or that one particular riser showed higher or lower concentrations in general than the other two. Also, the measurement variability for aluminum, manganese, potassium, and sodium may have been underestimated and thus the conclusion of significant differences between the sample means from different locations may be incorrect. Therefore, it can generally be said that the 12 individual sample analytical results indicate that the tank supernate was homogeneous (Welsh 1991).

5.4 COMPARISON OF ANALYTICAL AND TRANSFER HISTORY INFORMATION

It is difficult to reconcile the transfer history with analytical data because a full characterization of the heel and crust has not been performed, and the concentration of chemical constituents is unknown. Also, historical tank content estimates are not yet available. The supernate analytical results from the 1990 sampling event generally agree with what would be expected from the historical uses of this tank. High concentrations of aluminum, sodium, NO_3^-, NO_2^-, CO_3^{2-}, and OH^- were found as expected from the concentrated PXMSC and other dilute miscellaneous waste (shown in Table 2-2). Large quantities of PO_4^{3-} and SO_4^{2-} were also expected to be found, although the supernate analytical results did not reflect as high an amount as expected. Again, the missing PO_4^{3-} and SO_4^{2-} may be present in the heel. Analytes found in greater quantities than anticipated from the process history include potassium, Cl^-, and chromium. Minor amounts of organic carbon are characteristic of PXMSC. Organic carbon was found both in the supernate and crust, possibly in concentrations greater than was expected based on the value in Table 2-2. The only radionuclide expected to be in the waste in substantial amounts was ^{137}Cs, which was supported by the supernate results. Finally, the predicted density and percent water values were fairly consistent with the determined results from the supernate.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

Only one of the two sampling events being used to characterize the waste in Tank 241-AW-101 was specifically governed by a DQO. The potential for a crust burn was assessed by comparing the data from the 1995 auger samples with the decision criteria listed in WHC-SD-WM-DQO-003, *Data Requirements Developed Through the Data Quality Objectives Process for the Crust Burn Issue Associated with Flammable Gas Tanks* (Johnson 1994). The 1990 grab samples were acquired before the existence of DQOs; however, for informational purposes, comparisons have still been made between results from this sampling event and criteria discussed in WHC-SD-WM-SP-004, *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The analytical results from the 1987 core sample were limited. They were presented as historical information only and were not used to characterize the waste in Tank 241-AW-101.

5.5.1 Safety Evaluation

The data criteria identified in the crust burn DQO were used to assess the potential for a secondary ignition of organic-nitrate/nitrite mixtures in the crust layer initiated by the burning of flammable gases or by a mechanical in-tank energy source (such as friction during core sampling). The DQO specified the analysis of three primary components: net exothermic energy by DSC, moisture content by TGA, and TOC.

Although exotherms were found in all but one sample, none exceeded the notification limit of 586 J/g. The largest observed exotherm of 248 J/g was over two times smaller than the limit. In addition, the total energy (sum of endotherms and exotherms) for each sample was endothermic; therefore, none of the DQO-specified secondary analyses were needed. No decision criteria were established for the TGA results under the crust burn DQO. The TGA results ranged from 33.8 to 42.0 percent water, with an average of 39.2 percent. The upper region of the crust sample had a TGA value of 41.2 percent. The TOC results ranged from 4,840 μg/g for the upper crust sample to 11,800 μg/g for the other regions. The largest result was recorded in the sludge from the lower half of auger sample #95-AUG-005. All results were well below the notification limit of 30,000 μg/g. Additionally, TIC analyses were performed. No decision limits were established for these analyses, and it appeared that none of the samples contained excessive amounts of inorganic carbon, as the greatest value was 8,640 μg/g.

The data criteria identified in the safety screening DQO (Babad and Redus 1994) can be compared to the results from the 1990 grab samples for a rudimentary safety screening of the waste. A true safety screening of these samples is not possible because the sampling was not done to the DQO specifications and DSC analysis and TGA were not performed.

Although a DSC analysis was not performed on the 1990 grab samples, the waste fuel content can be evaluated by reviewing TOC and cyanide results. The TOC concentration of the supernate is ~0.16 percent wet weight (~0.28 percent dry weight at 43.6 percent

water), which is well below the 5 percent TOC (dry weight) criteria established by the organic safety program (Babad et al. 1994). Results from cyanide analyses reveal that the cyanide concentration in the supernate is 0.0017 percent (wet weight), which is nearly 300 times below the 0.5 percent limit listed in the ferrocyanide DQO (Meacham et al. 1994). This is consistent with what was expected because there is no historical basis to expect large concentrations of cyanide.

A weight percent water determination by evaporation showed that the supernate was 43.6 percent water. Although low for a supernate sample, the result more than satisfies the 17 percent safety screening criterion.

The potential for criticality is assessed from either total alpha or plutonium analysis. The safety screening criterion is 1 gram/liter (g/L). This is equivalent to 61.5 μCi/mL of $^{239/240}$Pu in the waste, using the specific activity of $^{239/240}$Pu. The 1990 grab sample data revealed that the supernate contained 0.00115 μCi/mL of $^{239/240}$Pu, which is far below the safety screening limit. Because the plutonium inventory is <10 kg, there is no restriction on the pH of the waste. Results from the 1987 core sample demonstrated that the sludge was TRU contaminated (>100 nCi/g total TRU) (Weiss 1987), but the highest $^{239/240}$Pu concentration was far below the criticality limit.

Another factor in assessing the safety of the tank waste is the heat generation and temperature of the wastes. Heat is generated in the tanks primarily from radioactive decay. The major contributors for Tank 241-AW-101 from the supernate are ^{134}Cs, ^{137}Cs and $^{89/90}$Sr. The estimated heat generated from these isotopes in the supernate is 33,300 Btu/h (9,760 watts), which although significant, is still below the 70,000 Btu/h (20,500 watts) operating limit for the tanks in the AW Tank Farm (Harris 1994). Data for the sludge from the 1987 core sample were not included in Table 5-5 because the heat generated from the evaluated isotopes was negligible. However, ^{90}Sr, the principal heat contributor, was not analyzed in those samples. Thermocouple readings in the tank since 1989 have ranged from 25 °C (77 °F) to 43 °C (109 °F). Because an upper temperature limit is exhibited, it may be concluded that any heat generated from radioactive sources throughout the year is dissipated.

The flammability of the gas in the headspace of a tank is an additional safety screening consideration. Analysis of the tank head space is outside the scope of this report.

Table 5-5. Tank 241-AW-101 Projected Heat Load.

Radionuclide	Curies	Watts
^{134}Cs	6,010	61
^{137}Cs	2.05E+06	9,680
$^{89/90}$Sr	4,270	21
Total watts		9,760

5.5.2 Operational Evaluations

Tank 241-AW-101 is in active service; however, because of the safety issues surrounding the tank, waste has not been received since 1986. The tank is now included on the Flammable Gas Watch List, and it is unlikely that it will receive or transfer waste until this safety issue is resolved. Consequently, a compatibility assessment for the supernate was not relevant. It should be noted that the density of the 1990 supernate samples was 1.56 gram/milliliter (g/mL), exceeding the compatibility criterion of 1.41 g/mL (Fowler 1995). This matter should be investigated further before supernate is removed from the tank.

5.5.3 Environmental Evaluation

The 1990 waste samples from Tank 241-AW-101 were taken to determine if grout would be an environmentally acceptable waste treatment. However, this is no longer applicable. Other Tank 241-AW-101 waste samples were not characterized with regard to any environmental compliance issues. They have been characterized to resolve the crust burn safety issue. Analyses were performed to determine the concentration of many volatile and semivolatile organic compounds. None of the organic compounds tested were detected. The supernate contains a relatively high level of chromium which is an environmentally sensitive metal. Such metals are important in the environmental assessment of the waste and must be considered before final disposal. The pH of the supernate is above 12.5. In addition, the supernate contains high concentrations of dissolved salts that must be considered in making disposal decisions.

5.5.4 Process Development Evaluation

A full characterization of the sludge, including physical properties, may be needed before the waste can be evaluated for disposal and vitrification formulations. The need for additional sampling and analysis of the sludge will be assessed through the DQO process.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

The crust in Tank 241-AW-101 was sampled in 1995 to address the crust burn safety issue. All results satisfied the decision limits listed in the crust burn DQO (Johnson 1994). None of the observed exotherms exceeded the 586 J/g threshold, as the largest one measured 248 J/g. All TOC results were below the 30,000 μg/g limit, ranging from 4,840 to 11,800 μg/g. The weight percent water values ranged from 33.8 to 42.0 percent. Results from the 1987 core sample indicated that the sludge heel was TRU contaminated, containing more than 100 nCi/g of $^{239/240}$Pu and ^{241}Am but was well below the criticality limit.

The sampling and analysis of the 1990 supernate samples did not fully meet the requirements of the safety screening DQO. However, when the results were compared with the DQO limits, all criteria were satisfied. The supernate contained large quantities of Al, Na, NO_3^-, NO_2^-, CO_3^{2-}, and OH^-, as expected from PXMSC and other dilute miscellaneous waste which had been concentrated in the 242-A Evaporator. Substantial amounts of K, Cl^-, and PO_4^{3-} also were found. The major radionuclide detected was ^{137}Cs as expected. Also, the amounts of organic carbon observed in both the supernate and sludge are characteristic of PXMSC.

The heat generated by the isotopes in the supernate is 33,300 Btu/h (9,760 watts), which is less than the 70,000 Btu/h (20,500 watts) operating limit for tanks in the AW Tank Farm (Harris 1994). The radionuclides analyzed in the 1987 core sample had a negligible impact on the calculated heat load. However, ^{90}Sr was not evaluated in the core sample. When the tank is core sampled in the future, an analysis for ^{90}Sr should be performed to accurately determine the heat load of the tank waste and ascertain if the heat load will exceed the 40,000 Btu/h (11,700 watts) threshold. A more comprehensive chemical analysis of the sludge layer would provide a more accurate estimate of the tank chemical inventory.

