Accession #: D196061044

Document #: SD-WM-ER-544

Title/Desc:

TANK CHARACTERIZATION REPORT FOR SST 241T106

Pages: 62

MAR 25 1996

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT № 615365

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Data Assessment and Interpretation	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: Tank 241-T-106/Waste Management/DAI/Characterization Technical Basis	6. Cog. Engr.: Jaiduk Jo	7. Purchase Order No.: N/A
8. Originator Remarks: This document is being released into the supporting document system for retrievability purposes.		9. Equip./Component No.: N/A 10. System/Bldg./Facility: 241-T-106
11. Receiver Remarks: For release.		12. Major Assm. Dwg. No.: N/A 13. Permit/Permit Application No.: N/A 14. Required Response Date: 03/25/96

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-ER-544	N/A	0	Tank Characterization Report for Single-Shell Tank 241-T-106	N/A	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. J. Jo	[signature]	3/25/96	R2-12						
2	1	Cog. Mgr. J.G. Kristofzski	[signature]	3/25/96							
		QA									
		Safety									
		Env.									

18. A.E. Young [signature] 3/25/96 Signature of EDT Originator Date	19. N/A Authorized Representative Date for Receiving Organization	20. J.G. Kristofzski [signature] 3/25/96 Cognizant Manager Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

BD-7400-172-1

Tank Characterization Report for Single-Shell Tank 241-T-106

Jaiduk Jo
Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: EDT-615365 UC: 2070
Org Code: 79400 Charge Code: N4G4D
B&R Code: EW 3120074 Total Pages: 54

Key Words: Tank Characterization Report, TCR, Single-Shell, SST, Tank 241-T-106, Tank T-106, T-106, T Farm

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-T-106. This report supports the requirements of Tri-Party Agreement Milestone M-44-09.

Printed in the United States of America. To obtain copies of this document, contact: WHC/BCS Document Control Services, P.O. Box 1970, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.

3

4

Release Approval 3/25/96 Date

MAR 2 5 1996

Release Stamp

Approved for Public Release

WHC-SD-WM-ER-544, Rev. 0

UC-2070

Tank Characterization Report for Single-Shell Tank 241-T-106

J. Jo
Westinghouse Hanford Company

L. C. Amato
J. D. Franklin
T. T. Tran
Los Alamos Technical Associates

Date Published
March 1996

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse
Hanford Company
P.O Box 1970
Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

This page intentionally left blank.

EXECUTIVE SUMMARY

This tank characterization report summarizes the information on the historical uses, current status, and sampling and analysis results of waste stored in Hanford Site single-shell underground storage tank 241-T-106. This report supports requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994), Milestone M-44-09.

Tank 241-T-106 is one of twelve type 100 series single-shell tanks located in the 200 West Area T Tank Farm on the Hanford Site. A plan view schematic and a profile of tank 241-T-106 are provided in Figure ES-1. Tank 241-T-106 is the last tank in a three-tank cascade series. The tank went into service in June 1947, receiving second-cycle decontamination (2C) waste via the cascade tie line with tank 241-T-105. This waste type originated from the bismuth phosphate process in use at T Plant, and continued to be transferred to the tank until March 1948. Most of the 2C waste was pumped from the tank to a crib during the third quarter of 1948. An active process history followed these initial transfers. The tank received first-cycle decontamination waste, and supernatant from other tanks that included cladding waste from the REDOX Plant, B Plant low-level waste, ion exchange waste, and other waste types. Shortly after the transfer of supernatant from tank 241-T-105 during the second quarter of 1973, surface levels indicated that 453 kL (115 kgal) of waste leaked from the tank. The remaining supernatant was then pumped out and the tank was removed from service.

A description of tank 241-T-106 is summarized in Table ES-1. The tank has an operating capacity of 2,010 kL (530 kgal), and presently contains 79 kL (21 kgal) of non-complexed waste. The total amount is composed of 72 kL (19 kgal) of sludge, and 8 kL (2 kgal) of supernatant liquid (Hanlon 1996).

Figure ES-1. Profile of Tank 241-T-106.

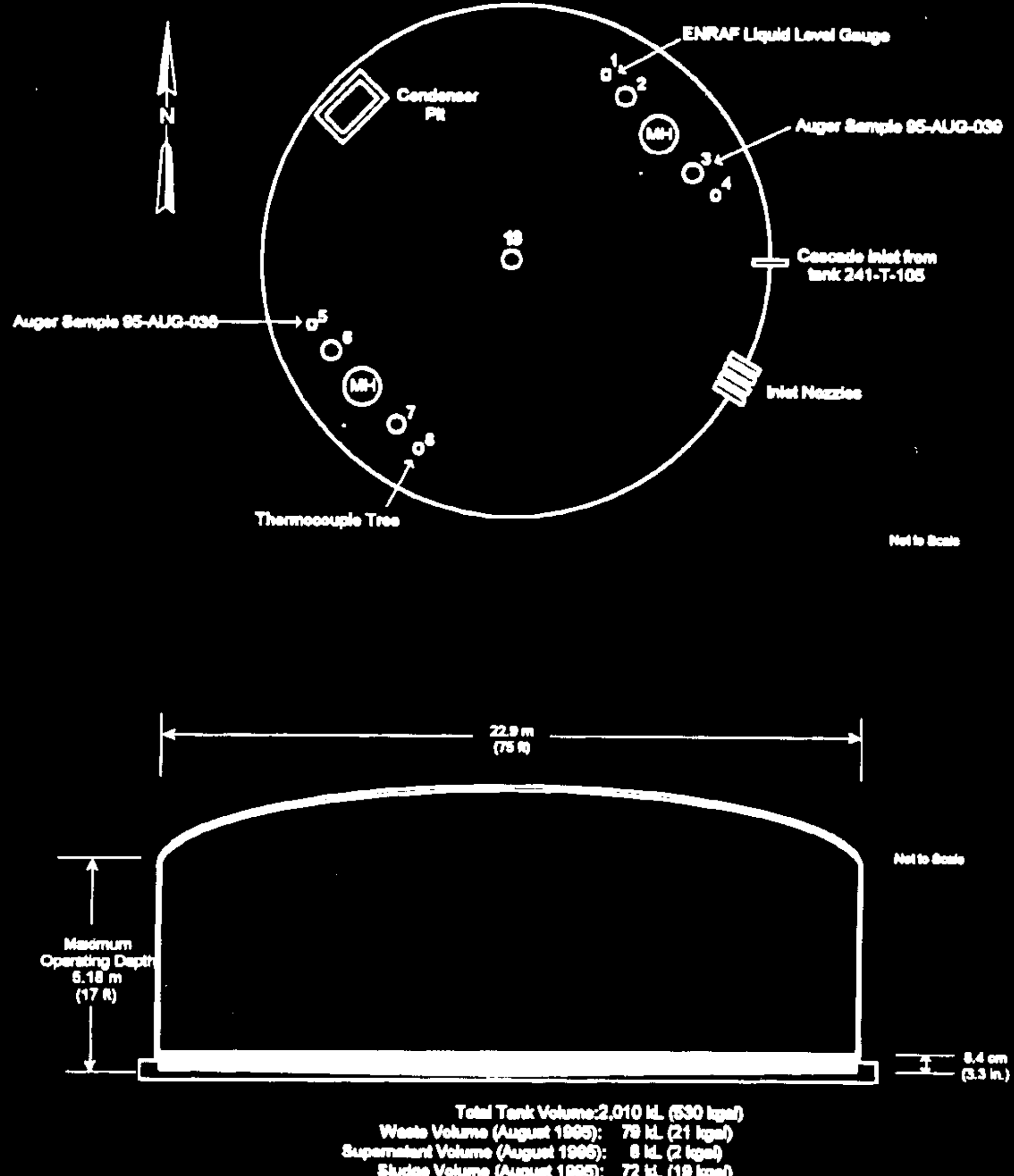


Table ES-1. Description and Status of Tank 241-T-106.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1943-1944
In-service	1947
Diameter	22.9 m (75 ft)
Operating depth	5.18 m (17 ft)
Capacity	2,010 kL (530 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Noncomplexed
Total waste volume	79 kL (21 kgal)
Sludge volume	72 kL (19 kgal)
Drainable interstitial liquid volume	0
Supernatant volume	8 kL (2 kgal)
Waste surface level (1983 to 1995)	7.9 cm (3.1 in.) to 8.6 cm (3.4 in.)
Temperature (September 1975 to February 1996)	12 °C (54 °F) to 31 °C (87 °F)
Integrity	Assumed leaker
Watch List	None
SAMPLING DATES	
Auger samples	July/August 1995
SERVICE STATUS	
Out of service	1973
Interim stabilization	August 1981
Intrusion prevention	August 1981

This report summarizes the collection and analysis of the auger samples acquired in July and August of 1995. The sampling event was performed to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), and directed according to the *Tank 241-T-106 Auger Sampling and Analysis Plan* (Jo 1995b). The sampling effort involved taking two auger samples of the tank waste from widely spaced risers. Auger sample 95-AUG-038 was obtained from riser 5, while auger sample 95-AUG-039 was acquired from riser 3. The safety screening data quality objective (DQO) requires analyses for fuel content using differential scanning calorimetry (DSC), percent water by thermogravimetric analysis (TGA), and total alpha activity. The DQO also requires a determination of the flammability of the gases in the tank headspace. To satisfy this requirement, vapor samples were taken prior to auger sampling, and the flammability was measured using a combustible gas meter.

Auger sampling was chosen because of the shallow depth of the waste. Recovery was low for both auger samples, with no discernible breaks in the strata. For these reasons, the samples were analyzed on the whole segment basis, rather than on the half segment basis specified in the sampling and analysis plan (Jo 1995b).

Percent water values by TGA were less than the safety screening notification limit of 17 weight percent for the 95-AUG-038 sample, with an average value of 11.96 percent water. The lower limit to a one-sided 95 percent confidence interval on the mean percent by TGA was zero, which was substantially less than the safety screening limit. The mean for the gravimetric analysis of sample 95-AUG-038 was 14.38 percent water. Sample 95-AUG-039 exhibited slightly higher results with an average for TGA of 17.09 percent and a rerun average of 19.14 percent. Gravimetric analysis of sample 95-AUG-039 exhibited an average of 19.94 percent. Notifications were not made, however, because the DSC results were all within the DQO limits of 481 J/g (dry weight basis). In fact, no exothermic reactions were observed. Low moisture content alone does not constitute an unsafe condition. Total alpha activity results were well below the DQO notification limit of 41 μCi/g (Jo 1995b). The upper limit to a one-sided 95 percent confidence interval on the mean total alpha activity (0.931 μCi/g) was approximately a factor of 40 below the notification limit of 41 μCi/g. Quality control results were within the limits specified in the tank sampling and analysis plan for the DSC analysis. Some of the analytical precision quality control results, evaluated by the relative percent difference between primary and duplicate samples, were outside the specified limits for the TGA and total alpha activity measurements. Finally, the flammability of the tank headspace gases was measured at 0 percent of the lower flammability limit (WHC 1995). The average values for total alpha activity and percent water are presented in Table ES-2, along with the headspace gas flammability results.

