AUG 08 1995 START 9613456.1303 0041945

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT № 612677

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Characterization Plans, Coordination, and Reports	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: WM/Characterization	6. Cog. Engr.: L. A. Tusler	7. Purchase Order No.: NA
8. Originator Remarks: N/A		9. Equip./Component No.: NA
		10. System/Bldg./Facility: Tank Farms
11. Receiver Remarks:		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date: NA

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-489		0	Tank Characterization Report for Single-Shell Tank 241-C-105	NA	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.
1	1	Cog.Eng. L. A. Tusler	L A Tusler	8/8/95		Org Saf Prog D. A. Turner	for DAT	8/8/95		1	1
1	1	Cog. Mgr. J. G. Kristofzski	John Kunt	8/8/95		~~High Heat Saf Prog R. J. Cash~~	LJ			1	
		QA NA									
		Safety NA									
		Env. NA									

18.	19.	20.	21. DOE APPROVAL (if required)
L. A. Tusler L A Tusler 8/8/95	NA	J. G. Kristofzski John Kunt 8/8/95	Ctrl. No.
Signature of EDT Originator / Date	Authorized Representative for Receiving Organization / Date	Cognizant Manager / Date	[] Approved [] Approved w/comments [] Disapproved w/comments

AUG 1995 RECEIVED EDMC

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

BD-7400-172-1

9613456.1301

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-ER-489, REV 0
Document Title:	Tank Characterization Report for Single-Shell Tank 241-C-105
Release Date:	8/8/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz 8/8/95

9613456.1302

SUPPORTING DOCUMENT

SUPPORTING DOCUMENT	1. Total Pages ~~102~~ 101 kmg 8/8/95

2. Title	3. Number	4. Rev No.
Tank Characterization Report for Single-Shell Tank 241-C-105	WHC-SD-WM-ER-489	0

5. Key Words	6. Author
Waste Characterization; Single-Shell Tank; C-105; Tank Characterization Report; AW Farm; Waste Inventory; TPA Milestone M-44.	Name: L. A. Tusler L.A. Tusler Signature Name: T. T. Tran, LATA Ruth D. Schil for per telecon Signature Organization/Charge Code 75310/N4190

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-C-105. This report supports the requirements of Tri-Party Agreement Milestone M-44-08.

8. RELEASE STAMP

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WHC-SD-WM-ER-489
Revision 0

Tank Characterization Report for Single-Shell Tank 241-C-105

L. A. Tusler
Westinghouse Hanford Company

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Date Published
August 1995

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

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EXECUTIVE SUMMARY

This tank characterization report summarizes the information concerning the historical uses and present status of single-shell underground storage tank 241-C-105. It also presents information concerning sampling and analysis of the waste that the tank contains. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, milestone M-44-08[1].

Tank 241-C-105 is one of 16 underground storage tanks located in the C Tank Farm in the Hanford Site's 200 East Area. The tank went into service in February 1947, receiving metal waste that was generated by the bismuth phosphate process. The tank cascaded to tank 241-C-106 from June 1947 until the fourth quarter of 1947. During the service life of the tank, it received metal waste from the bismuth phosphate process, uranium recovery from the tri-butyl phosphate process, cladding waste from PUREX, and supernate from other waste storage tanks in the A, AX, B, BX, C, and TX tank farms. An estimate of the tank contents provided by the Historical Tank Content Estimate[2] is 204 kiloliters (kL) (54 kilogallons [kgal]) of unknown waste, 307 kL (81 kgal) of cladding waste from PUREX, and 57 kL (15 kgal) of uranium recovery waste. Partial interim isolation was completed in August 1983. The tank is actively ventilated and is categorized as sound. The tank is currently not on a Watch List and there are no current unreviewed safety questions associated with this tank.

[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.

[2]Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1994, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas*, ICF Kaiser Hanford Company, WHC-SD-WM-ER-349, Rev. 0A, ICF Kaiser Hanford Company, Richland, Washington.

The tank was listed as a high-heat tank (a tank with a heat load greater than 11,700 watts [W] or 40,000 Btu/hr) until 1993. Water was added periodically to the tank for cooling purposes until the tank's high-heat load status was re-evaluated in 1993. Based on actual field data the heat load was found to be 5,860 watts (20,000 Btu/hr)[3]; consequently, the tank was removed from the list of high-heat load tanks in July 1993, and water additions to the tank were suspended[4,5].