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APPENDIX A

ANALYTICAL RESULTS
DOUBLE-SHELL TANK 241-AW-101
1987 SAMPLING RESULTS

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LIST OF TABLES

A-1 1987 Core Sample Analysis for Tank 241-AW-101 . . . . . A-5

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Table A-1. 1987 Core Sample Analysis for Tank 241-AW-101[1].

Analyte	Sample source			
	Supernate composite (nCi/L)	Upper segment $HCl/HNO_3/HF$ (nCi/g)	Upper segment HCl dissolution (nCi/g)	Lower segment $HCl/HNO_3/HF$ (nCi/g)
$^{239/240}Pu$	0.82	14.7	11.5	92.1
^{241}Am	2.2	25.8	18.4	248.5
Np	.0002	<0.01	<0.01	<0.01
U	.0058 (g/L)	0.4(μg/g)	0.4 (μg/g)	0.4 (μg/g)
^{134}Cs[2]	—	2,685	2,830	1,560
^{137}Cs	548,000	341,000	351,000	230,000
$^{106}Ru/Rh$[2]	—	45,800	46,800	—
$^{144}Ce/Pr$[2]	—	—	—	48,500

Notes:
[1]Source: Weiss, R.L., 1987, *Results of Analysis of Tank 241-AW-101 Heel Samples*, Internal Memo 65453-87-105 to W.G. Richmond, Westinghouse Hanford Company, Richland, Washington.

[2]These isotopes have short half-lives and would not be present in significant quantities today.

nCi/g = nanocurie/gram.
nCi/L = nanocurie/liter.
μg/g = microgram/gram.
g/L = grams/liter.

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APPENDIX B

1990 SAMPLE NUMBERS

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LIST OF TABLES

B-1 1990 Grab Sample Numbers for Tank 241-AW-101 . . . . . B-5

B-2 1990 Composite Sample Numbers for Tank 241-AW-101 . . . . . B-7

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Table B-1. 1990 Grab Sample Numbers for Tank 241-AW-101 (2 pages).[1]

Tank sample number	AC sample number	AL sample number	Tank sample number	AC sample number	AL sample number
R4792	APH-287	R7912	**R4795**	APH-290	R7915
	APH-300	R7929		APH-303	R7934
	APH-313	R7948		APH-316	R7951
	APH-325	R7964		APH-328	R7969
	APH-337	R7873		APH-340	R7876[2]
	APH-349	R7889		APH-352	R7894
R4793	APH-288	R7913	**R4796**	APH-291	R7916
	APH-301	R7930		APH-304	R7935
	APH-314	R7949		APH-317	R7952
	APH-326	R7965		APH-329	R7970
	APH-338	R7874[2]		APH-341	R7877[2]
	APH-350	R7890		APH-353	R7895
R4794	APH-289	R7914	**R4797**	APH-292	R7919
	APH-302	R7933		APH-305	R7936
	APH-315	R7950		APH-318	R7955
	APH-327	R7966		APH-330	R7971
	APH-339	R7875[2]		APH-342	R7880[2]
	APH-351	R7891		APH-354	R7896
R4798	APH-293	R7920	**R4801**	APH-296	R7923
	APH-306	R7937		APH-309	R7942
	APH-319	R7956		APH-322	R7959
	APH-331	R7972		APH-334	R7977
	APH-343	R7881[2]		APH-346	R7884[2]
	APH-355	R7897		APH-358	R7802
R4799	APH-294	R7921	**R4802**	APH-297	R7926
	APH-307	R7940		APH-310	R7943
	APH-320	R7957		APH-323	R7962
	APH-332	R7973		APH-335	R7978
	APH-344	R7882[2]		APH-347	R7887
	APH-356	R7898		APH-359	R7903

Table B-1. 1990 Grab Sample Numbers for Tank 241-AW-101 (2 pages).[1]

Tank sample number	AC sample number	AL sample number	Tank sample number	AC sample number	AL sample number
R4800	APH-295	R7922	**R4803**	APH-298	R7927
	APH-308	R7941		APH-311	R7944
	APH-321	R7958		APH-324	R7963
	APH-333	R7976		APH-336	R7979
	APH-345	R7883[2]		APH-348	R7888
	APH-357	R7901		APH-360	R7904

Notes:
[1]Source: Welsh, T. L., 1991, *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-055, Rev. B, Westinghouse Hanford Company, Richland, Washington.

[2]Sample lost.

AC = Analytical chemistry.
AL = Analytical laboratory.

Table B-2. 1990 Composite Sample Numbers for Tank 241-AW-101[1].

AC sample number	AL sample number
APH-368	R8795
APH-369	R8796
APH-370	R8798
APH-371	R8799
APH-372	R8801
APH-373	R8802
APH-374	R8804
APH-375	R8805

Notes:
[1]Source: Welsh, T. L., 1991, *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-055, Rev. B, Westinghouse Hanford Company, Richland, Washington.

AC = Analytical chemistry.
AL = Analytical laboratory.

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APPENDIX C

ANALYTICAL RESULTS SUMMARY
DOUBLE-SHELL TANK 241-AW-101
1990 SAMPLING EVENT

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APPENDIX C

ANALYTICAL RESULTS SUMMARY DOUBLE-SHELL TANK 241-AW-101 1990 SAMPLING EVENT

C.1 INTRODUCTION

This appendix presents a summary of the data for the chemical, radiological, and physical characteristics associated with the 1990 sampling event of tank 241-AW-101. The result from the analyses are presented in tabular form. The individual sample results for each analyte may be seen in Appendix D of this report.

The data table for each analyte lists the analyte abbreviation along with the method of laboratory analysis, the type of sample (composite or single sample) used for the evaluation, the number of samples used for each evaluation, an analytical data result for each sample, and a projected inventory. The data are listed in standard notation for values >0.001 and <100,000. Values outside these limits are listed in scientific notation.

C.2 COLUMN HEADINGS

The "Analyte" column contains, in addition to the abbreviated name of the analyte or physical characteristic, information about the method of measurement.

The "Type of sample" column lists the type of sample from which the results were obtained, either composite or segment. The types are abbreviated in the table as C (composite) and S (individual supernate samples). Sample data were used for the evaluation of each analyte unless composite data were the only available data.

Column three, "Number of samples," displays the number of samples used in the evaluation of the analyte.

"Mean," column four, is the mean of the analytes concentration obtained from the different sampling points. This information may be obtained from Appendix D of this report.

Table C-1. 1990 Grab Sample Analytical Data Summary for Tank 241-AW-101 (3 sheets).

Analyte	Type of sample	Number of samples	Mean	Standard deviation of the data	Calculated mean	Projected inventory
Metal	(C or S)		M	M	µg/mL	kg
ICP.Al	S	12	1.033	0.0350	27,900	1.10E+05
AAS.As	C	2	<1.33E-07	--	<0.00996	<0.0392
ICP.Ba	S	12	<6.80E-05	--	<9.32	<36.7
ICP.Bi	S	12	<5.79E-04	--	<121	<476
ICP.Cd	S	12	<1.08E-04	--	<1.21	<4.76
ICP.Ca	S	12	8.26E-04	7.05E-04	33.1	130
ICP.Cr	S	12	0.00309	0.00143	161	632
ICP.Cu	S	12	<3.81E-04	--	24.2	95.3
ICP.Fe	S	12	<7.86E-04	--	<43.9	<173
ICP.Pb	S	12	<0.00146	--	<302	<1,190
ICP.Mg	S	12	0.00216	0.00205	52.4	206
ICP.Mn	S	12	4.76E-04	6.54E-04	26.1	103
AAS.Hg	S	12	<0.157 mg/L	--	<0.157	<0.617
ICP.Mo	S	12	6.00E-04	4.04E-05	57.5	226
ICP.K	S	12	1.07	0.201	41,800	1.64E+05
AAS.Se	C	2	4.20E-07	1.38E-07	0.0331	0.131
ICP.Si	S	12	<0.00436	--	<123	<483
ICP.Ag	S	12	<3.09E-04	--	<33.4	<131
ICP.Na	S	12	10.0	0.310	2.30E+05	9.06E+05
ICP.Ti	S	12	<9.88E-05	--	<4.73	<18.6
LF.U	C	2	9.39E-04	1.99E-04	224	880
ICP.Zn	S	12	<0.00484	--	<317	<1,250
ICP.Zr	S	12	<5.54E-04	--	<50.5	<199
Ions			M	M	µg/mL	kg
NH_3/NH_4^+	C	2	0.0145	0.00212	247	971
CO_3^{2-}	S	12	0.205	0.0623	12,300	48,500
IC.Cl^-	S	12	0.146	0.0114	5,180	20,400
Dist.CN^-	C	2	0.00103	2.83E-05	26.8	105
IC.F^-	S	12	<0.00402	--	<76.3	<300

Table C-1. 1990 Grab Sample Analytical Data Summary for Tank 241-AW-101 (3 sheets).