Table ES-2. Tank 241-T-106 Safety Screening Analytical Averages.

Analyte	Average Result
Total alpha activity	0.193 μCi/g[1]
Percent water by TGA	15 weight percent water[1]
Percent water by gravimetric	17.2 weight percent water[1]
Tank headspace gas flammability	0 percent of the lower flammability limit[2]
Exothermic reaction by DSC	0

Notes:

[1]Jo (1995a)

[2]WHC (1995)

The heat load in the tank produced by radioactive decay is estimated to be 13.5 W (46 Btu/hr) and calculated to be 360 W (1,230 Btu/hr), decayed to 1996. These values are a fraction of the limit listed in the relevant safety analysis report for single-shell tanks (Bergmann 1991).

This page intentionally left blank.

CONTENTS

CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TERMS

1C	first-cycle decontamination waste
1C1	first-cycle decontamination waste produced from 1944 to 1949
1C2	first-cycle decontamination waste produced from 1950 to 1956
2C	second-cycle decontamination waste
ANOVA	analysis of variance
Btu/hr	British thermal units per hour
C	Celsius
Ci	curies
Ci/g	curies per gram
Ci/L	curies per liter
cm	centimeters
c/s	counts per second
CWR1	REDOX cladding waste generated between 1952 and 1960
CWR2	REDOX cladding waste generated between 1961 and 1972
DQO	data quality objective
DSC	differential scanning calorimetry
F	Fahrenheit
ft	feet
g	grams
g/L	grams per liter
g/mL	grams per milliliter
HDW	Hanford Defined Wastes
HTCE	Hanford Tank Content Estimate
in.	inches
J/g	joules per gram
kg	kilograms
kgal	kilogallons
kL	kiloliters
m	meters
mm	millimeters
μCi/g	microcuries per gram
μg/g	micrograms per gram
QC	quality control
REDOX	Reduction Oxidation (Plant)
RPD	relative percent difference
SAP	sampling and analysis plan
TGA	thermogravimetric analysis
TLM	Tank Layer Model
W	watts
WSTRS	Waste Status and Transaction Record Summary

1.0 INTRODUCTION

This tank characterization report presents an overview of single-shell tank 241-T-106 and its waste components. It provides estimated concentrations and inventories for the waste constituents based on the latest sampling and analysis activities, historical information, and modeling results. Tank 241-T-106 was auger sampled in July and August 1995 in accordance with the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994).

Tank 241-T-106 began operation in 1947 and received waste until it was removed from service in 1973. Interim stabilization and intrusion prevention were completed in 1981; therefore, the composition of the waste should not dramatically change until pretreatment and retrieval activities commence. The analyte concentrations reported in this document reflect the best composition estimates of the waste based on the available analytical data and historical models. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order* Milestone M-44-09 (Ecology et al. 1994).

1.1 PURPOSE

This report summarizes information about the past use and remaining contents of tank 241-T-106. When possible, this information will be used to assess issues associated with safety operations, environmental, and process activities. This report also provides a consolidated reference for detailed information about tank 241-T-106.

1.2 SCOPE

As required by the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), the objective of the 1995 auger sampling event for tank 241-T-106 was to screen the tank for three potential safety issues: energetics, criticality, and flammability. Because of the narrow focus of the sampling event, only three analyses were performed as directed in the *Tank 241-T-106 Auger Sampling and Analysis Plan* (Jo 1995b). These analyses were differential scanning calorimetry (to evaluate fuel level and energetics), thermogravimetric analysis (to determine moisture content), and total alpha activity analysis (to evaluate criticality potential). The tank headspace was also screened for flammability concerns.

This page intentionally left blank.

2.0 HISTORICAL TANK INFORMATION

This section describes tank 241-T-106 based on historical information and surveillance data. The first part of the section details the current condition of the tank. This is followed by discussions of the tank's background, transfer history, and the process sources that contributed to the tank waste, including an estimate of the current contents based on the process history. Events that may be related to tank safety issues are included. The final part of the section details any surveillance data available for the tank.

2.1 TANK STATUS

According to Hanlon (1996) tank 241-T-106 contained 79 kL (21 kgal) of non-complexed waste as of November 30, 1995. The amounts of the various phases comprising the waste are presented in Table 2-1.

Table 2-1. Summary Tank Contents Status.[1]

Waste Type	Volume	
	kL[2]	kgal
Total waste amount	79	21
Supernatant	8	2
Drainable interstitial liquid	0	0
Sludge	72	19
Saltcake	0	0

Notes:

[1]Hanlon (1996)

[2]Differences from rounding may be observed.

Tank 241-T-106 is an assumed leaker. Interim stabilization and intrusion prevention were completed in August 1981. Tank 241-T-106 is not on any Watch Lists. All monitoring systems were in compliance with documented standards as of November 30, 1995 (Hanlon 1996).

2.2 TANK DESIGN AND BACKGROUND

The 241-T Tank Farm is a first-generation tank farm, built between 1943 and 1944, consisting of twelve 2,010-kL (530-kgal) tanks and four 208-kL (55-kgal) tanks. These tanks were designed for nonboiling waste with a maximum fluid temperature of 104 °C (220 °F). As with all first-generation tank farms, equipment to monitor and maintain the waste is sparse. A typical T Farm tank contains 11 to 13 risers, ranging in size from 50 mm (2 in.) to 1.07 m (42 in.) in diameter, which provide surface level access to the underground tank. Generally, there is one riser through the center of the tank dome, five each on opposite sides of the tank, and the remaining one to three are scattered on the dome.

Tank 241-T-106 entered service in June 1947 and is last in a three-tank cascading series. The single-shell tank is constructed of 30-cm (1-ft)-thick reinforced concrete with a 6.4-mm (0.25-in.) mild carbon steel liner on the bottom and sides, and a 38-cm (1.25-ft)-thick domed concrete top. The tank has a dished bottom with a 1.2-m (4-ft) radius knuckle, a diameter of 22.9 m (75 ft), and a 5.18-m (17-ft) operating depth. The cascade overflow height is approximately 4.78 m (15.7 ft) from the tank bottom and 60 cm (2 ft) below the top of the steel liner. The tank is set on a reinforced concrete foundation. It is covered with approximately 2.1 m (7 ft) of overburden.

The waste surface level is monitored through riser 1 with an ENRAF[1] gauge (Hanlon 1996). The thermocouple tree is in riser 8. A plan view depicting the riser configuration is shown in Figure 2-1. A list of tank 241-T-106 risers showing the size and general use is provided in Table 2-2. This constitutes all installed equipment for tank 241-T-106 (Brevick et al. 1995a). This tank is passively ventilated.

A tank cross-section showing the approximate waste level, and a schematic of the tank equipment, are found in Figure 2-2. Tank 241-T-106 has nine risers, of which six (2, 3, 4, 5, 6 and 7) are available for sampling. If used as sampling ports, the risers would give access to the southwest and northeast sides of the tank.

[1]ENRAF is a trademark of ENRAF, Inc., Stafford, Texas.

Figure 2-1. Riser Configuration for Tank 241-T-106.