The tank is described and its status is summarized in Tables ES-1 and ES-2 and Figures ES-1 and ES-2. The tank, which has an operating capacity of 2,010 kL (530 kgal), contains 511 kL (135 kgal) of non-complexed waste. This includes 19 kL (5 kgal) of supernate and 492 kL (130 kgal) of sludge[6].

This report summarizes two sampling and analysis events. Sludge composition and properties are based on a core sample taken from the tank in 1986 and two core samples taken in March 1995. The data from the 1986 sampling event are considered to be the best estimate of the current waste because no significant transfers, except water additions for cooling, to or from the tank have been made since 1976. Because these samples were taken

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[3]Bander, T. J., and P. F. Stevens, 1993, *Thermal Analysis of Tank 21-C-105 in Support of Process Test*, WHC-SD-WM-ER-189, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[4]Fulton, J. C., 1993, *Recommendations Based on Thermal Analysis of Tank 241-C-105*, (internal memorandum to D. G. Hamrick and J. D. Thomson, March 3), Westinghouse Hanford Company, Richland, Washington.

[5]Wang, O. S., 1994, *Completion of Tank 241-C-105 Process Test*, (internal memorandum 74290-94-008, to R. E. Raymond, December 5) Westinghouse Hanford Company, Richland, Washington.

[6]Hanlon, B. M., 1995, *Waste Tank Summary for Month Ending April 30, 1995*, WHC-EP-0182-85, Westinghouse Hanford Company, Richland, Washington.

Table ES-1. Description and Status of Tank 241-C-105.

Tank description	
Type	Single-shell
Constructed	1943 to 1944
In-service	1947
Diameter	23 m (75 ft)
Usable depth	5.18 m (17 ft)
Operating capacity	2,010 kL (530 kgal)
Bottom shape	Dish
Ventilation	Active
Tank status (as of April 1995)	
Waste type	Non-complexed
Total waste volume	511 kL (135 kgal)
Sludge volume	492 kL (130 kgal)
Supernate volume	19 kL (5 kgal)
FIC surface level (July 1995)	112 cm (44.2 in.)
Waste Temperature (April 1994 - July 1995)	24.2 °C (75.6 °F) to 35.6 °C (96.1 °F)
Integrity	Sound
Watch List	None
Sampling dates	
Core sample	April 1986
Core samples	March 1995
Service status	
Declared inactive	November 1980
Partially interim isolated	August 1983

Notes:

FIC	=	Food Instrument Corporation
cm	=	centimeters
ft	=	feet
in.	=	inches
kL	=	kiloliters
kgal	=	kilogallons
m	=	meters
°C	=	degrees Celsius
°F	=	degrees Fahrenheit

Table ES-2. Single-Shell Tank 241-C-105 Concentrations and Inventories for Major Analytes of Concern.

Physical properties	Results		
pH[1]	9.69		
Bulk density[1]	1.55 g/mL		
Percent water[2]	40.0		
Heat load[3]	5,860 Watts (20,000 Btu/hr)		
Chemical constituents	**Sludge concentration**	**Liquid concentration**	**Inventory**
Metals[1]	**µg/g**	**µg/mL**	**kg**
Al(Aluminum)	61,800	9.02	47,100
Ca (Calcium)	7,790	4.15	5,940
Fe (Iron)	10,600	3.29	8,080
P (Phosphorous)	2,530	2,560	1,980
Si (Silicon)	39,900	103	30,400
Na (Sodium)	71,800	115,000	57,000
U (Uranium)	9,830	966	7,510
Ions[1]	**µg/g**	**µg/mL**	**kg**
NO_3^- (Nitrate)	10,500	34,300	8,660
Organics[1]	**µg C/g**	**µg C/mL**	**kg C**
Total organic carbon	999	2,870	817
Radionuclides[1]	**µCi/g**	**µCi/mL**	**Ci**
^{137}Cs	147	442	121,000
^{90}Sr	864	5.12	659,000
Total gamma	182	448	147,000

Table ES-2. Single-Shell Tank 241-C-105 Concentrations and Inventories for Major Analytes of Concern.