Analyte	Type of sample	Number of samples	Mean	Standard deviation of the data	Calculated mean	Projected inventory
Ions (cont)			M	M	µg/mL	kg
Titra.OH^-	S	12	5.07	0.115	86,200	3.40E+05
IC.NO_3^-	S	12	3.46	0.119	2.14E+05	8.44E+05
IC.NO_2^-	S	12	2.21	0.104	1.02E+05	4.01E+05
Spec.NO_2^-	S	12	2.16	0.0560	99,500	3.92E+05
IC.PO_4^{3-}	S	12	0.0222	0.0152	2,110	8,300
IC.SO_4^{2-}	S	12	0.0107	0.00448	1,030	4,060
Radchem			µCi/L	µCi/L	µCi/mL	Ci
AEA.^{241}Am	C	2	1.20	0.376	0.00120	4.74
AEA.$^{243/244}$Cm	C	2	0.107	0.00919	1.07E-04	0.421
LSC.^{14}C	C	2	0.370	0.0113	3.70E-04	1.47
GEA.^{134}Cs	S	12	1,530	49.0	1.53	6,010
GEA.^{137}Cs	S	12	5.20E+05	17,400	520	2.05E+06
GEA.^{60}Co	S	12	<29.6	--	<0.0296	<117
GEA.^{129}I	C	2	0.303	0.0750	3.03E-04	1.19
AEA.^{237}Np	C	2	<2.16	--	<0.00216	<8.50
GEA.^{94}Nb	S	12	<68.2	--	<0.0682	<269
AEA.$^{239/240}$Pu	C	2	1.15	0.149	0.00115	4.51
GEA.^{106}Ru/Rh	S	12	<3,700	--	<3.70	<14,600
LSC.^{79}Se	C	2	0.480	0.0226	4.80E-04	1.89
BPC.$^{89/90}$Sr	C	2	1,090	77.8	1.09	4,270
LSC.^{99}Tc	C	2	152	33.9	0.152	598
LSC.^{3}H	C	2	7.07	0.410	0.00707	27.8
Physical properties						
Grav.wt%H_2O	C	2	43.6% H_2O	1.98%		
Density	S	12	1.56 g/mL	0.0240 g/mL		

Table C-1. 1990 Grab Sample Analytical Data Summary for Tank 241-AW-101 (3 sheets).

Analyte	Type of sample	Number of samples	Mean	Standard deviation of the data	Calculated mean	Projected inventory
Carbon			g/L	g/L	μg/mL	kg
TOC	C	2	2.46	0.0990	2,460	9,690

Notes:
Ci = curie.
g/L = gram/liter.
g/mL = gram/milliliter.
kg = kilogram.
mg/L = milligram/liter.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.
μg/mL = microgram/milliliter.
TOC = Total organic carbon.

The standard deviation of the data column lists values statistically derived by Westinghouse Hanford Personnel and reported in WHC-SD-WM-TRP-005, *Tank 241-AW-101 Characterization Results* (Welsh 1991).

The "Calculated mean" is the laboratory-listed mean converted, using the appropriate conversion factors, into standard metric units. This function was performed for ease of readability and to achieve units that are usable for the conversion into the tank inventory.

"Projected inventory" is the product of the concentration of the analyte and the volume of the waste in the tank (3,937 kiloliter [kL] or 1,040 kilogallon [kgal]).

C.3 REFERENCES

Welsh, T. L., 1991. *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-005, Rev. B, Westinghouse Hanford Company, Richland, Washington.

APPENDIX D

ANALYTICAL RESULTS
DOUBLE-SHELL TANK 241-AW-101
1990 SAMPLING EVENT

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APPENDIX D

ANALYTICAL RESULTS
DOUBLE-SHELL TANK 241-AW-101
1990 SAMPLING EVENT

D.1 INTRODUCTION

This Appendix presents the chemical, radiological, and physical characteristics from the 1990 sampling event of tank 241-AW-101. These characteristics are presented in tabular form in terms of the specific concentrations of metals, ions, radionuclides, physical properties, total carbon, and semivolatile and volatile compounds.

The data table for each analyte lists the laboratory sample identification number, a description of where the sample was obtained, an analytical data result for each sample, an evaluated sample mean, a standard deviation of the data, and a projected tank inventory for the particular analyte using the highest concentration as a base. The projected tank inventory column is not applicable for the physical properties. The data are listed in standard notation for values >0.001 and <100,000. Values outside these limits are listed in scientific notation.

D.2 TABLE DESCRIPTION

The tables in this appendix are divided into groups dependent on the characteristics of the analytes. The tables are divided as described in the following table.

Analyte characteristic	Table number
Metals	Table D-1
Ions (anions and cations)	Table D-2
Radionuclides	Table D-3
Physical properties	Table D-4
Total organic carbon	Table D-5
Semivolatile organics	Table D-6
Volatile organics	Table D-7

Standard abbreviations are used in the tables to describe analytical methods and analytes. The abbreviations used for the analytes are the common labels as described on a periodic table of the elements. The abbreviations used to describe analytical methods are shown in the following table.

Metals	ICP - Inductively coupled plasma (generic for all metals unless otherwise specified)
	AAS - Atomic absorption spectrometry
Ions	IC - Ion chromatography
	Titra - Titration
	Dist/Spec - Distillation and spectrometry
	Spec - Spectrometry
Radionuclides	GEA - Gamma energy analysis
	AEA - Alpha energy analysis
	BPC - Beta proportional counting
	LSC - Liquid scintillation counting
	LF - Laser fluorimetry
Physical properties	TOC - Total organic carbon
	Evap. - Evaporation
Volatile organics	GC/MS - Gas chromatography/mass spectrometry

D.3 COLUMN HEADINGS

The "Analyte" column contains, in addition to the abbreviated name of the analyte or physical characteristic, information about the method of measurement.

The "Sample number" column lists the laboratory sample from which the analyte was measured; this identification number is different from the number assigned to the samples at the tank farm at the time of sampling. Sampling rationale, locations, and descriptions of the sampling events are contained in Section 3.0 of this report.

Column three, "Sample identification," describes the riser and depth from which each sample was derived. The first set of numbers lists the riser number from which the sample was obtained. This number is followed by a colon and another number which correlates with the depth at which the sample was taken, measured from the bottom of the tank.

"Sample Result" is the specific concentration of the analyte, in molarity, determined at the different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. This information may be obtained from WHC-SD-WM-TRP-055, *Tank 241-AW-101 Characterization Results* (Welsh 1991).

The number listed is an average between the primary sample and its duplicate sample. Where more than one duplicate sample was performed, the primary sample was averaged with all the duplicates.

Numbers that are preceded by a less than symbol (<) indicate the analyte was noted, but was below the analytical instrument's calibrated detection limit for the sample.

The "Sample mean" column was statistically derived by Westinghouse Hanford Company personnel. These data may be obtained from WHC-SD-WM-TRP-055, *Tank 241-AW-101 Characterization Results* (Welsh 1991).

Column six, "Standard deviation of the data," was statistically derived by Westinghouse Hanford Company personnel. These data may be obtained from WHC-SD-WM-TRP-055, *Tank 241-AW-101 Characterization Results* (Welsh 1991).

"Calculated mean" is the sample mean from column five, converted to units of microgram/milliliter (μg/mL) or microcurie/milliliter (μCi/mL). The converted numbers are included for ease of comprehension and for further conversions to projected tank inventories.

Column eight, "Projected inventory," is the product of the concentration of the analyte and the volume of the waste in the tank (3,937 kiloliter [kL] or 1,040 kilogallon [kgal]). The following formula is used to convert the calculated mean to the projected inventory.

(Waste volume)(mean concentration)(conversion factors) = projected inventory

Example:
Aluminum proj. inv. (kg) = 3,937 kL (27,900 μg/ml)(1.00E+06 mL/kL)
(kg/1.00E+09 μg/g)

9613456.0246

Table D-1A. Tank 241-AW-101 Analytical Data for 1990 Sample: Aluminum.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Al	R8795	Composite	1.30	1.29			
	R8796		1.28				
ICP.Al	R7889	16C:94	1.030	1.033	0.0350	27,900	1.10E+05
	R7890	16C:138	1.045				
	R7891	16C:291	1.050				
	R7894	16C:387	0.9510				
	R7895	10A:55	1.035				
	R7896	10A:150	1.015				
	R7897	10A:241	1.105				
	R7898	10A:338	1.030				
	R7901	22A:52	1.040				
	R7902	22A:170	1.040				
	R7887 R7903	22A:260	1.045				
	R7888 R7904	22A:367	1.008				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.

Table D-1B. Tank 241-AW-101 Analytical Data for 1990 Sample: Arsenic.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	μg/mL	kg
AAS.As	R8798	Composite	<1.33E-07	<1.33E-07	N/A	<0.00996	<0.0392
	R8799		<1.33E-07				

Notes:
kg = kilogram.
μg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1C. Tank 241-AW-101 Analytical Data for 1990 Sample: Barium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Ba	R8795	Composite	6.25E-06	<4.43E-06			
	R8796		<2.60E-06				
ICP.Ba	R7889	16C:94	<6.62E-05	<6.80E-05	N/A	<9.32	<36.7
	R7890	16C:138	<6.62E-05				
	R7891	16C:291	<6.62E-05				
	R7894	16C:387	<8.81E05				
	R7895	10A:55	<6.62E-05				
	R7896	10A:150	<6.62E-05				
	R7897	10A:241	<6.62E-05				
	R7898	10A:338	<6.62E-05				
	R7901	22A:52	<6.62E-05				
	R7902	22A:170	<6.62E-05				
	R7887/R7903	22A:260	<6.62E-05				
	R7888/R7904	22A:367	<6.62E-05				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1D. Tank 241-AW-101 Analytical Data for 1990 Sample: Bismuth.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Bi	R8795	Composite	<5.50E-05	<5.50E-05			
	R8796		<5.50E-05				
ICP.Bi	R7889	16C:94	<5.79E-04	<5.79E-04	N/A	<121	<476
	R7890	16C:138	<5.79E-04				
	R7891	16C:291	<5.79E-04				
	R7894	16C:387	<5.79E-04				
	R7895	10A:55	<5.79E-04				
	R7896	10A:150	<5.79E-04				
	R7897	10A:241	<5.79E-04				
	R7898	10A:338	<5.79E-04				
	R7901	22A:52	<5.79E-04				
	R7902	22A:170	<5.79E-04				
	R7887/R7903	22A:260	<5.79E-04				
	R7888/R7904	22A:367	<5.79E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