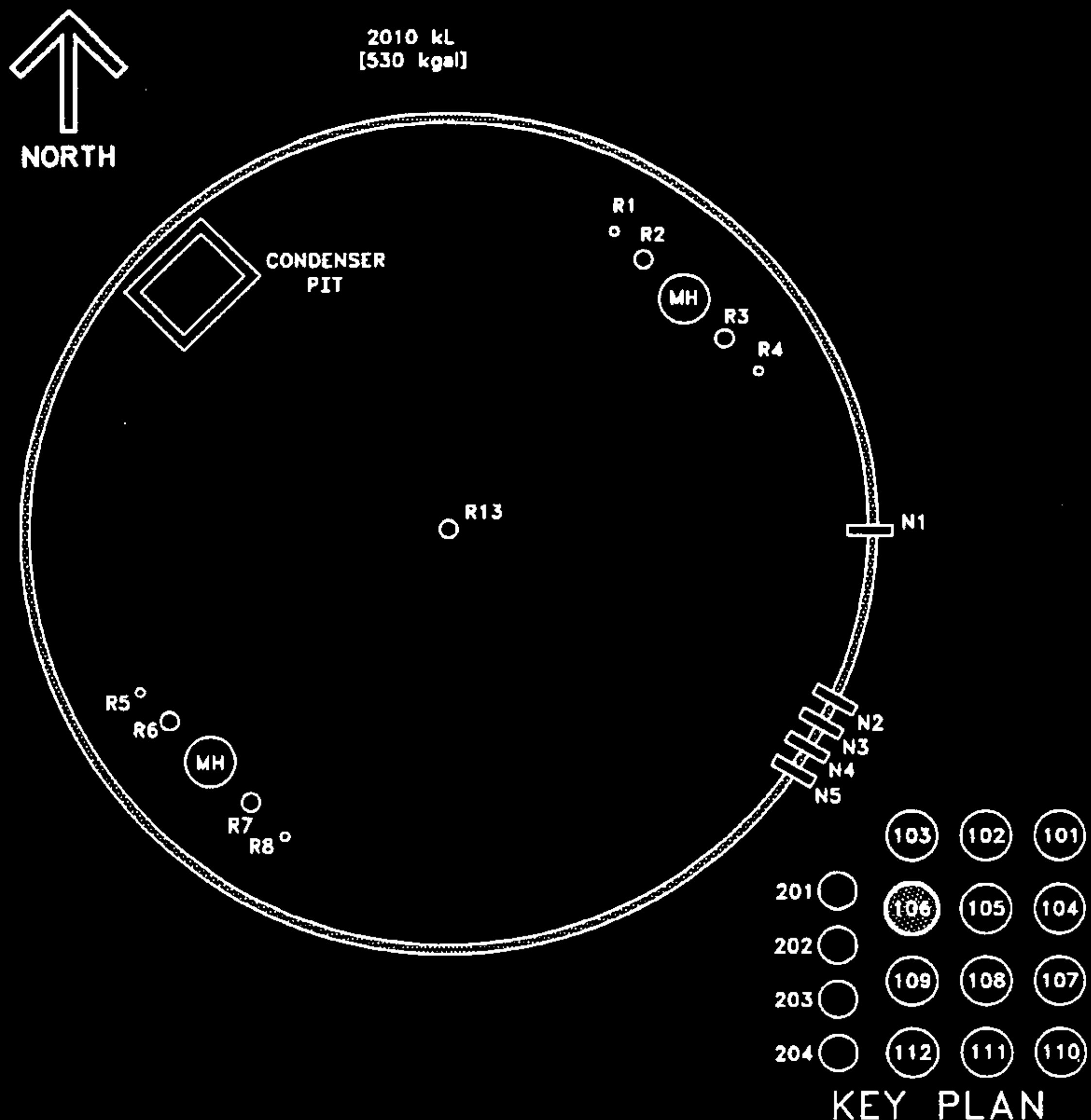
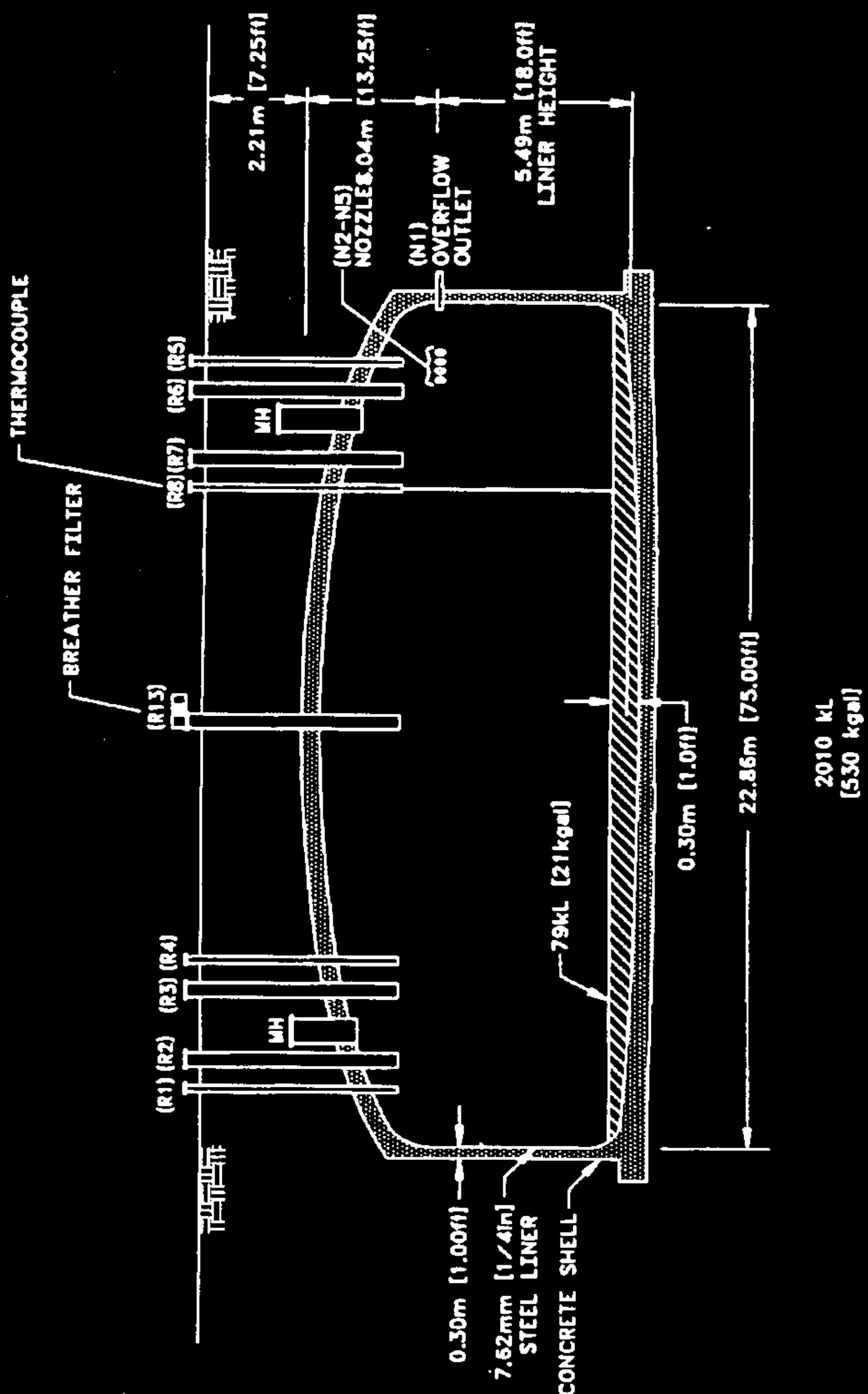


Table 2-2. Tank 241-T-106 Risers and Nozzles.

Riser Number	Diameter (inches)	Description and Comments
R1	4	Surface level gauge (bench mark)
R2	12	Flange with bale
R3	12	Observation
R4	4	Flange
R5	4	Flange
R6	12	Flange
R7	12	Flange
R8	4	Thermocouple tree
R13	12	Breather filter (bench mark)
Nozzle Number	Diameter (inches)	Description and Comments
N1	3	Cascade inlet
N2	3	Inlet nozzle
N3	3	Inlet nozzle
N4	3	Inlet nozzle
N5	3	Inlet nozzle

Figure 2-2. Tank 241-T-106 Configuration.



2.3 PROCESS KNOWLEDGE

This section presents the transfer history of tank 241-T-106 followed by an estimate of the tank's contents based on process knowledge.

2.3.1 Waste Transfer History

According to the *Waste Status Transaction Record Summary for the Northwest Quadrant* (Agnew et al. 1995a), tank 241-T-106 initially received second-cycle decontamination (2C) waste via the cascade tie line with tank 241-T-105 during June 1947. This waste originated from the bismuth phosphate process in use at T Plant. Tank 241-T-106 was filled by March 1948. During the third quarter of 1948 most of the 2C waste was pumped to a crib and the tank began receiving first-cycle decontamination (1C) waste via the cascade. The tank was filled and continued to receive 1C waste transfers through 1954. Excess waste was pumped to a crib. Solids level measurements indicate about 38 kL (10 kgal) of 1C solids settled from the waste during this period.

Most of the 1C supernatant was pumped from tank 241-T-106 during 1955; the following year the tank received a transfer from tank 241-U-110 consisting of about 670 kL (177 kgal) of cladding waste from the Reduction Oxidation (REDOX) Plant, specifically CWR1. Agnew (1995) defines CWR1 as aluminum cladding removal waste generated between 1952 and 1960 at REDOX. During 1965, tank 241-T-106 received 1,180 kL (311 kgal) of CWR2 (cladding waste generated between 1961 and 1972 at REDOX) from tank 241-S-107. Based on solids level measurements, Agnew et al. (1995b) estimate 26 kL (7 kgal) of CWR1 solids and about 8 kL (2 kgal) of CWR2 solids settled in the tank from these wastes.

Most of the supernatant was removed from tank 241-T-106 in the third quarter of 1969 during a transfer to tank 241-TY-103. Tank 241-T-106 was refilled during the second quarter of 1973 with supernatant from tank 241-T-105. This waste consisted of a mixture of cladding, B Plant low-level, ion exchange, and decontamination wastes. Shortly after the transfer, surface level measurements indicated about 435 kL (115 kgal) of waste leaked from the tank. The supernatant was then pumped from the tank, and the tank was removed from service.

The transfer history of tank 241-T-106 is summarized in Table 2-3 and depicted in Figure 2-3.

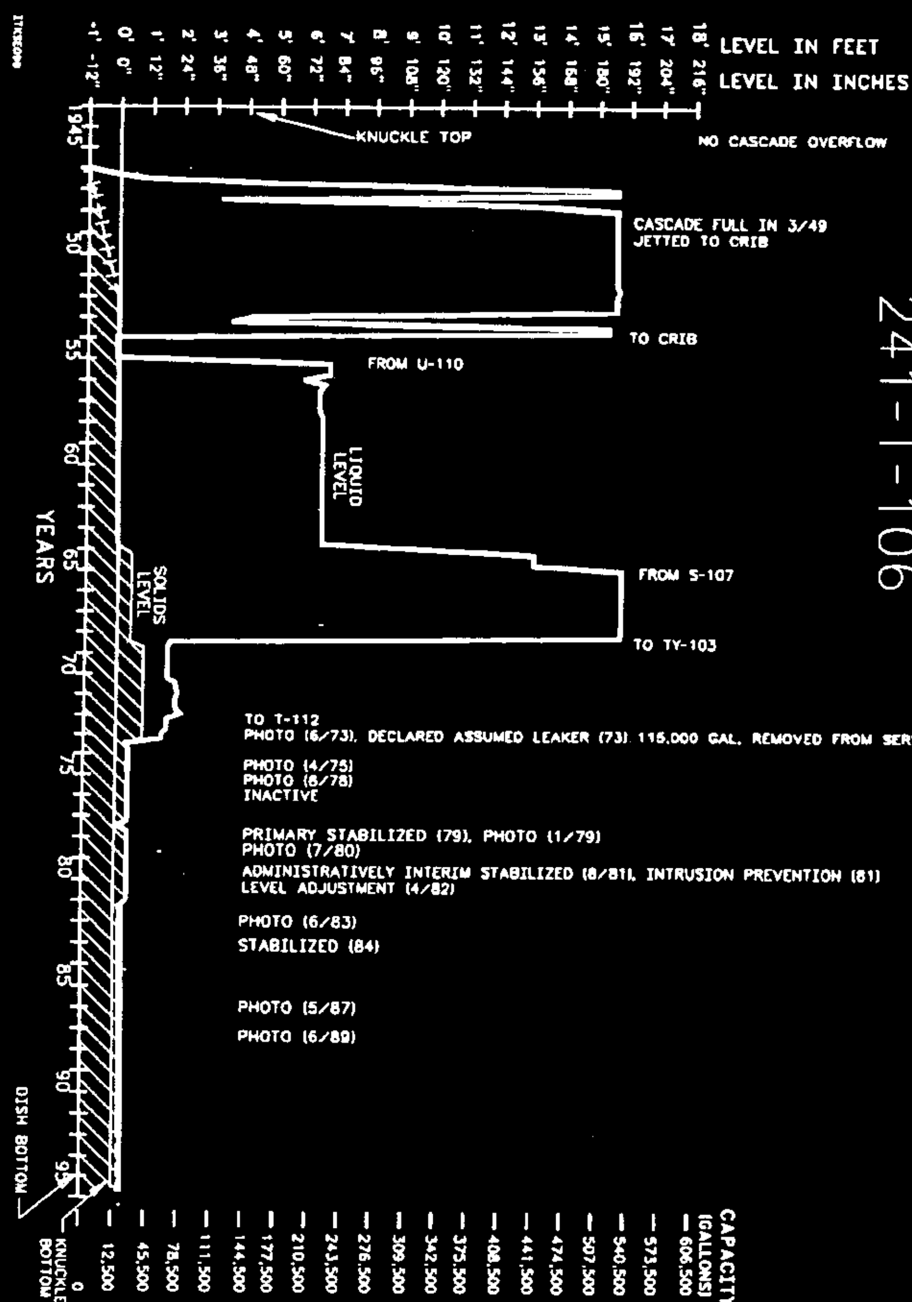
Table 2-3. Summary of Tank 241-T-106 Transfer History.[1]