Notes:

Btu/hr	=	British thermal units per hour
C	=	carbon
Ci	=	Curie
g/mL	=	grams per milliliter
kg	=	kilogram
μg C/g	=	micrograms carbon per gram
μg C/mL	=	micrograms carbon per milliliter
μCi/g	=	microcuries per gram
μCi/mL	=	microcuries per milliliter
μg/g	=	micrograms per gram
μg/mL	=	micrograms per milliliter
NR	=	Not reported

[1]Weiss, R. L., 1987, *Reissue of Letter 65453-87-050*, (internal memorandum 65453-87-074 to Distribution, May 28), Westinghouse Hanford Company, Richland, Washington.

[2]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[3]Bander, T. J., and P. F. Stevens, 1993 *Thermal Analysis of Tank 241-C-105 in Support of Process Test*, WHC-SD-WM-ER-189, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Figure ES-1. Tank 241-C-105.

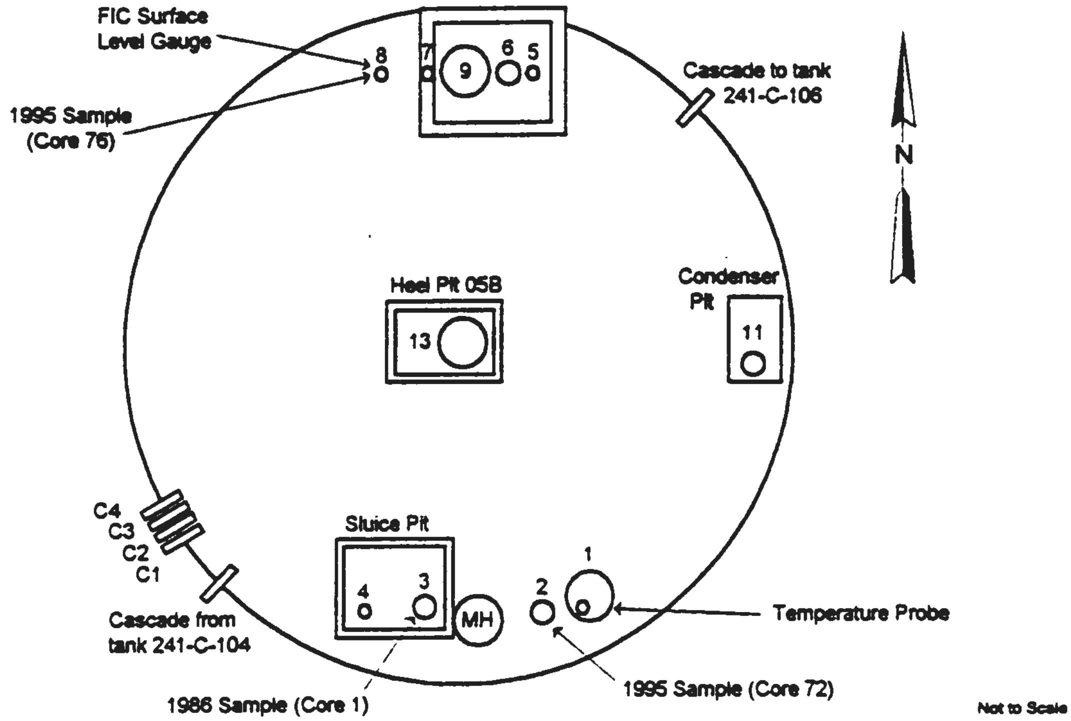
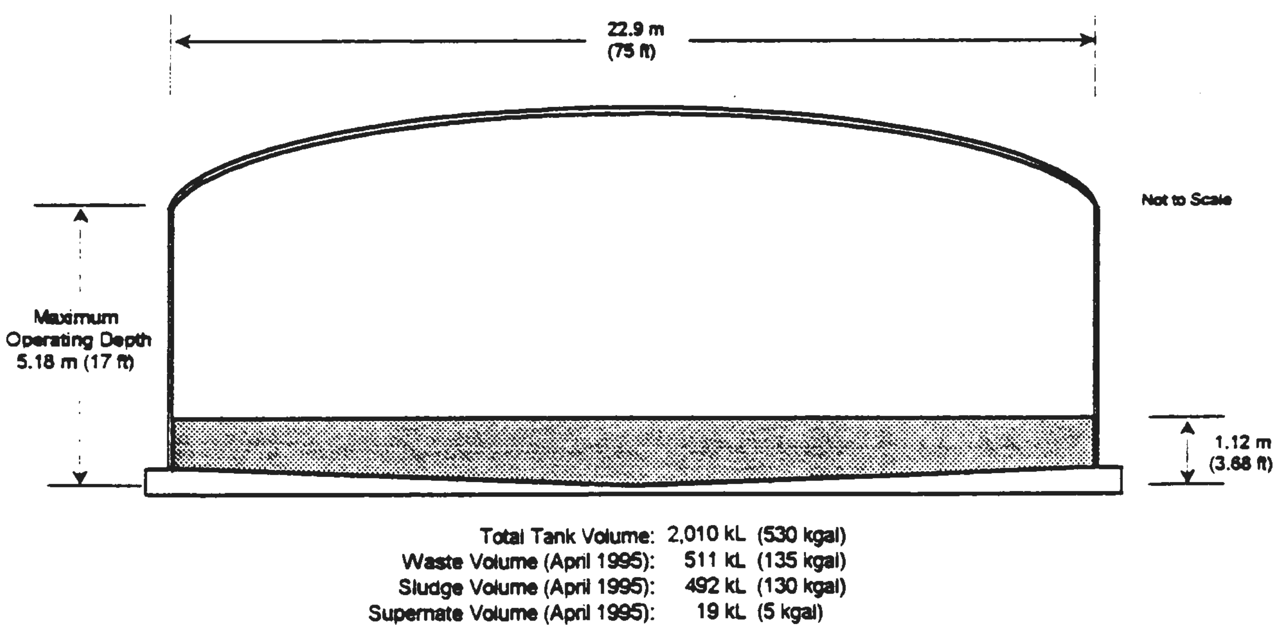