9613456.0240

Table D-1E. Tank 241-AW-101 Analytical Data for 1990 Sample: Cadmium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Cd	R8795	Composite	6.28E-05	5.88E-05			
	R8796		5.47E-05				
ICP.Cd	R7889	16C:94	<1.08E-04	<1.08E-04	N/A	<1.21	<4.76
	R7890	16C:138	<1.08E-04				
	R7891	16C:291	<1.08E-04				
	R7894	16C:387	<1.08E-04				
	R7895	10A:55	<1.08E-04				
	R7896	10A:150	<1.08E-04				
	R7897	10A:241	<1.08E-04				
	R7898	10A:338	<1.08E-04				
	R7901	22A:52	<1.08E-04				
	R7902	22A:170	<1.08E-04				
	R7887/R7903	22A:260	<1.08E-04				
	R7888/R7904	22A:367	<1.08E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1F. Tank 241-AW-101 Analytical Data for 1990 Sample: Calcium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	μg/mL	kg
ICP.Ca	R8795	Composite	0.00156	0.00154			
	R8796		0.00151				
ICP.Ca	R7889	16C:94	4.15E-04	8.26E-04	7.05E-04	33.1	130
	R7890	16C:138	4.48E-04				
	R7891	16C:291	4.18E-04				
	R7894	16C:387	0.00146				
	R7895	10A:55	0.00257				
	R7896	10A:150	5.57E-04				
	R7897	10A:241	0.00174				
	R7898	10A:338	4.96E-04				
	R7901	22A:52	5.07E-04				
	R7902	22A:170	4.14E-04				
	R7887/R7903	22A:260	4.68E-04				
	R7888/R7904	22A:367	4.27E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-1G. Tank 241-AW-101 Analytical Data for 1990 Sample: Chromium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Cr	R8795	Composite	0.00469	0.00457			
	R8796		0.00446				
ICP.Cr	R7889	16C:94	0.00246	0.00309	0.00143	161	632
	R7890	16C:138	0.00239				
	R7891	16C:291	0.00242				
	R7894	16C:387	0.00717				
	R7895	10A:55	0.00426				
	R7896	10A:150	0.00245				
	R7897	10A:241	0.00372				
	R7898	10A:338	0.00263				
	R7901	22A:52	0.00243				
	R7902	22A:170	0.00227				
	R7887/R7903	22A:260	0.00221				
	R7888/R7904	22A:367	0.00267				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.

Table D-1H. Tank 241-AW-101 Analytical Data for 1990 Sample: Copper.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Cu	R8795	Composite	4.58E-05	<4.00E-05			
	R8796		<3.41E-05				
ICP.Cu	R7889	16C:94	<3.81E-04	<3.81E-04	N/A	24.2	95.3
	R7890	16C:138	<3.81E-04				
	R7891	16C:291	<3.81E-04				
	R7894	16C:387	<3.80E-04				
	R7895	10A:55	<3.81E-04				
	R7896	10A:150	<3.81E-04				
	R7897	10A:241	<3.81E-04				
	R7898	10A:338	<3.81E-04				
	R7901	22A:52	<3.81E-04				
	R7902	22A:170	<3.81E-04				
	R7887/R7903	22A:260	<3.81E-04				
	R7888/R7904	22A:367	<3.81E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1I. Tank 241-AW-101 Analytical Data for 1990 Sample: Iron.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Fe	R8795	Composite	0.00149	0.00146			
	R8796		0.00143				
ICP.Fe	R7889	16C:94	<4.33E-04	<7.86E-04	N/A	<43.9	<173
	R7890	16C:138	<4.33E-04				
	R7891	16C:291	<4.33E-04				
	R7894	16C:387	0.00183				
	R7895	10A:55	0.00212				
	R7896	10A:150	<4.33E-04				
	R7897	10A:241	0.00159				
	R7898	10A:338	<4.33E-04				
	R7901	22A:52	<4.33E-04				
	R7902	22A:170	<4.33E-04				
	R7887/R7903	22A:260	<4.33E-04				
	R7888/R7904	22A:367	<4.33E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

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Table D-1J. Tank 241-AW-101 Analytical Data for 1990 Sample: Lead.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Pb	R8795	Composite	5.60E-04	5.24E-04			
	R8796		4.87E-04				
ICP.Pb	R7889	16C:94	<0.00146	<0.00146	N/A	<302	<1,190
	R7890	16C:138	<0.00146				
	R7891	16C:291	<0.00146				
	R7894	16C:387	<0.00146				
	R7895	10A:55	<0.00146				
	R7896	10A:150	<0.00146				
	R7897	10A:241	<0.00146				
	R7898	10A:338	<0.00146				
	R7901	22A:52	<0.00146				
	R7902	22A:170	<0.00146				
	R7887/R7903	22A:260	<0.00146				
	R7888/R7904	22A:367	<0.00146				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

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Table D-1K. Tank 241-AW-101 Analytical Data for 1990 Sample: Magnesium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Mg	R8795	Composite	3.66E-04	3.55E-04			
	R8796		3.44E-04				
ICP.Mg	R7889	16C:94	0.00284	0.00216	0.00205	52.4	206
	R7890	16C:138	5.28E-04				
	R7891	16C:291	3.04E-04				
	R7894	16C:387	0.00572				
	R7895	10A:55	0.00168				
	R7896	10A:150	<1.37E-04				
	R7897	10A:241	3.74E-04				
	R7898	10A:338	0.00421				
	R7901	22A:52	0.00196				
	R7902	22A:170	7.04E-04				
	R7887/R7903	22A:260	0.00169				
	R7888/R7904	22A:367	0.00572				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1L. Tank 241-AW-101 Analytical Data for 1990 Sample: Manganese.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Mn	R8795	Composite	9.06E-04	8.84E-04			
	R8796		8.61E-04				
ICP.Mn	R7889	16C:94	1.21E-04	4.76E-04	6.54E-04	26.1	103
	R7890	16C:138	1.27E-04				
	R7891	16C:291	1.09E-04				
	R7894	16C:387	0.00133				
	R7895	10A:55	2.04E-04				
	R7896	10A:150	9.36E-05				
	R7897	10A:241	1.01E-04				
	R7898	10A:338	8.46E-05				
	R7901	22A:52	0.00197				
	R7902	22A:170	1.85E-04				
	R7887/R7903	22A:260	0.00128				
	R7888/R7904	22A:367	1.14E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

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Table D-1M. Tank 241-AW-101 Analytical Data for 1990 Sample: Mercury.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	mg/L	mg/L	mg/L	µg/mL	kg
AAS.Hg	R8798	Composite	0.0334	<0.0217			
	R8799		<0.0100				
AAS.Hg	R7912/R7929	16C:94	<0.177	<0.157	N/A	<0.157	<0.617
	R7913/R7930	16C:138	<0.165				
	R7914/R7933	16C:291	<0.165				
	R7915/R7934	16C:387	<0.165				
	R7916/R7935	10A:55	<0.165				
	R7919/R7936	10A:150	<0.165				
	R7920/R7937	10A:241	<0.110				
	R7921/R7940	10A:338	<0.110				
	R7922/R7941	22A:52	<0.165				
	R7923/R7942	22A:170	<0.165				
	R7926/R7943	22A:260	<0.165				
	R7927/R7944	22A:367	<0.165				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1N. Tank 241-AW-101 Analytical Data for 1990 Sample: Molybdenum.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	μg/mL	kg
ICP.Mo	R8795	Composite	8.33E-04	8.09E-04			
	R8796		7.84E-04				
ICP.Mo	R7889	16C:94	6.01E-04	6.00E-04	4.04E-05	57.5	226
	R7890	16C:138	5.65E-04				
	R7891	16C:291	6.25E-04				
	R7894	16C:387	5.65E-04				
	R7895	10A:55	6.03E-04				
	R7896	10A:150	5.74E-04				
	R7897	10A:241	5.65E-04				
	R7898	10A:338	5.34E-04				
	R7901	22A:52	6.20E-04				
	R7902	22A:170	6.32E-04				
	R7887/R7903	22A:260	6.75E-04				
	R7888/R7904	22A:367	6.38E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1O. Tank 241-AW-101 Analytical Data for 1990 Sample: Potassium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	μg/mL	kg
ICP.K	R8795	Composite	1.26	1.26			
	R8796		1.26				
ICP.K	R7889	16C:94	1.20	1.07	0.201	41,800	1.64E+05
	R7890	16C:138	1.19				
	R7891	16C:291	1.16				
	R7894	16C:387	0.910				
	R7895	10A:55	0.963				
	R7896	10A:150	0.964				
	R7897	10A:241	0.956				
	R7898	10A:338	0.919				
	R7901	22A:52	0.989				
	R7902	22A:170	0.857				
	R7887/R7903	22A:260	1.09				
	R7888/R7904	22A:367	0.924				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1P. Tank 241-AW-101 Analytical Data for 1990 Sample: Selenium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
AAS.Se	R8798	Composite	3.22E-07	4.20E-07	1.38E-07	0.0331	0.131
	R8799		5.17E-07				

Notes:
kg = kilogram.
µg/mL = microgram/milliliter.