Waste Type	Time Period	Volume kiloliters (kilogallons)	Comments
Second-cycle decontamination waste (via tank 241-T-105)	1947 to 1948	2,010 (530)	Most waste removed in 1948.
First-cycle decontamination waste (via tank 241-T-105)	1948 to 1954	8,290 (2,190)	Excess disposed to a crib. This waste created an estimated 38-kL (10-kgal) sludge layer.
REDOX cladding waste (1952 to 1960) from tank 241-U-110	1956	670 (177)	This waste is estimated to have contributed a 26-kL (7-kgal) sludge layer.
REDOX cladding waste (1961 to 1972) from tank 241-S-107	1965 to 1966	1,180 (311)	This waste is estimated to have contributed an 8-kL (2-kgal) sludge layer. Wastes were largely supernatant; no sludge was estimated to have contributed to the inventory.
Various supernatant wastes from tank 241-T-105	1973	1,710 (451)	Tank 241-T-106 was assumed to be leaking shortly after this transfer and supernatant was pumped from the tank.

Note:

[1]Agnew et al. (1995a)

Figure 2-3. Tank Level History.



2.3.2 Historical Estimation of Tank Contents

The Historical Tank Content Estimate (HTCE) (Brevick et al. 1995b) is a prediction of the contents for tank 241-T-106 based on historical transfer data. The concentration estimates provided in the HTCE are not validated and should be used with caution. The historical data used for the estimates are from the Waste Status and Transaction Record Summary (WSTRS) (Agnew et al. 1995a), the Hanford Defined Waste (HDW) (Agnew 1995) list, and the Tank Layer Model (TLM) (Agnew et al. 1995b). The WSTRS is a compilation of available waste transfer and volume status data. The HDW provides the assumed typical compositions for 50 separate waste types. In some cases, the available data are incomplete, reducing the usability of the transfer data and the modeling results. The TLM takes the WSTRS data, models the waste deposition processes, and, using additional data from the HDW (which may introduce more error), generates an estimate of the tank contents. Thus, these model predictions can only be considered as estimates that require further evaluation using analytical data.

The HDW divides 1C waste into two categories: 1C1, generated from 1944 to 1949; and 1C2, produced from 1950 to 1956. Tank 241-T-106 received 1C waste from 1948 to 1954. The TLM predicts that the solids remaining in the tank from these transfers were of the 1C2 waste type. The total waste breakdown by waste type, according to the HTCE and TLM, shows that tank 241-T-106 contains approximately 38 kL (10 kgal) of 1C2, 26 kL (7 kgal) of CWR1, 8 kL (2 kgal) of CWR2, and 8 kL (2 kgal) of supernatant. Figure 2-4 presents a graphic representation of the estimated waste types and volumes for the tank layers. The 1C2 should contain large amounts of sodium, aluminum, nitrate, and phosphate. Also present will be iron, bismuth, nitrite, fluoride, ^{137}Cs, and ^{90}Sr. The presence of cesium and strontium will give this waste layer a modest level of radioactivity. The CWR1 layer should have high concentrations of sodium, aluminum, uranium, nitrate, and nitrite. CWR1 waste can be distinguished from the 1C2 because bismuth, iron, fluoride, and phosphate are absent from CWR1. The concentrations of strontium and cesium are lower in CWR1 than in 1C2; therefore, CWR1 will have less activity. The CWR2 waste type is very similar to CWR1. The difference between the two waste layers (CWR2 and CWR1) is that the CWR2 has smaller concentrations of sodium, aluminum, and nitrite, and no silicate. The CWR1 and CWR2 concentrations of cesium and strontium are similar; therefore, the highest radioactivity will be found in the 1C2 layer. An estimate of the chemical constituents of the supernatant layer is not available, but typically these layers consist of mostly aqueous sodium nitrate solutions. Table 2-4 shows an estimate of the expected sludge constituents and their concentrations.

Figure 2-4. Tank Layer Model.

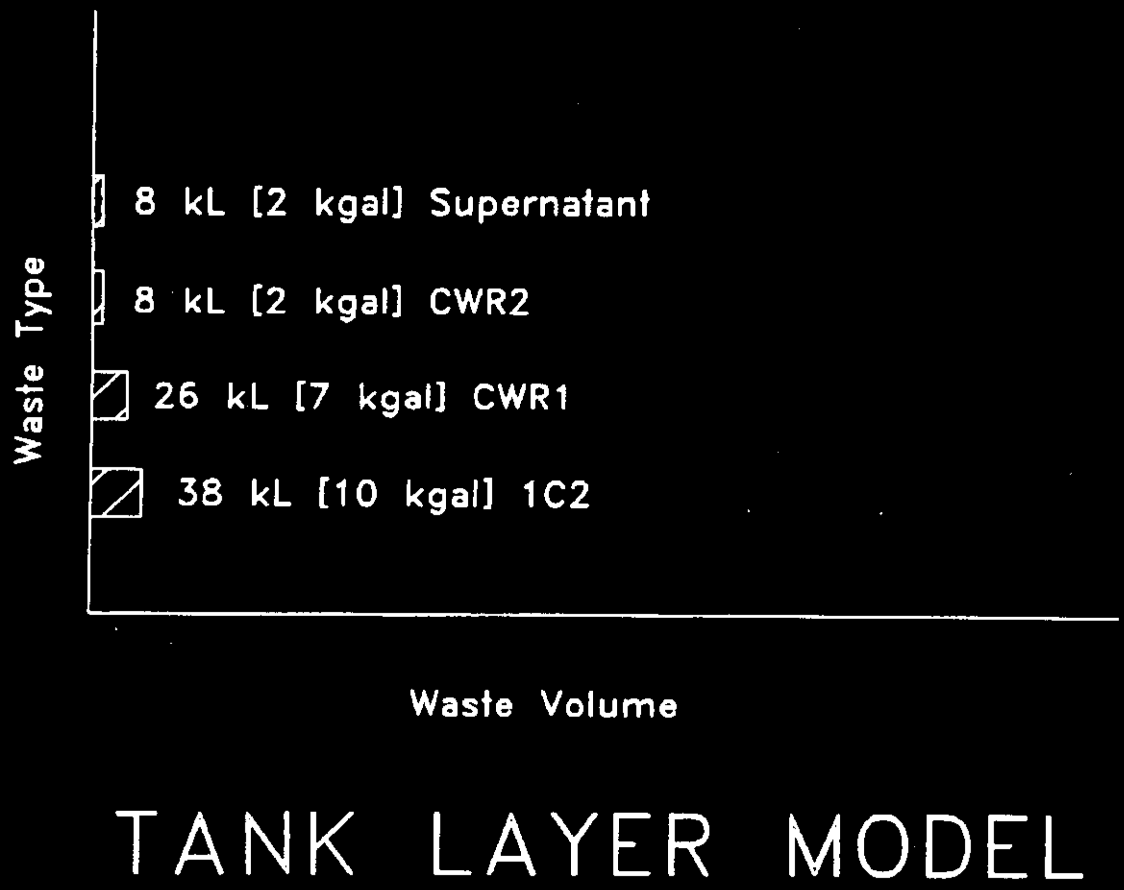


Table 2-4. Tank 241-T-106 Historical Tank Content Estimate (2 sheets).[1,2]

Solids Composite Inventory Estimate[3]			
Chemical Constituents			
Analyte	moles per liter	parts per million ($\mu g/g$)	kilograms
Na^{+}	3.52	58,200	5,820
Al^{3+}	3.38	65,600	6,550
Fe^{3+} (total Fe)	0.457	18,300	1,830
Cr^{3+}	0.00741	277	27.7
Bi^{3+}	0.0272	4,090	409
La^{3+}	0	0	0
Ce^{3+}	0	0	0
Zr (as $ZrO(OH)_2$)	0.00369	242	24.2
Pb^{2+}	0	0	0
Ni^{2+}	0.0244	1,030	103
Sr^{2+}	0.00533	336	33.6
Mn^{4+}	0	0	0
Ca^{2+}	0.0560	1,620	161
K^{+}	0	0	0
OH^{-}	12.7	1.55E+05	15,500
NO_3^{-}	0.653	29,100	2,910
NO_2^{-}	0.524	17,300	1,730
CO_3^{2-}	0.0560	2,420	242
PO_4^{3-}	0.481	32,900	3,290
SO_4^{2-}	0.0292	2,020	202
Si (as SiO_3^{2-})	0.101	2,050	205
F^{-}	0.165	2,250	225
Cl^{-}	0.0125	318	31.8
$C_6H_5O_7^{3-}$	0	0	0
$EDTA^{4-}$	0	0	0
$HEDTA^{3-}$	0	0	0
NTA^{3-}	0	0	0
$Glycolate^{-}$	0	0	0
$Acetate^{-}$	0	0	0

Table 2-4. Tank 241-T-106 Historical Tank Content Estimate (2 sheets).[1,2]

Solids Composite Inventory Estimate[3]			
Chemical Constituents			
Analyte	moles per liter	parts per million (μg/g)	kilograms
Oxalate^{2-}	0	0	0
DBP	0	0	0
NPH	0	0	0
CCl_4	0	0	0
Hexone	0	0	0
$6Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents			
Analyte	Ci/L	μCi/g	Ci
Pu	---	0.974	1.62 (kg)
U	0.0949 (moles/liter)	16,300 (μg/g)	1,620 (kg)
Cs	0.0378	27.2	2,720
Sr	0.00156	1.12	112
Physical Properties			
Total solid waste	1.00E+05 kilograms (19 kilogallons)		
Heat load	0.0135 kilowatts (46 British thermal units/hour)		
Bulk density	1.39 grams/milliliter		
Void fraction	0.789		
Water weight percent	71.3%		
Total organic carbon weight percent carbon (wet)	0		

Notes:

EDTA = ethylenediaminetetraacetic acid
HEDTA = N-(hydroxylethyl)-ethylenediaminetriacetic acid
NTA = nitrilotriacetic acid
DBP = dibutyl phosphate
NPH = normal paraffin hydrocarbon

[1]Brevick et al. (1995b)
[2]The HTCE predictions have not been validated and should be used with caution.
[3]Composite inventory excludes supernatant. Unknowns in tank inventory are assigned by Tank Layer Model.