Table D-1Q. Tank 241-AW-101 Analytical Data for 1990 Sample: Silicon.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Si	R8795	Composite	0.00965	0.00939			
	R8796		0.00912				
ICP.Si	R7889	16C:94	<0.00421	<0.00436	N/A	<123	<483
	R7890	16C:138	<0.00419				
	R7891	16C:291	<0.00360				
	R7894	16C:387	<0.00710				
	R7895	10A:55	<0.00360				
	R7896	10A:150	<0.00360				
	R7897	10A:241	<0.00360				
	R7898	10A:338	<0.00360				
	R7901	22A:52	<0.00527				
	R7902	22A:170	<0.00438				
	R7887/R7903	22A:260	<0.00493				
	R7888/R7904	22A:367	<0.00429				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1R. Tank 241-AW-101 Analytical Data for 1990 Sample: Silver.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Ag	R8795	Composite	<2.32E-05	<2.32E-05			
	R8796		<2.32E-05				
ICP.Ag	R7889	16C:94	<3.09E-04	<3.09E-04	N/A	<33.4	<131
	R7890	16C:138	<3.09E-04				
	R7891	16C:291	<3.09E-04				
	R7894	16C:387	<3.08E-04				
	R7895	10A:55	<3.09E-04				
	R7896	10A:150	<3.09E-04				
	R7897	10A:241	<3.09E-04				
	R7898	10A:338	<3.09E-04				
	R7901	22A:52	<3.09E-04				
	R7902	22A:170	<3.09E-04				
	R7887/R7903	22A:260	<3.09E-04				
	R7888/R7904	22A:367	<3.09E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

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Table D-1S. Tank 241-AW-101 Analytical Data for 1990 Sample: Sodium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	μg/mL	kg
ICP.Na	R8795	Composite	13.4	13.4			
	R8796		13.4				
ICP.Na	R7889	16C:94	10.4	10.0	0.310	2.30E+05	9.06E+05
	R7890	16C:138	10.4				
	R7891	16C:291	10.1				
	R7894	16C:387	9.46				
	R7895	10A:55	10.2				
	R7896	10A:150	9.88				
	R7897	10A:241	10.2				
	R7898	10A:338	9.66				
	R7901	22A:52	10.3				
	R7902	22A:170	9.64				
	R7887/R7903	22A:260	10.3				
	R7888/R7904	22A:367	9.87				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-1T. Tank 241-AW-101 Analytical Data for 1990 Sample: Titanium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	μg/mL	kg
ICP.Ti	R8795	Composite	<2.35E-06	<2.35E-06			
	R8796		<2.35E-06				
ICP.Ti	R7889	16C:94	<9.88E-05	<9.88E-05	N/A	<4.73	<18.6
	R7890	16C:138	<9.88E-05				
	R7891	16C:291	<9.88E-05				
	R7894	16C:387	<9.84E-05				
	R7895	10A:55	<9.88E-05				
	R7896	10A:150	<9.88E-05				
	R7897	10A:241	<9.88E-05				
	R7898	10A:338	<9.88E-05				
	R7901	22A:52	<9.88E-05				
	R7902	22A:170	<9.88E-05				
	R7887/R7903	22A:260	<9.88E-05				
	R7888/R7904	22A:367	<9.88E-05				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1U. Tank 241-AW-101 Analytical Data for 1990 Sample: Uranium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
LF.U	R8801	Composite	0.00108	9.39E-04	1.99E-04	224	880
	R8802		7.98E-04				

Notes:
kg = kilogram.
µg/mL = microgram/milliliter.

Table D-1V. Tank 241-AW-101 Analytical Data for 1990 Sample: Zinc.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Zn	R8795	Composite	1.49E-04	1.44E-04			
	R8796		1.39E-04				
ICP.Zn	R7889	16C:94	<0.00591	<0.00484	N/A	<317	<1,250
	R7890	16C:138	<0.00305				
	R7891	16C:291	<0.00560				
	R7894	16C:387	0.0128				
	R7895	10A:55	<0.00566				
	R7896	10A:150	<0.00123				
	R7897	10A:241	<0.00706				
	R7898	10A:338	0.00228				
	R7901	22A:52	0.00116				
	R7902	22A:170	0.00236				
	R7887/R7903	22A:260	0.00508				
	R7888/R7904	22A:367	0.00591				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-1W. Tank 241-AW-101 Analytical Data for 1990 Sample: Zirconium.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Metal		Riser:depth	M	M	M	µg/mL	kg
ICP.Zr	R8795	Composite	<2.13E-05	<2.13E-05			
	R8796		<2.13E-05				
ICP.Zr	R7889	16C:94	<5.54E-04	<5.54E-04	N/A	<50.5	<199
	R7890	16C:138	<5.54E-04				
	R7891	16C:291	<5.54E-04				
	R7894	16C:387	<5.54E-04				
	R7895	10A:55	<5.54E-04				
	R7896	10A:150	<5.54E-04				
	R7897	10A:241	<5.54E-04				
	R7898	10A:338	<5.54E-04				
	R7901	22A:52	<5.54E-04				
	R7902	22A:170	<5.54E-04				
	R7887/R7903	22A:260	<5.54E-04				
	R7888/R7904	22A:367	<5.54E-04				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-2A. Tank 241-AW-101 Analytical Data for 1990 Sample: Ammonia.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
NH_3	R8798	Composite	0.0130	0.0145	0.00212	247	971
	R8799		0.0160				

Notes:
kg = kilogram.
μg/mL = microgram/milliliter.

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Table D-2B. Tank 241-AW-101 Analytical Data for 1990 Sample: Carbonate.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
TOC.CO_3^{2-}	R8801	Composite	0.204	0.206			
	R8802		0.208				
TOC.CO_3^{2-}	R7912/R7929	16C:94	0.175	0.205	0.0623	12,300	48,500
	R7913/R7930	16C:138	0.160				
	R7914/R7933	16C:291	0.158				
	R7915/R7934	16C:387	0.217				
	R7916/R7935	10A:55	0.236				
	R7919/R7936	10A:150	0.173				
	R7920/R7937	10A:241	0.187				
	R7921/R7940	10A:338	0.175				
	R7922/R7941	22A:52	0.385				
	R7923/R7942	22A:170	0.185				
	R7926/R7943	22A:260	0.233				
	R7927/R7944	22A:367	0.182				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-2C. Tank 241-AW-101 Analytical Data for 1990 Sample: Chloride.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
IC.Cl^-	R8801	Composite	0.169	0.162			
	R8802		0.154				
IC.Cl^-	R7912/R7929	16C:94	0.139	0.146	0.0114	5,180	20,400
	R7913/R7930	16C:138	0.139				
	R7914/R7933	16C:291	0.138				
	R7915/R7934	16C:387	0.129				
	R7916/R7935	10A:55	0.160				
	R7919/R7936	10A:150	0.160				
	R7920/R7937	10A:241	0.154				
	R7921/R7940	10A:338	0.160				
	R7922/R7941	22A:52	0.136				
	R7923/R7942	22A:170	0.140				
	R7926/R7943	22A:260	0.140				
	R7927/R7944	22A:367	0.160				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-2D. Tank 241-AW-101 Analytical Data for 1990 Sample: Cyanide.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
Dist.CN^-	R8801	Composite	0.00105	0.00103	2.83E-05	26.8	105
	R8802		0.00101				

Notes:
kg = kilogram.
μg/mL = microgram/milliliter.

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Table D-2E. Tank 241-AW-101 Analytical Data for 1990 Sample: Fluoride.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	µg/mL	kg
IC.F^-	R8801	Composite	<0.00106	<0.00106			
	R8802		<0.00106				
IC.F^-	R7912/R7929	16C:94	<0.00411	<0.00402	N/A	<76.3	<300
	R7913/R7930	16C:138	<0.00411				
	R7914/R7933	16C:291	<0.00411				
	R7915/R7934	16C:387	<0.00585				
	R7916/R7935	10A:55	<0.00354				
	R7919/R7936	10A:150	<0.00354				
	R7920/R7937	10A:241	<0.00180				
	R7921/R7940	10A:338	<0.00180				
	R7922/R7941	22A:52	<0.00585				
	R7923/R7942	22A:170	<0.00411				
	R7926/R7943	22A:260	<0.00585				
	R7927/R7944	22A:367	<0.00354				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.
N/A = Not applicable.

Table D-2F. Tank 241-AW-101 Analytical Data for 1990 Sample: Hydroxide.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
Titra.OH^-	R8798	Composite	4.51	4.73			
	R8799		4.95				
Titra.OH^-	R7948/R7964	16C:94	5.10	5.07	0.115	86,200	3.40E+05
	R7949/R7965	16C:138	5.16				
	R7950/R7966	16C:291	5.05				
	R7951/R7969	16C:387	4.90				
	R7952/R7970	10A:55	5.25				
	R7955/R7971	10A:150	5.09				
	R7956/R7972	10A:241	5.16				
	R7957/R7973	10A:338	4.82				
	R7958/R7976	22A:52	5.05				
	R7959/R7977	22A:170	5.08				
	R7962/R7978	22A:260	5.11				
	R7963/R7979	22A:367	5.13				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-2G. Tank 241-AW-101 Analytical Data for 1990 Sample: Nitrate.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	µg/mL	kg
$IC.NO_3^-$	R8801	Composite	3.81	3.62			
	R8802		3.43				
$IC.NO_3^-$	R7912/R7929	16C:94	3.43	3.46	0.119	2.14E+05	8.44E+05
	R7913/R7930	16C:138	3.52				
	R7914/R7933	16C:291	3.62				
	R7915/R7934	16C:387	3.34				
	R7916/R7935	10A:55	3.67				
	R7919/R7936	10A:150	3.21				
	R7920/R7937	10A:241	3.40				
	R7921/R7940	10A:338	3.46				
	R7922/R7941	22A:52	3.47				
	R7923/R7942	22A:170	3.45				
	R7926/R7943	22A:260	3.46				
	R7927/R7944	22A:367	3.48				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.

Table D-2H. Tank 241-AW-101 Analytical Data for 1990 Sample: Nitrite (by Dionex Method).

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	µg/mL	kg
IC.NO_2^-	R8801	Composite	2.17	2.17			
	R8802		2.16				
IC.NO_2^-	R7912/R7929	16C:94	2.37	2.21	0.104	1.02E+05	4.01E+05
	R7913/R7930	16C:138	2.28				
	R7914/R7933	16C:291	2.34				
	R7915/R7934	16C:387	2.22				
	R7916/R7935	10A:55	2.37				
	R7919/R7936	10A:150	2.11				
	R7920/R7937	10A:241	2.10				
	R7921/R7940	10A:338	2.14				
	R7922/R7941	22A:52	2.22				
	R7923/R7942	22A:170	2.13				
	R7926/R7943	22A:260	2.14				
	R7927/R7944	22A:367	2.14				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
µg/mL = microgram/milliliter.

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Table D-2I. Tank 241-AW-101 Analytical Data for 1990 Sample: Nitrite (by Spec Method).