2.4 SURVEILLANCE DATA

Tank 241-T-106 surveillance consists of surface level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), in-tank photographs, and drywell monitoring for radioactivity outside the tank. These data are important because they provide the basis for determining tank integrity.

Liquid level measurements are used to determine if the tank has a major leak. Solid surface level measurements provide an indication of physical changes and consistency of the solid layers of a tank. In-tank photography is another waste volume determination method used to explain measurement anomalies and determine tank integrity. Drywells located around the perimeter of the tank may detect increased radioactivity if there is a leak to the soil.

2.4.1 Surface Level Readings

Tank 241-T-106 is an assumed leaker. An ENRAF gauge, installed in riser 1 in July 1995, is used to measure the surface level. Previously, a Food Instrument Corporation gauge was used. Surface level measurements from 1983 to 1995 have remained steady, ranging from 7.9 cm (3.1 in.) to 8.6 cm (3.4 in.). Waste volume measurements from when the tank entered service in 1947 until 1995 were presented earlier in Figure 2-3. The plot indicates that the waste level has been steady since 1982.

2.4.2 Drywell Monitoring

Tank 241-T-106 has nine drywells. In 1973, significant levels of contamination were detected around the tank as a result of a leak. Approximately 435 kL (115 kgal) of waste had been released into the surrounding soil. As a consequence, all of the supernatant was pumped from the tank at that time, except for a minimal heel (2 kgal). All nine drywells still have radiation levels greater than the 50 c/s background level; several continue to have extremely high readings. For example, drywells #50-06-06 and 50-06-08 had readings in early 1994 of 61,000 and 28,000 c/s, respectively.

Test drillings were made during 1975 to determine the extent of the leak plume for evidence of movement of the contamination in the soil (Welty 1988). The results indicated that the leak plume was essentially stable, though some slow migration toward the southeast (vicinity of drywell #50-06-06) was apparent, causing drywell activity in the proximity of tanks 241-T-108 and 241-T-105. More information concerning this matter is available in *Waste Storage Tank Status and Leak Detection Criteria* (Welty 1988) and the T Farm supporting document (Brevick et al. 1995a).

2.4.3 Internal Tank Temperatures

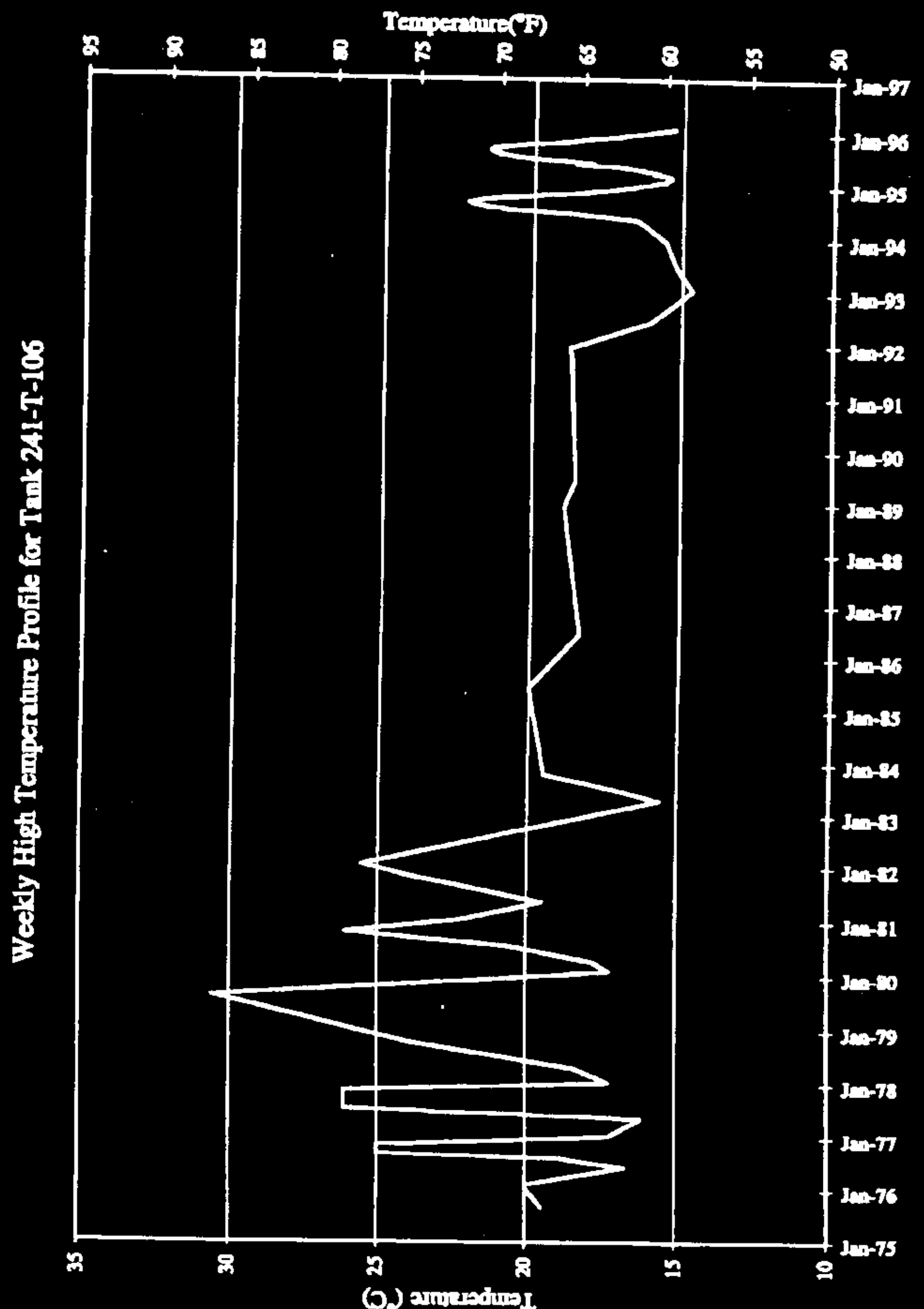
Tank 241-T-106 has a single thermocouple tree, located in riser 8, that contains 11 thermocouples. Elevations are available for all thermocouples on the tree (Tran 1993). The first thermocouple is located 37 cm (1.2 ft) from the bottom of the tank. Because the waste depth is approximately 8 cm (3 in.), the temperature data since 1981 could be from the headspace. Thermocouples 1 through 9 are spaced 60 cm (2 ft) apart. Thermocouples 9 through 11 are spaced 1.2 m (4 ft) apart.

Non-suspect temperature data recorded between September 1975 and February 1996 were obtained from the Surveillance Analysis Computer System for all 11 thermocouples. There are several gaps in the temperature data for the period July 1986 through January 1989. The average temperature was 18 °C (64 °F) with a minimum of 12 °C (54 °F) and a maximum of 31 °C (87 °F). The thermocouple plots for each probe can be found in the *Supporting Document for the Historical Tank Content Estimate for T-Farm* (Brevick et al. 1995a). Figure 2-5 graphs the weekly high temperature.

2.4.4 In-Tank Photographs

Many of the photographs in the 1989 montage of tank 241-T-106 are dark black, making it difficult to distinguish detail. The waste surface appears to be covered with a black, tar-like substance. Some of the waste surface is covered with a light brown material that appears to be made up of fine particles resembling sand. An old level probe, a temperature probe, some risers, and some nozzles have been identified and labeled in the photographs. The tank has been inactive since the photographs were taken, so the picture should represent the existing tank contents.

Figure 2-5. Tank 241-T-106 Weekly High Temperature Plot.



This page intentionally left blank.

3.0 TANK SAMPLING OVERVIEW

This section describes the July and August 1995 sampling and analysis event for tank 241-T-106. Auger samples were taken from two risers to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The sampling and analyses were performed in accordance with the *Tank 241-T-106 Auger Sampling and Analysis Plan* (Jo 1995b). Further discussion of the sampling and analysis procedures can be found in the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994).

3.1 DESCRIPTION OF SAMPLING EVENT

Auger samples from two risers were collected from tank 241-T-106. Sample 95-AUG-038 was collected from riser 5 on July 26, and was received at the 222-S Laboratory July 28. Extrusion took place August 1. Sample 95-AUG-039 was collected from riser 3 on August 11 and was received at the 222-S Laboratory August 11. Extrusion was performed August 15.

Due to the shallow depth of the tank, the auger sampling method was chosen. A primary objective of the sampling was to obtain a vertical profile of the waste, which is a requirement of the safety screening data quality objective (DQO). Safety screening analyses include total alpha content to determine criticality potential, differential scanning calorimetry (DSC) to ascertain the fuel energy value, and thermogravimetric analysis (TGA) to obtain the total moisture content. Sampling and analytical requirements from the safety screening DQO are summarized in Table 3-1.

Table 3-1. Integrated Data Quality Objective Requirements for Tank 241-T-106.[1]

Sampling Event	Applicable DQOs	Sampling Requirements	Analytical Requirements
Auger Sampling	Safety Screening	Samples from a minimum of two risers separated radially to the maximum extent possible	▸ Energetics ▸ Moisture Content ▸ Total Alpha ▸ Flammable Gas Concentration

Note:

[1]Jo (1995b)

3.2 SAMPLE HANDLING

Sample 95-AUG-038 had a total of 47.6 g of solid material recovered from the auger. Analyses were performed on the whole segment instead of half-segments due to the low sample recovery and because there was not a noticeable break in the stratum.

When the auger sample was extruded, the sleeve was difficult to remove because a wire was wrapped around the auger. Most of the material fell into the sample tray during the removal of the sleeve. The majority of the material left on the auger was on flutes 3 through 6. This material appeared brown and damp. Sample material on flutes 1, 2, and 7 through 10 appeared thin, dry, brown, and crusty. Sample archiving was performed in accordance with the sampling and analysis plan (SAP) (Jo 1995b).

Sample 95-AUG-039 had a total of 27.8 g of solid material recovered from the auger. After extrusion, a thin, dry coating of waste material was found on flutes 1 through 10. Sample material on flutes 1, 2, and 3 was thin, dry, gray-brown, and crusty in appearance. Sample material on flutes 6 through 10 appeared thin, gray, and crusty. Flutes 4 and 5 contained very little material. Analyses on this auger sample were also performed on the whole segment due to the same reasons as those discussed for sample 95-AUG-038. The SAP archiving requirements for solid samples were met.