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
Spec.NO_2^-	R8801	Composite	2.29	2.28			
	R8802		2.26				
Spec.NO_2^-	R7912/R7929	16C:94	2.24	2.16	0.0560	99,500	3.92E+05
	R7913/R7930	16C:138	2.17				
	R7914/R7933	16C:291	2.20				
	R7915/R7934	16C:387	2.05				
	R7916/R7935	10A:55	2.20				
	R7919/R7936	10A:150	2.20				
	R7920/R7937	10A:241	2.10				
	R7921/R7940	10A:338	2.22				
	R7922/R7941	22A:52	2.17				
	R7923/R7942	22A:170	2.15				
	R7926/R7943	22A:260	2.18				
	R7927/R7944	22A:367	2.10				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

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Table D-2J. Tank 241-AW-101 Analytical Data for 1990 Sample: Phosphate.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
IC.PO_4^{3-}	R8801	Composite	<0.00213	<0.00213			
	R8802		<0.00213				
IC.PO_4^{3-}	R7912/R7929	16C:94	0.0140	0.0222	0.0152	2,110	8,300
	R7913/R7930	16C:138	0.0138				
	R7914/R7933	16C:291	0.0131				
	R7915/R7934	16C:387	0.0651				
	R7916/R7935	10A:55	0.0330				
	R7919/R7936	10A:150	0.0153				
	R7920/R7937	10A:241	0.0243				
	R7921/R7940	10A:338	0.0134				
	R7922/R7941	22A:52	0.0182				
	R7923/R7942	22A:170	0.0138				
	R7926/R7943	22A:260	0.0128				
	R7927/R7944	22A:367	0.0296				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-2K. Tank 241-AW-101 Analytical Data for 1990 Sample: Sulfate.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Ion		Riser:depth	M	M	M	μg/mL	kg
IC.SO_4^{2-}	R8801	Composite	0.0235	0.0226			
	R8802		0.0217				
IC.SO_4^{2-}	R7912/R7929	16C:94	0.00820	0.0107	0.00448	1,030	4,060
	R7913/R7930	16C:138	0.00829				
	R7914/R7933	16C:291	0.00791				
	R7915/R7934	16C:387	0.0157				
	R7916/R7935	10A:55	0.0215				
	R7919/R7936	10A:150	0.0105				
	R7920/R7937	10A:241	0.0154				
	R7921/R7940	10A:338	0.00779				
	R7922/R7941	22A:52	0.0111				
	R7923/R7942	22A:170	0.00774				
	R7926/R7943	22A:260	0.00744				
	R7927/R7944	22A:367	0.00740				

Notes:
Depth is measured as inches from the bottom of the tank.
kg = kilogram.
μg/mL = microgram/milliliter.

Table D-3A. Tank 241-AW-101 Analytical Data for 1990 Sample: Americium-241.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
AEA.^{241}Am	R8804	Composite	0.938	1.20	0.376	0.00120	4.74
	R8805		1.47				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-3B. Tank 241-AW-101 Analytical Data for 1990 Sample: Curium-243/244.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
AEA.$^{243/244}$Cm	R8804	Composite	0.113	0.107	0.00919	1.07E-04	0.421
	R8805		0.100				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.
N/A = Not applicable.

Table D-3C. Tank 241-AW-101 Analytical Data for 1990 Sample: Carbon-14.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
LSC.^{14}C	R8804	Composite	0.378	0.370	0.0113	3.70E-04	1.47
	R8805		0.362				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

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Table D-3D. Tank 241-AW-101 Analytical Data for 1990 Sample: Cesium-134.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
GEA. ^{134}Cs	R8804	Composite	954	1,090			
	R8805		1,220				
GEA. ^{134}Cs	R7912/R7929	16C:94	1,530	1,530	49.0	1.53	6,010
	R7913/R7930	16C:138	1,540				
	R7914/R7933	16C:291	1,530				
	R7915/R7934	16C:387	1,480				
	R7916/R7935	10A:55	1,610				
	R7919/R7936	10A:150	1,470				
	R7920/R7937	10A:241	1,530				
	R7921/R7940	10A:338	1,550				
	R7922/R7941	22A:52	1,510				
	R7923/R7942	22A:170	1,500				
	R7926/R7943	22A:260	1,470				
	R7927/R7944	22A:367	1,620				

Notes:
Depth is measured as inches from the bottom of the tank.
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-3E. Tank 241-AW-101 Analytical Data for 1990 Sample: Cesium-137.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
GEA.^{137}Cs	R8804	Composite	4.34E+05	4.89E+05			
	R8805		5.44E+05				
GEA.^{137}Cs	R7912/R7929	16C:94	5.18E+05	5.20E+05	17,400	520	2.05E+06
	R7913/R7930	16C:138	5.18E+05				
	R7914/R7933	16C:291	5.22E+05				
	R7915/R7934	16C:387	4.97E+05				
	R7916/R7935	10A:55	5.52E+05				
	R7919/R7936	10A:150	4.97E+05				
	R7920/R7937	10A:241	5.01E+05				
	R7921/R7940	10A:338	5.39E+05				
	R7922/R7941	22A:52	5.13E+05				
	R7923/R7942	22A:170	5.19E+05				
	R7926/R7943	22A:260	5.22E+05				
	R7927/R7944	22A:367	5.41E+05				

Notes:
Depth is measured as inches from the bottom of the tank.
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

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Table D-3F. Tank 241-AW-101 Analytical Data for 1990 Sample: Cobalt-60.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
GEA.^{60}Co	R8804	Composite	<21.6	<61.3			
	R8805		<101				
GEA.^{60}Co	R7912/R7929	16C:94	<18.7	<29.6	N/A	<0.0296	<117
	R7913/R7930	16C:138	<16.6				
	R7914/R7933	16C:291	<22.2				
	R7915/R7934	16C:387	<16.3				
	R7916/R7935	10A:55	<30.4				
	R7919/R7936	10A:150	<15.5				
	R7920/R7937	10A:241	<18.6				
	R7921/R7940	10A:338	<21.9				
	R7922/R7941	22A:52	<27.5				
	R7923/R7942	22A:170	<19.7				
	R7926/R7943	22A:260	<31.5				
	R7927/R7944	22A:367	<117				

Notes:
Depth is measured as inches from the bottom of the tank.
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.
N/A = Not applicable.

Table D-3G. Tank 241-AW-101 Analytical Data for 1990 Sample: Iodine-129.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
GEA.^{129}I	R8804	Composite	0.250	0.303	0.0750	3.03E-04	1.19
	R8805		0.356				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-3H. Tank 241-AW-101 Analytical Data for 1990 Sample: Neptunium-237.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
AEA.^{237}Np	R8804	Composite	<2.16	<2.16	N/A	<0.00216	<8.50
	R8805		<2.16				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-3I. Tank 241-AW-101 Analytical Data for 1990 Sample: Niobium-94.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:Depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
GEA.^{94}Nb	R8804	Composite	<63.8	<85.4			
	R8805		<107				
GEA.^{94}Nb	R7912/R7929	16C:94	<56.5	<68.2	N/A	<0.0682	<269
	R7913/R7930	16C:138	<59.4				
	R7914/R7933	16C:291	<61.1				
	R7915/R7934	16C:387	<55.9				
	R7916/R7935	10A:55	<68.5				
	R7919/R7936	10A:150	<48.3				
	R7920/R7937	10A:241	<57.5				
	R7921/R7940	10A:338	<68.1				
	R7922/R7941	22A:52	<76.6				
	R7923/R7942	22A:170	<56.9				
	R7926/R7943	22A:260	<66.5				
	R7927/R7944	22A:367	<144				

Notes:
Depth is measured as inches from the bottom of the tank.
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.
N/A = Not applicable.

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Table D-3J. Tank 241-AW-101 Analytical Data for 1990 Sample: Plutonium-239/240.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
AEA. $^{239/240}Pu$	R8804	Composite	1.25	1.15	0.149	0.00115	4.51
	R8805		1.04				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcuric/milliliter.

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Table D-3K. Tank 241-AW-101 Analytical Data for 1990 Sample: Ruthenium/Rhodium-106.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	µCi/L	µCi/L	µCi/L	µCi/mL	Ci
GEA.^{106}Ru/Rh	R8804	Composite	<3,840	<4,560			
	R8805		<5,280				
GEA.^{106}Ru/Rh	R7912/R7929	16C:94	<3,260	<3,700	N/A	<3.70	<14,600
	R7913/R7930	16C:138	<3,290				
	R7914/R7933	16C:291	<3,260				
	R7915/R7934	16C:387	<3,180				
	R7916/R7935	10A:55	<3,990				
	R7919/R7936	10A:150	<2,640				
	R7920/R7937	10A:241	<3,240				
	R7921/R7940	10A:338	<3,900				
	R7922/R7941	22A:52	<3,270				
	R7923/R7942	22A:170	<3,320				
	R7926/R7943	22A:260	<3,850				
	R7927/R7944	22A:367	<7,170				

Notes:
Depth is measured as inches from the bottom of the tank.
Ci = curie.
µCi/L = microcurie/liter.
µCi/mL = microcurie/milliliter.
N/A = Not applicable.

Table D-3L. Tank 241-AW-101 Analytical Data for 1990 Sample: Selenium-79.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
LSC.^{79}Se	R8804	Composite	0.464	0.480	0.0226	4.80E-04	1.89
	R8805		0.496				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-3M. Tank 241-AW-101 Analytical Data for 1990 Sample: Strontium-89/90.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
BPC.$^{89/90}$Sr	R8804	Composite	1,030	1,090	77.8	1.09	4,270
	R8805		1,140				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

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Table D-3N. Tank 241-AW-101 Analytical Data for 1990 Sample: Technetium-99.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
LSC.^{99}Tc	R8804	Composite	128	152	33.9	0.152	598
	R8805		176				

Notes:
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-3O. Tank 241-AW-101 Analytical Data for 1990 Sample: Tritium.*

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Radchem		Riser:depth	μCi/L	μCi/L	μCi/L	μCi/mL	Ci
LSC.^{3}H	R8798	Composite	6.78	7.07	0.410	0.00707	27.8
	R8790		7.36				

Notes:
*Standards were outside laboratory quality control limits.
Ci = curie.
μCi/L = microcurie/liter.
μCi/mL = microcurie/milliliter.