Neither drainable liquid nor liner liquid were found for either auger sample.

Table 3-2 presents a description of the samples in terms of sample location (riser number), sample number, mass, and visual characteristics.

Table 3-2. Tank 241-T-106 Subsampling Scheme and Sample Description.[1]

Riser	Sample Identification	Mass (g)	Flute(s)	Sample Characteristics
5	95-AUG-038	47.6	3 through 6	brown and damp
			1, 2, 7 through 10	thin, dry, brown, crusty
3	95-AUG-039	27.8	1, 2, 3	thin, dry, crusty, gray-brown
			4 and 5	thin, dry
			6 through 10	thin, crusty, gray

Note:

[1]Jo (1995a)

3.3 SAMPLE ANALYSIS

The analyses performed on the auger samples were limited to those required by the safety screening DQO. These included analyses for thermal properties by DSC, moisture by TGA, and for fissile content by total alpha activity analysis. The TGA and DSC analyses were performed on 6- to 41-milligram aliquots. Because several TGA results fell below the notification limit, weight percent water was measured by gravimetry. Prior to being analyzed for total alpha activity, the samples were prepared by a fusion procedure, using hydrochloric and nitric acids. A liquid aliquot of the fused sample was then dried on a counting planchet and measured for alpha activity using an alpha proportional counter.

The results of the tank safety screening analyses are discussed in Sections 4.0 and 5.0 of this report and reported in *90-Day Safety Screening Results and Final Report for Tank 241-T-106, Auger Samples 95-AUG-038 and 95-AUG-039* (Jo 1995a).

Laboratory control standards, matrix spikes, and duplicate analysis quality control checks were applied to the total alpha activity analysis. Laboratory control standards and duplicate analysis quality control checks were used for the TGA and DSC analyses. An assessment of the quality control procedures and data is presented in Section 5.1.2 of this report.

All reported analyses were performed in accordance with approved laboratory procedures. A list of the sample numbers and applicable analyses is presented in Table 3-3. Table 3-4 displays the analytical procedures by title and number. No deviations or modifications were noted by the laboratory.

Table 3-3. Tank 241-T-106 Sample Analysis Summary.[1]

Riser	Sample Identification	Sample Number	Analyses
5	95-AUG-038	S95T001343	DSC, TGA, Gravimetry
		S95T001344	Alpha Total
3	95-AUG-039	S95T001457	DSC, TGA, Gravimetry
		S95T001457 R1	TGA
		S95T001459	Alpha Total

Notes:

R1 = rerun #1

[1]Jo (1995a)

Table 3-4. Analytical Procedures.[1]

Analysis	Instrument	Preparation Procedure[2]	Analytical Procedure[2]
Energetics by DSC	Mettler™ and Perkin-Elmer™	N/A	LA-514-113, Rev. B-1 LA-514-114, Rev. B-0
Percent water by TGA	Mettler™ and Perkin-Elmer™	N/A	LA-514-114, Rev. B-0 LA-560-112, Rev. A-2
Total alpha activity	Alpha proportional counter	LA-549-141, Rev. C-2	LA-508-101, Rev. D-2

Notes:

N/A = not applicable
Rev. = revision
Mettler™ is a registered trademark of Mettler Electronics, Anaheim, California
Perkin-Elmer™ is a registered trademark of Perkins Research and Manufacturing Company, Inc., Canoga Park, California.

[1]Jo (1995a)

[2]Procedures of Westinghouse Hanford Company, Richland, Washington

3.4 DESCRIPTION OF HISTORICAL SAMPLING EVENT

The analytical results from a sample of the waste in tank 241-T-106 were reported on April 22, 1975 (Horton 1975). The sample was described as soft, black solids. The results are presented in Appendix A and compared to the recent analytical results in Section 5.2.

4.0 ANALYTICAL RESULTS

4.1 OVERVIEW

This section presents a summary of the analytical results associated with the July/August 1995 sampling of tank 241-T-106, and a discussion of the statistical treatment of the data. The total alpha activity, percent water, and energetics results are presented as indicated in Table 4-1. The samples from which these results were derived were collected between July 26 and August 11, 1995, as discussed in Section 3.0, and were reported in Jo (1995a).

Table 4-1. Analytical Data Tables.

Analysis	Table Number
Total alpha	4-2
Percent water	4-3
Differential scanning calorimetry	4-4

Overall tank means were calculated for total alpha activity and weight percent water. To derive an overall mean, auger means were first determined by taking an average of the sample and duplicate pair results from each auger. The overall mean was then derived by averaging the two auger means. An overall relative standard deviation of the mean was also calculated for both analytes. The relative standard deviation of the mean is defined as 100 times the standard deviation of the mean divided by the tank mean. The standard deviation of the mean was estimated using a hierarchical statistical model to fit the data (Jensen and Liebetrau 1988). The four quality control (QC) parameters assessed on the tank 241-T-106 samples were standards, spikes, duplicates, and blanks. The QC results are summarized in Section 5.1.2. More specific QC information is provided in each of the analyte data summary tables found in this section. Sample and duplicate pairs in which any of the QC parameters were outside their specified limits have been footnoted appropriately.

4.2 TOTAL ALPHA ACTIVITY

Analyses for total alpha activity were performed on the sludge samples recovered from tank 241-T-106. The samples were prepared by a fusion digestion and measured using an alpha proportional counter.

Table 4-2 displays the total alpha activity analytical results (Jo 1995a). All total alpha activity results were at least two orders of magnitude below the safety screening limit of 41 μCi/g. The upper limit to a one-sided 95 percent confidence interval on the mean total alpha activity was 0.931 μCi/g, which is approximately a factor of 40 below the safety screening limit.

Table 4-2. Tank 241-T-106 Total Alpha Activity Results.[1]

Sample Number	Riser	Result (µCi/g)	Duplicate (µCi/g)	Sample Mean (µCi/g)	RPD %	Auger Mean (µCi/g)	Overall Mean (µCi/g)
S95T001459	3	0.0952	0.1080	0.102[2,3]	12.6[4]	0.0816	0.193
		0.0571	0.0314	0.0443[3]	58.1[4]		
		0.1240	0.0728	0.0984[3]	52.0[4]		
S95T001344	5	0.246	0.364	0.305	38.7[4]	0.305	
Relative Standard Deviation of the Mean = 57.9%							

Notes:

[1]Jo (1995a)

[2]The standard recovery was greater than the 90 to 110 percent recovery range defined in the SAP.

[3]The spike recovery was lower than the 90 to 110 percent recovery range defined in the SAP.

[4]The RPD was greater than the 10 percent criterion defined in the SAP.

RPD = relative percent difference

4.3 THERMODYNAMIC ANALYSES

As requested by the safety screening DQO, TGA and DSC were performed on the solid samples (Babad and Redus 1994). No other physical tests were requested or performed.

4.3.1 Thermogravimetric Analysis

Thermogravimetric analysis measures the mass of a sample while its temperature is increased at a constant rate. Nitrogen is passed over the sample during heating to remove any released gases. Any decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample, either through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 130 °C to 140 °C) is due to water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions can often be differentiated by inflection points as well.

As can be seen in Table 4-3, the TGA results for sample number S95T001343 (95-AUG-038) and one of the four TGA results for sample number S95T001457 (95-AUG-039) were below the notification limit of 17 weight percent. A 95 percent lower confidence interval on the mean was calculated for the thermogravimetric analysis. The TGA results were substantially less than the 17 percent limit. The low value for the lower limit of the one-sided 95 percent confidence interval of the mean is due to the large variability in the data. No notification to cognizant personnel was made, because the DSC results for these samples showed no exothermic reactions. Low moisture content alone does not constitute an unsafe condition for the tank.

Because the DQO notification limit had been exceeded for these samples, secondary analysis of percent water by a gravimetric method was requested. Sample and duplicate gravimetric analysis results for sample S95T001343 were below the notification threshold. The moisture contents in the sample and duplicate were 14.18 percent and 14.59 percent, respectively. The average percent water of this sample and duplicate was approximately 20 percent higher than the average from the original TGA analysis. Sample and duplicate gravimetric analysis results for sample S95T001457 were above the notification limit with an average value of 19.94 percent water. The overall average for the gravimetric analysis was 17.2 weight percent, which is the reported weight percent water value for this report. This result was similar to the TGA average value of 15 percent. Table 4-3 presents the percent water results for tank 241-T-106.

4.3.2 Differential Scanning Calorimetry

In a DSC analysis, heat absorbed or emitted by a substance is measured while the substance is heated. Nitrogen is passed over the sample to remove any gases being released. The onset temperature for an endothermic or exothermic event is determined graphically.

No exothermic reactions were observed in any of the samples. All samples met the accuracy criterion stated in the SAP. The results for these samples are presented in Table 4-4.

Table 4-3. Percent Water Results for Tank 241-T-106.[1]

Sample Number	Riser	Instrument	Result % H_2O	Duplicate % H_2O	RPD %	Mean % H_2O	Auger Mean % H_2O
Thermogravimetric Analysis Results							
S95T001343	5	Perkin Elmer	11.85	12.06	1.76	11.96	11.96
S95T001457 R1	3	Mettler	18.38	19.91	7.99	19.14	18.12
S95T001457	3	Mettler	15.62	18.56	17.2[2]	17.09	
Mean Weight Percent Water = 15							
Relative Standard Deviation of the Mean = 20.5							
Gravimetric analysis results							
S95T001343	5	N/A	14.18	14.59	2.85	14.38	14.38
S95T001457	3	N/A	19.39	20.49	5.52	19.94	19.94
Mean Weight Percent Water = 17.2							
Relative Standard Deviation of the Mean = 16.2 percent							

Notes:

[1]Jo (1995a)

[2]The RPD was greater than the 10 percent criterion defined in the SAP.

Table 4-4. Differential Scanning Calorimetry Results for Tank 241-T-106.[1]

Sample Number	Riser	Run	Transition 1 Temp. range (° C)	Transition 1 Δ H (J/g)	Transition 2 Temp. range (° C)	Transition 2 Δ H (J/g)	Transition 3 Temp. range (°C)	Transition 3 Δ H (J/g)
S95T001343	5	1	amb-130	252.7	220-350	671.7	---	---
		2	amb-130	243.6	210-340	651.2	---	---
S95T001457	3	1	amb-170	439.7	220-350	609.9	---	---
		2	amb-140	475.1	220-340	658.7	---	---

Notes:

amb = ambient
Δ H = change in enthalpy

[1]Jo (1995a)

4.4 TANK HEADSPACE FLAMMABILITY

To address flammable vapor issues, the safety screening DQO requires sampling of the tank headspace. Prior to removal of the auger samples, vapor samples were obtained from the tank headspace and analyzed using a combustible gas meter. Readings were 0 percent of the lower flammability limit (WHC 1995), indicating no flammability concerns. In addition, the total organic carbon concentration (1.7 parts per million) and the oxygen level (20.6 percent) were measured.

This page intentionally left blank.

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

The purpose of this chapter is to evaluate the overall quality and consistency of the available results for tank 241-T-106 and to assess and compare these results against historical information and program requirements.

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 the use of the data. Most of the usual consistency checks were not possible given the limited scope of the required safety screening analyses. For example, an assessment of data quality made by the calculation of a mass and charge balance was not possible due to a lack of analyses, and the only possible comparison of different analytical methods was percent water by gravimetry and TGA.

5.1.1 Field Observations

According to the SAP, the expected depth of the tank waste to be sampled was 7.8 cm (3.1 in.) (Jo 1995b). However, waste material was found on the entire length of both 10-in. augers. However, the sampling anomalies should not have affected the average results.

5.1.2 Quality Control Assessment

The usual QC assessment includes an evaluation of the appropriate blanks, duplicates, spikes, and standards performed in conjunction with the chemical analyses. All of the pertinent QC tests were conducted on the 1995 sample results and reported in Jo (1995a). The SAP (Jo 1995b) established the specific accuracy and precision criteria for the QC checks. Sample and duplicate pairs that had one or more QC results outside the SAP target levels were identified (by footnoting) in the Section 4 data presentation tables.

One of two standard recoveries and one of two spike recoveries conducted with the total alpha activity analyses were slightly outside the target level. The precision (estimated by the RPD, which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times one hundred) between all total alpha activity sample pairs was also outside the criterion. However, the analytical results were far below the safety screening action limit, and any deviations were not substantial enough to affect the criticality evaluation. The RPD of one TGA sample pair was slightly outside the criteria, but a rerun produced an acceptable result. Finally, none of the samples exceeded the criterion for preparation blanks; thus, contamination was not a problem for any of the analyses.

The majority of the QC results were within the boundaries specified in the SAP. Although a few were outside their target levels, they were not found to substantially impact either the validity or the use of the data.

5.1.3 Data Consistency Checks

Comparisons of different analytical methods can help to assess the consistency and quality of the data. Examples would be the comparison of phosphorus as determined by inductively coupled plasma versus phosphate as determined by ion chromatography, and the calculation of a mass and charge balance to check the overall consistency of the data. Given the limited data available, the only consistency check possible was the comparison of percent water as determined by TGA and gravimetry.

The mean percent water result as determined by TGA was 15 percent, while the average from gravimetry was 17.2 percent (Jo 1995a). As a basis for comparison, an RPD was calculated between the two methods. This calculation resulted in an RPD of 14 percent, indicating fairly good consistency between the two methods.

5.2 COMPARISON OF ANALYTICAL RESULTS FROM DIFFERENT SAMPLING EVENTS

Comparisons for percent water and total alpha were not possible between the 1995 safety screening results and an April 1975 (Horton 1975) sludge sampling event. Because the last transfer from the tank was during the third quarter of 1974, the comparison would seem to be valid. However, no specific information was available regarding the 1975 data as to the sampling location or depth. The sample was described as being black and soft in appearance, as compared to the descriptions of the 1995 samples given in Section 3, which reported that samples varied from thin, dry, crusty, and gray to brown and damp.

The comparison of the 1975 and the 1995 total alpha activities was not possible because of the absence of a total alpha activity result, *per se*, from the 1975 data. Only a plutonium value was given. It is unknown which isotope or isotopes this result represented; therefore, for the purposes of this comparison, it was assumed that the measured isotope was ^{239}Pu. A conversion factor of 0.0615 Ci/g and a density of 1.29 g/mL (from the 1975 data report) were used to convert the 1975 reported value of 0.00711 g/L to 0.339 μCi/g. This value was compared to the 1995 reported total alpha activity value of 0.193 μCi/g.

The comparison of percent water results also yielded high RPDs, caused by the aging and drying of the waste that has occurred in the years between the two sampling events. The 1975 percent water results were 36.6 percent; the 1995 percent water results by TGA were 15 percent, and by the gravimetric method were 17.2 percent. Relative percent differences between the 1975 data and the 1995 TGA and gravimetric data were 84 and 72 percent, respectively.

5.3 TANK WASTE PROFILE

The SAP (Jo 1995b) specified that the objective of the 1995 sampling event was to obtain a vertical profile of the waste. The safety screening DQO (Babad and Redus 1994) specified that the waste be sampled from two widely spaced risers. In the case of the 1995 sampling for tank 241-T-106, two widely spaced risers were sampled (located approximately 180° apart and near the outer edge of the tank). The visual descriptions of the samples, presented here for information only, indicate some vertical differences (see Table 3-2). Material on flutes 1, 2, and 7-10 of auger sample 95-AUG-038 was described as thin, dry, brown, and crusty, while the material on flutes 3-6 appeared brown and damp. A possible explanation for dampness on flutes 3-6 is that larger samples take more time to dry out than smaller samples; only thin coats of sample material were found on flutes 1, 2 and 7-10. Auger sample 95-AUG-039 appeared to be more uniform, with the material on flutes 1-3 described as thin, dry, gray-brown, and crusty, while flutes 6-10 were thin, gray, and crusty. Flutes 4 and 5 contained very little material. No supernatant or drainable liquid were found in the 1995 auger samples.

The fact that two risers were sampled allowed a statistical analysis of the percent water and total alpha data. The statistical procedure known as the analysis of variance (ANOVA) was used to compare analyte concentrations in the two auger samples. The ANOVA generates a p-value that is compared to a standard significance level ($\alpha = 0.05$). If a p-value is below 0.05, there is sufficient evidence to conclude that the sample means are significantly different from each other. However, if a p-value is above 0.05, evidence is insufficient to conclude that the samples are significantly different from each other.

The ANOVA tests were conducted on the data for percent water by TGA, percent water by gravimetry, and total alpha activity. The statistical results indicated that the analyte concentrations were significantly different between the two risers for all three analytes. The p-values were 0.001 for total alpha activity, and 0.010 and 0.011 for percent water by TGA and gravimetry, respectively.

5.4 COMPARISON OF TRANSFER HISTORY WITH ANALYTICAL RESULTS

The HTCE data (from Table 2-4) for tank 241-T-106 were compared to the 1995 analytical results for percent water and total alpha. The HTCE percent water estimate was 71.3, which compares poorly to the 1995 gravimetric result of 17.2 percent (RPD = 122 percent) and the 1995 TGA result of 15 percent (RPD = 130 percent). For the total alpha comparison, only total plutonium was estimated by the HTCE, reporting a value of 0.974 μCi/g. This also compares poorly to the 1995 total alpha result of 0.193 μCi/g, yielding an RPD of 134 percent.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

Tank 241-T-106 is classified as a non-Watch List tank. This section details the data needs as defined in the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), and determines whether tank 241-T-106 has been appropriately categorized concerning safety issues. The safety screening DQO establishes decision criteria or notification limits for concentrations of analytes of concern. The decision criteria are used to determine if a tank is safe, or if further investigation into the tank's safety is warranted. Insufficient data were available to assess impacts on operational, environmental, or process development issues.

5.5.1 Safety Evaluation

The primary analytical requirements identified in the safety screening DQO (Babad and Redus 1994) were energetics, total alpha activity, moisture content, and flammable gas concentration. Table 5-1 lists the safety issue, the applicable analytes along with their notification limits, and the corresponding analytical results.

The waste fuel energy value was determined by DSC. No exothermic reactions were observed in the 1995 safety screening samples.

Half of the percent water primary and duplicate samples were below the 17 percent criterion as determined by both TGA (overall mean = 15 percent) and gravimetry (overall mean = 17.2 percent). The lower limit to one-sided 95 percent confidence interval on the mean percent water by TGA fell below the minimum criterion of 17 percent. However, the DSC results for these samples indicated no exotherms. No notifications were made because the low moisture content of the samples alone does not constitute an unsafe condition (Jo 1995a).

The potential for criticality can be assessed from the total alpha data. None of the individual samples from the 1995 data contained total alpha activity greater than 0.364 μCi/g, and the mean result was 0.193 μCi/g, well below the notification limit of 41 μCi/g (1 g/L) as specified in the safety screening DQO. A 95 percent confidence upper limit calculated for the total alpha activity results was also well below the notification limit of 41 μCi/g.

Table 5-1. Safety Screening Data Quality Objective Decision Variables and Criteria.

Safety Issue	Primary Decision Variable	Decision Criteria Threshold	Analytical Result
Ferrocyanide/Organics	Total fuel content	-481 joules/gram (-115 calories/gram)	No exothermic reactions
Organics	Percent moisture	17 weight percent	15% (TGA) 17.2% (gravimetry)
Criticality	Total alpha	1 g/L (41 μCi/g)	0.193 (μCi/g)
Flammable gas	Flammable gas	25% of the lower flammability limit	0% of the lower flammability limit

Note:

[1]Jo (1995b)
[2]WHC (1995)

In addition to weight percent water, energetics, and total alpha activity, the safety screening DQO requires measurement of the flammability of the gas in the tank headspace. Analysis of the headspace was performed as a requirement of the auger sampling procedure (WHC 1995) prior to sampling. The tank was found to be safe for sampling with a lower flammability limit of 0 percent (WHC 1995).

An important factor in assessing the safety of tank waste is the heat generated by the decay of the radioactive components of the waste and the possible resultant increase in temperature. The heat produced by the radioactive decay of the waste is estimated in the HTCE (Brevick et al. 1995b) to be 13.5 W (46 Btu/hr), and was calculated using data from Anderson (1990) and Horton (1975) to be 360 W (1,230 Btu/hr), decayed to 1996. Both values are well within the limit listed in Bergmann (1991) for single-shell tanks. Furthermore, because an upper temperature limit was exhibited (Section 2.4.3), it may be concluded that any heat generated by radioactive decay throughout the year is dissipated.

This page intentionally left blank.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The waste in tank 241-T-106 was auger sampled in July and August 1995. The sampling and analyses were performed in accordance with the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The sample analyses were performed at the Westinghouse 222-S Laboratory.