Table D-4A. Tank 241-AW-101 Analytical Data for 1990 Sample: Weight Percent Water.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation
Physical property		Riser:depth	$\%H_2O$	$\%H_2O$	%
Evap. wt$\%H_2O$	R8798	Composite	42.2	43.6	1.98
	R8790		45.0		

Table D-4B. Tank 241-AW-101 Analytical Data for 1990 Sample: Density.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation
Physical property		Riser:depth	g/mL	g/mL	g/mL
Density	R8798	Composite	1.54	1.54	
	R8799		1.54		
Density	R7912/R7929	16C:94	1.53	1.56	0.0240
	R7913/R7930	16C:138	1.54		
	R7914/R7933	16C:291	1.57		
	R7915/R7934	16C:387	1.54		
	R7916/R7935	10A:55	1.63		
	R7919/R7936	10A:150	1.56		
	R7920/R7937	10A:241	1.56		
	R7921/R7940	10A:338	1.56		
	R7922/R7941	22A:52	1.56		
	R7923/R7942	22A:170	1.56		
	R7926/R7943	22A:260	1.55		
	R7927/R7944	22A:367	1.58		

Notes:
Depth is measured as inches from the bottom of the tank.
g/mL = gram/milliliter.

Table D-5. Tank 241-AW-101 Analytical Data for 1990 Sample: Total Organic Carbon.

Analyte	Sample number	Sample identification	Sample result	Sample mean	Standard deviation	Calculated mean	Projected inventory
Carbon		Riser:depth	g/L	g/L	g/L	μg/mL	kg
TOC	R8801	Composite	2.39	2.46	0.0990	2,460	9,690
	R8802		2.53				

Notes:
g/L = gram/liter.
kg = kilogram.
μg/mL = microgram/milliliter.
TOC = Total organic carbon.

Table D-6. Tank 241-AW-101 Analytical Data: Non-Detected Semivolatile Organics. (2 sheets)

Complexant	
Phenol	3-Nitroaniline
bis(2-Chloroethyl)Ether	Acenaphthene
2-Chlorophenol	2, 4-Dinitrophenol
1, 3-Dichlorobenzene	4-Nitrophenol
1, 4-Dichlorobenzene	Dibenzofuran
Benzyl alcohol	2, 4-Dinitrotoluene
1, 2-Dichlorobenzene	Diethylphthalate
2-Methylphenol	4-Chlorophenyl-phenylether
bis(2-chloroisopropyl)ether	Fluorene
4-Methylphenol	4-Nitroaniline
N-Nitroso-Di-n-propylamine	4, 6-Dinitro-2-methylphenol
Hexachloroethane	N-Nitrosodiphenylamine
Nitrobenzene	4-Bromophenyl-phenylether
Isophorone	Hexachlorobenzene
2-Nitrophenol	Pentachlorophenol
2, 4-Diethylphenol	Phenanthrene
Benzoic acid	Anthracene
bis(2-Chloroethoxy)methane	Di-n-butylphthalate
2, 4-Dichlorophenol	Fluoranthene
1, 2, 4-Trichlorobenzene	Pyrene
Naphthalene	Butylbenzylphthalate
4-Chloroaniline	3, 3'-Dichlorobenzidine
Hexachlorobutadiene	Benzo(a)anthracene
4-Chloro-3-methylphenol	Chrysene
2-Methylnaphthalene	bis(2-Ethylhexyl)phthalate
Hexachlorocyclopentadiene	Di-n-octylphthalate
2, 4, 6-Trichlorophenol	Benzo(b)fluoranthene
2, 4, 5-Trichlorophenol	Benzo(k)fluoranthene
2-Chloronaphthalene	Benzo(a)pyrene
2-Nitroaniline	Indeno(1, 2, 3-cd)pyrene
Dimethylphthalene	Dibenz(a, h)anthracene

Table D-6. Tank 241-AW-101 Analytical Data: Non-Detected Semivolatile Organics. (2 sheets)

Complexant	
Acenaphthalene	Benzo(g, h, i)perylene
2, 6-Dinitrotoluene	

Table D-7. Tank 241-AW-101 Analytical Data: Non-Detected Volatile Organics.

Complexant	
Chloromethane	1,2-Dichloropropane
Bromomethane	cis-1, 3-Dichloropropene
Vinyl chloride	Trichloroethene
Chloroethane	Dibromochloroethane
Methylene chloride	1, 1, 2-Trichloroethane
Acetone	Benzene
Carbon disulfide	trans-1, 3-Dichloropropene
1, 1-Dichloroethene	Bromoform
1, 1-Dichloroethane	4-Methyl-2-pentanone
1, 2-Dichloroethene (total)	2-Hexanone
Chloroform	Tetrachloroethene
1, 2-Dichloroethane	1, 1, 2, 2-Tetrachloroethane
2-Butanone	Toluene
1, 1, 1-Trichloroethane	Chlorobenzene
Carbon tetrachloride	Ethylbenzene
Vinyl acetate	Styrene
Bromodichloromethane	Xylene (total

D.4 REFERENCES

Welsh, T. L., 1991, *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-055, Rev. B, Westinghouse Hanford Company, Richland, Washington.

APPENDIX E

ANALYTICAL METHODS FOR 1990 GRAB SAMPLES

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LIST OF TABLES

E-1 Analytical Methods for 1990 Grab Samples for Tank 241-AW-101 . . . . . E-5

E-2 Analytical Methods for 1995 Auger Samples for Tank 241-AW-101 . . . . . E-6

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Table E-1. Analytical Methods for 1990 Grab Samples for Tank 241-AW-101[1].

Analyte	Method	WHC procedure
Hg, As, Se	Atomic absorption spectrophotometer	LA-355-131
Cl, F, NO_3, NO_2, PO_4, SO_4	Ion chromatography	LA-553-105
NO_2	Spectrophotometer	LA-645-001
Total metals	Inductively coupled plasma	LA-505-143
^{3}H ^{14}C ^{99}Tc ^{79}Se	Chemical separation/ Liquid scintillation Counting	LA-218-111 LA-348-103 LA-438-101 TBD
^{90}Sr	Separation/total beta proportional counting	LA-220-101
^{129}I	Separation/low energy GAMMA energy analysis	LA-378-103
^{237}Np	Separation/alpha PC/ alpha energy analysis	LA-933-141
^{238}Pu, $^{239/240}Pu$ $^{243/244}Cm$, ^{241}Am	Separation/alpha PC/ alpha energy analysis	LA-503-156
^{60}Co, $^{106}Rh/Ru$, ^{137}Cs, ^{94}Nb, ^{134}Cs	GAMMA energy analysis	LA-548-121
CN	Distillation/spec.	TBD/SD-WM-TI-315
CO_3	Total inorganic carbon	LA-622-101
TOC	Total organic carbon	LA-344-101
% H_20	Evaporation/weighing	LA-564-101
OH	Autotitrator	LA-661-102
U	Laser fluorimeter	LA-925-105
Volatile organics	GC/mass spectroscopy	PNL-ALO-335
Semivolatile organics	GC/mass spectroscopy	PNL-ALO-345

Notes:
[1]Source: Welsh, T. L., 1991, *Tank 241-AW-101 Characterization Results*, WHC-SD-WM-TRP-055, Rev. B, Westinghouse Hanford Company, Richland, Washington.

GC =
g/m = gram/meter.
PC = Alpha proportional counting.
TBD = To be determined (methods were in development stages).
WHC = Westinghouse Hanford Company.

Table E-2. Analytical Methods for 1995 Auger Samples for Tank 241-AW-101.[1]

Analyte	Method	WHC procedure
TIC (CO_3^{2-}) TOC	Hot persulfate Acid/coulometry	LA-342-100
Energy	DSC	LA-514-113
% water	TGA	LA-560-112

Notes:
[1]Source: Sathyanarayana, P., 1994, *Tank 241-AW-101 Tank Characterization Plan*, WHC-SD-WM-TP-229, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DSC = Differential scanning calorimetry.
PNL = Pacific Northwest Laboratory.
TGA = Thermogravimetric analysis.
TIC = Total inorganic carbon.
TOC = Total organic carbon.

APPENDIX F

ANALYTICAL RESULTS
DOUBLE-SHELL TANK 241-AW-101
1995 SAMPLING EFFORT

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APPENDIX F

ANALYTICAL RESULTS
DOUBLE-SHELL TANK 241-AW-101
1995 SAMPLING EFFORT

F.1 INTRODUCTION

This appendix presents the total organic carbon (TOC) and the total inorganic carbon (TIC) analyses associated with the 1995 auger sampling event of tank 241-AW-101. The results from the analyses are presented in tabular form.

The data table for each analyte lists the laboratory sample identification number, a description of where the sample was obtained, and an analytical data result for each sample. The data are listed in standard notation for values >0.001 and <100,000. Values outside these limits are listed in scientific notation. An overall waste tank inventory was not calculated because there was not a density measurement obtained for the 1995 samples. The density is used in the conversion of the individual results into a projected inventory.

F.2 TABLE DESCRIPTION

The tables in Appendix F are divided as described in the following table.

Analyte characteristic	Table number
Total organic carbon	Table F-1
Total inorganic carbon	Table F-2

Standard abbreviations are used in the tables to describe analytical methods and analytes. The abbreviations used to describe analytical methods are shown in the following table.

Total carbon	PS/Coul - Persulfate/coulometry
	A/Coul - Acid/coulometry

F.3 COLUMN HEADINGS

The "Analyte" column contains, in addition to the abbreviated name of the analyte or physical characteristic, information about the method of measurement.

The "Sample number" column lists the laboratory sample from which the analyte was measured; this identification number is different from the number assigned to the samples at the tank farm at the time of sampling. Sampling rationale, locations, and descriptions of the sampling events are contained in Section 3.0 of this report.

Column three, "Sample identification," describes the type of material (sludge or crust) and the type of sample (composite or segment) from which the sample data were derived.

"Result" is the specific concentration of the analyte, determined at the different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. This information may be obtained from WHC-SD-WM-DP-097, *136-Day Crust Burn Safety Issue Results for Tank 241-AW-101, Auger Samples, 95-AUG-001, 95-AUG-004, 95-AUG-005* (WHC 1995).

The number listed is an average between the primary sample and its duplicate sample. Where more than one duplicate sample was performed, the primary sample was averaged with all the duplicates.

Table F-1. Tank 241-AW-101 Analytical Data for 1995 Crust Sample: Total Organic Carbon.

Analyte	Sample number	Sample identification	Result
		Material and location	µg/g
PS/Coul.TOC	S95T000106	Composite	6,520
	S95T000107	Material from upper ½ of auger	4,840
	S95T000111	Material from lower ½ of auger	7,140
	S95T000114	Material from lower ½ of auger	11,800

Notes:
µg/g = microgram/gram.

Table F-2. Tank 241-AW-101 Analytical Data for 1995 Sample: Total Inorganic Carbon.

Analyte	Sample number	Sample identification	Result
		Material and location	μg/g
A/Coul.TIC	S95T000106	Composite	8,400
	S95T000107	Material from upper lower ½ of auger	8,640
	S95T000111	Material from lower ½ of auger	4,840
	S95T000114	Material from lower ½ of auger	3,100

Notes:
μg/g = microgram/gram.

F.4 REFERENCES

WHC, 1995, *136-Day Crust Burn Safety Issue Results for Tank 241-AW-101, Auger Samples, 95-AUG-001, 95-AUG-004, 95-AUG-005*, WHC-SD-WM-DP-097, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX G

TYPICAL THERMODYNAMIC SCANS OF TANK 241-AW-101 SAMPLES

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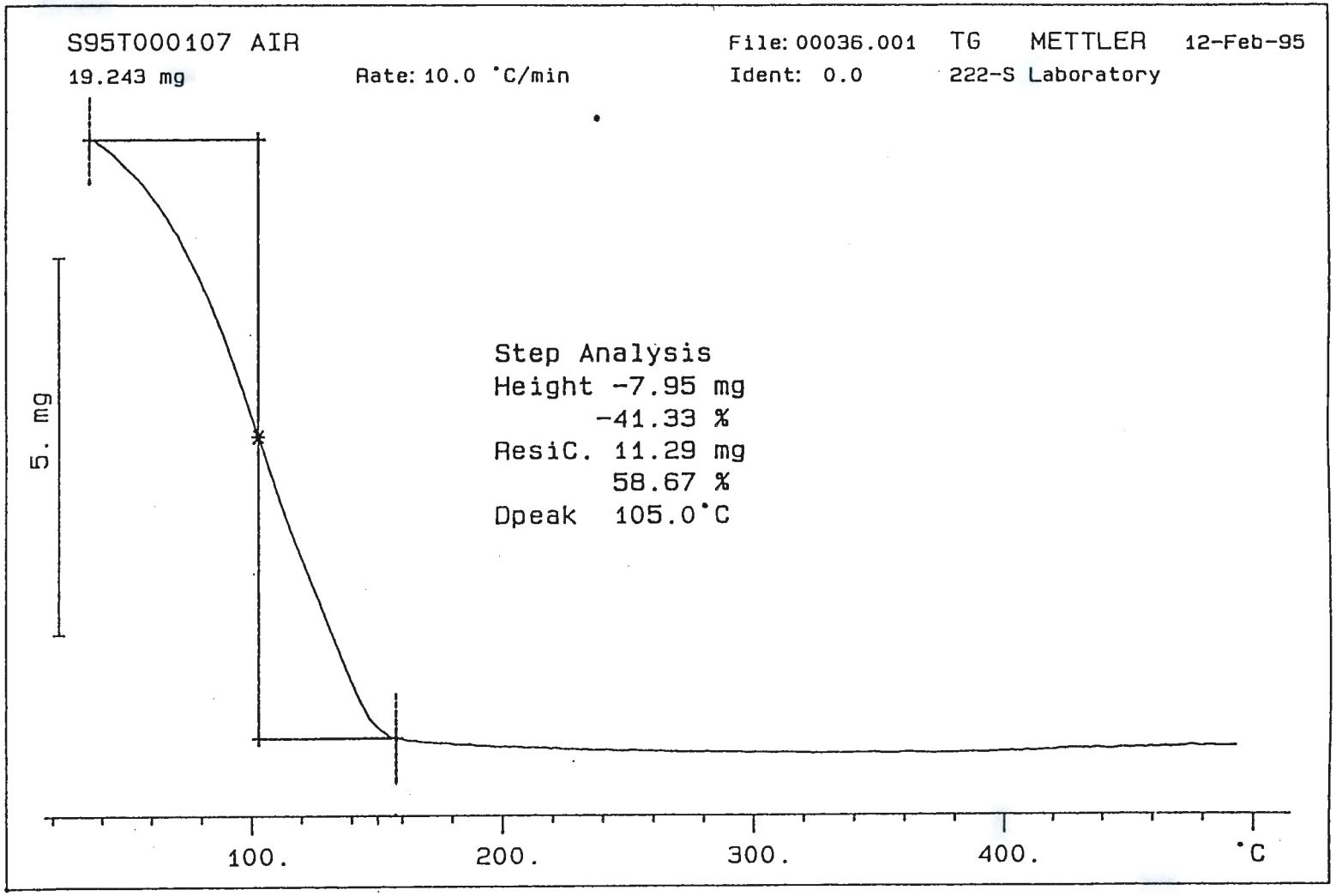

Figure G-1. Typical Thermogravimetric Analysis Scan for a Tank 241-AW-101 Waste Sample.

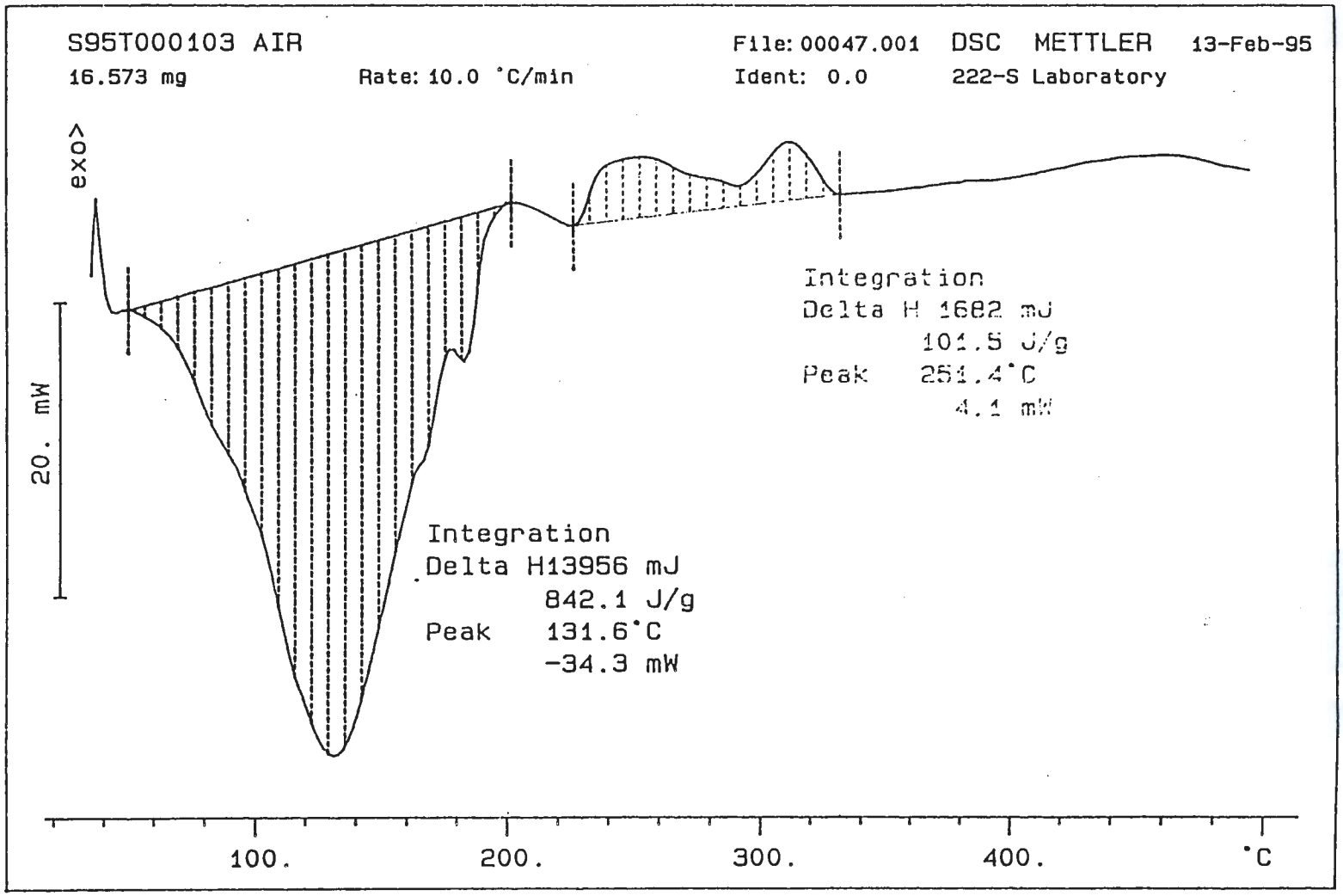

Figure G-2. Typical Differential Scanning Calorimetry Scan for a Tank 241-AW-101 Waste Sample.

G.1 REFERENCE

WHC, 1995a, *Tank Characterization 40-Day Crust Burn Report for Double-Shell Tank 241-AW-101*, WHC-SD-WM-DP-097, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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