Percent water analytical results for one auger sample (95-AUG-038) were less than the safety screening DQO notification limit of 17 percent, with an average value of 11.96 weight percent as determined by TGA. Gravimetric analytical results from the same sample were slightly higher, at 14.38 weight percent. Auger sample 95-AUG-039 exhibited weight percent water TGA results just above the notification limit, with an average value of 17.09 weight percent water from the initial run and a rerun result of 19.14 weight percent water. Gravimetric analyses of sample 95-AUG-039 exhibited weight percent water results of 19.94. Notifications were not made, however, because the energetics values for all samples as measured by DSC were within the DQO limits of 481 joules per gram on a dry weight basis; in fact, no exothermic reactions were observed in any of the samples. Low moisture content alone does not constitute an unsafe condition. Total alpha activity measurements were all far below the DQO limits of 41 μCi/g. The tank headspace vapor concentrations were 0 percent of the lower flammability limit, 1.7 parts per million total organic carbon, and 20.6 percent oxygen.

The heat produced by the radioactive decay of the waste is estimated in the HTCE (Brevick et al. 1995b) to be 13.5 W (46 Btu/hr), and was calculated to be 360 W (1,230 Btu/hr), decayed to 1996. Both values are well within the limit listed in Bergmann (1991) for single-shell tanks.

This page intentionally left blank.

7.0 REFERENCES

Agnew, S. F., 1995, *Hanford Defined Wastes*, LAUR-94-2657, Rev. 2, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., P. Baca, R. Corbin, T. Duran, and K. Jurgensen, 1995a, *Waste Status and Transaction Record Summary for the Northwest Quadrant*, WHC-SD-WM-TI-669, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Agnew, S. F., P. Baca, R. Corbin, K. Jurgensen, and B. Young, 1995b, *Tank Layer Model (TLM) for Northeast, Southwest, and Northwest Quadrants*, LA-UR-94-4269, Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

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.

Bergmann, L. M., 1991, *Single-Shell Tank Isolation Safety Analysis Report*, WHC-SD-WM-SAR-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995a, *Supporting Document for the Northwest Quadrant Historical Tank Content Estimate Report for T-Tank Farm*, WHC-SD-WM-ER-320, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1995b, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 West Area*, WHC-SD-WM-ER-351, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DeLorenzo, D. S., A. T. DiCenso, D. B. Hiller, K. W. Johnson, J. H. Rutherford, D. J. Smith, and B. C. Simpson, 1994, *Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending November 30, 1995*, WHC-EP-0182-92, Westinghouse Hanford Company, Richland, Washington.

Horton, J. E., 1975, "Analysis of 106-T Sludge Sample," (letter to W. R. Christensen, April 22), Atlantic Richfield Company, Richland, Washington.

Jensen, L., and A. M. Liebetrau, 1988, *Statistical Techniques for Characterizing Single-Shell Tank Wastes*, WHC-SA-0348-FP, Westinghouse Hanford Company, Richland, Washington.

Jo, J., 1995a, *90-Day Safety Screening Results and Final Report for Tank 241-T-106, Auger Samples 95-AUG-038 and 95-AUG-039*, WHC-SD-WM-DP-143, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Jo, J., 1995b, *Tank 241-T-106 Auger Sampling and Analysis Plan*, WHC-SD-WM-TSAP-012, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Tran, T. T., 1993, *Thermocouple Status Single-Shell and Double-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1995, *Perform Auger Sampling of Ferrocyanide, Organic, Organic/Ferrocyanide, or Non-Watch List Storage Tanks*, Tank Farm Operating Procedure, TO-080-500, Rev/Mod B-7, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

HISTORICAL SAMPLING RESULTS

This page intentionally left blank.

APPENDIX A

HISTORICAL SAMPLING RESULTS

Table A-1 lists the analytical results from a historical sampling event. According to the tank waste history, the tank contents have not changed (with the exception of drying and radioactive decay) since this 1975 sampling.

Table A-1. Historical Sampling Results for Tank 241-T-106.[1]

Analyte	Analytical Result
METALS	moles/liter
Aluminum	6.10
Calcium	0.16
Iron	0.56
Magnesium	0.09
Manganese	0.28
Sodium	5.82
Plutonium	0.00711 (grams/liter)
Silicon	1.81
ANIONS	moles/liter
Nitrate	24.30
Nitrite	0.06
Phosphate	0.94
RADIONUCLIDES	microcuries/liter
^{125}Sb	54,800
^{137}Cs	5.27E+05
$^{144}CePr$	4.74E+05
$^{89/90}Sr$	6.33E+05
PHYSICAL PROPERTIES	
Percent water	36.6%
Wet density	1.29 grams/milliliter
Dry density	0.817 grams/milliliter

Note:

[1]Horton (1975)

This page intentionally left blank.

DISTRIBUTION SHEET

To	From	Page 1 of 5
Distribution	Data Assessment and Interpretation	Date 03/25/96
Project Title/Work Order		EDT No. EDT-615365
Tank Characterization Report for Single-Shell Tank 241-T-106, WHC-SD-WM-ER-544, Rev. 0		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
OFFSITE					
Sandia National Laboratory P.O. Box 5800 MS-0744, Dept. 6404 Albuquerque, NM 87815					
D. Powers		X			
Nuclear Consulting Services Inc. P. O. Box 29151 Columbus, OH 43229-01051					
J. L. Kovach		X			
Chemical Reaction Sub-TAP P.O. Box 271 Lindsborg, KS 67456					
B. C. Hudson		X			
Tank Characterization Panel Senior Technical Consultant Contech 7309 Indian School Road Albuquerque, NM 87110					
J. Arvisu		X			
U. S. Department of Energy - Headquarters Office of Environmental Restoration and Waste Management EM-563 12800 Middlebrook Road Germantown, MD 20874					
J. A. Poppitti		X			

DISTRIBUTION SHEET

To	From	Page 2 of 5
Distribution	Data Assessment and Interpretation	Date 03/25/96
Project Title/Work Order Tank Characterization Report for Single-Shell Tank 241-T-106, WHC-SD-WM-ER-544, Rev. 0		EDT No. EDT-615365 ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
<u>SAIC</u> 20300 Century Boulevard, Suite 200-B Germantown, MD 20874					
H. Sutter		X			
555 Quince Orchard Rd., Suite 500 Gaithersburg, MD 20878					
P. Szerszen		X			
<u>Los Alamos Laboratory</u> CST-14 MS-J586 P. O. Box 1663 Los Alamos, NM 87545					
S. F. Agnew (4)		X			
<u>Los Alamos Technical Associates</u>					
T. T. Tran	B1-44	X			
<u>Ogden Environmental</u> 101 East Wellsian Way Richland, WA 99352					
R. J. Anema		X			
<u>CH2M Hill</u> P. O. Box 91500 Bellevue, WA 98009-2050					
M. McAfee		X			
<u>Tank Advisory Panel</u> 102 Windham Road Oak Ridge, TN 37830					
D. O. Campbell		X			

DISTRIBUTION SHEET

To	From	Page 3 of 5
Distribution	Data Assessment and Interpretation	Date 03/25/96
Project Title/Work Order: Tank Characterization Report for Single-Shell Tank 241-T-106, WHC-SD-WM-ER-544, Rev. 0		EDT No. EDT-615365
		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
ONSITE					
Department of Ecology					
A. B. Stone	B5-18	X			
Department of Energy - Richland Operations					
L. Erickson	S7-53	X			
W. S. Liou	S7-54	X			
N. W. Willis	S7-54	X			
ICF-Kaiser Hanford Company					
R. L. Newell	S3-09	X			
Pacific Northwest Laboratory					
G. H. Beeman	S7-71	X			
S. F. Bobrowski	K7-28	X			
N. G. Colton	K3-75	X			
* J. R. Gormsen	K7-28				X
S. A. Hartley	K5-12	X			
J. G. Hill	K7-94	X			
L. K. Holton	K9-73	X			
G. J. Lumetta	P7-25	X			
B. D. McVeety	K6-84	X			
A. F. Noonan	K9-81	X			
K. M. Remund	K5-12	X			
J. T. Slankas	K9-81	X			
Westinghouse Hanford Company					
D. A. Barnes	R1-80	X			
G. R. Bloom	H5-61	X			
T. M. Brown	R2-12	X			
T. H. Bushaw	T6-30	X			
R. J. Cash	S7-15	X			
C. S. Cho	B4-55	X			
W. L. Cowley	H4-65	X			
M. L. Dexter	R1-51	X			
* L. A. Diaz	T6-06	1 advance copy			
G. L. Dunford	S7-81	X			

DISTRIBUTION SHEET

To	From	Page 4 of 5
Distribution	Data Assessment and Interpretation	Date 03/25/96
Project Title/Work Order		EDT No. EDT-615365
Tank Characterization Report for Single-Shell Tank 241-T-106, WHC-SD-WM-ER-544, Rev. 0		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
<u>Westinghouse Hanford Company continued</u>					
D. B. Engelman	R1-49	X			
K. O. Fein	H4-65				X
G. D. Forehand	S7-21	X			
J. S. Garfield	H5-49	X			
J. D. Guberski	R2-06				X
R. D. Gustavson	R1-51	X			
G. A. Hanson	S7-16	X			
D. L. Herting	T6-09	X			
B. A. Higley	H5-27	X			
N. A. Homan	H6-25	X			
J. W. Hunt	R2-12	X			
G. Jansen	H6-33	X			
L. Jensen	T6-07	X			
G. D. Johnson	S7-15	X			
K. K. Kawabata	S7-55	X			
T. J. Kelley	S7-21	X			
N. W. Kirch	R2-11	X			
M. J. Kupfer	H5-49	X			
D. L. McGrew	R3-25	X			
B. D. McVeety	K6-96	X			
J. E. Meacham	S7-15	X			
W. C. Miller	R1-30	X			
C. T. Narquis	T6-16	X			
R. J. Nicklas	R1-43	X			
D. E. Place	H5-27	X			
D. A. Reynolds	R2-11	X			
L. M. Sasaki	R2-12	X			
F. A. Schmittroth	H0-35	X			
N. J. Scott-Proctor	S5-01	X			
L. W. Shelton, Jr.	H5-49	X			
B. C. Simpson	R2-12	X			
G. L. Smith	H4-60				X
G. L. Troyer	T6-50	X			
D. A. Turner	S7-15	X			
D. J. Washenfelder	H5-27	X			
M. S. Waters	S6-30	X			
K. A. White	S5-13	X			
W. I. Winters	T6-50	X			
TFIC (Tank Farm Information Center)	R1-20	X			
Central Files	A3-88	X			
EDMC	H6-08	X			

DISTRIBUTION SHEET

To	From	Page 5 of 5
Distribution	Data Assessment and Interpretation	Date 03/25/96
Project Title/Work Order		EDT No. EDT-615365
Tank Characterization Report for Single-Shell Tank 241-T-106, WHC-SD-WM-ER-544, Rev. 0		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Westinghouse Hanford Company continued					
TCRC (10)	R2-12	X			

* Distribution Done