Figure ES-2. Waste Profile of Tank 241-C-105.



before the data quality objective(DQO) process was implemented, the resulting data do not fully satisfy the requirements for safety screening. The 1995 samples were taken and analyzed in accordance with the *Tank Safety Screening Data Quality Objective*[7] and *Interim Data Quality Objectives for Waste Pretreatment and Vitrification*[8].

The primary analytical requirements identified in the safety screening DQO are energetics, total alpha activity, moisture content, and flammable gas concentration. The 1995 waste samples, as measured by differential scanning calorimetry, exhibited one exothermic reaction of 524 joules/gram (J/g) (dry-weight basis) above the safety screening notification limit of 481 J/g. The sample duplicate and a rerun sample yielded results less than the notification limit (170 and 109 J/g, respectively). The percent water ranged from 4.44 to 42.2 for the solids samples, and from 59.6 to 76.8 for the drainable liquids. Two of the solid samples yielded results less than 17 percent water as required by the tank safety screening DQO.

Proper verbal and written notifications concerning the low percent water and the high energetic value were made on April 28, 1995 and May 3, 1995[9]. In addition to the low percent water and the high energetic values, a lithium analyses indicated some sample contamination from the hydrostatic head fluid. The secondary analytes required by the safety

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[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]Kupfer, M. J., J. M. Conner, R. A. Kirkbridge, and J. R. Mobley, 1994, *Interim Data Quality Objectives for Waste Pretreatment and Vitrification*, WHC-SD-WM-DQO-011, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[9]Sasaki, L. M., 1995, *45-Day Safety Screening Results for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

screening DQO were all less than the notification limit, with the exception of the bromide analyses, which corroborated the results of the lithium analyses. Organic Watch List controls are being applied to tank 241-C-105, pending final evaluation of the secondary analyte results (WHC 1995). The total alpha activity ranged from 0.177 to 2.00 microcuries/gram, well below the notification limit of 40.5 microcuries/gram. The temperature of the tank waste has ranged from 24.2 degrees Celsius (°C) (76.5 degrees Fahrenheit [°F]) to 35.6 °C (96.1 °F) during the period from April 1994 to July 1995. This report contains no headspace vapor sampling and analysis information for evaluation. The headspace vapor is analyzed in *Tank 241-C-105 Vapor Sampling and Analysis Tank Characterization Report*.[10] The vapor analyses indicated very low concentrations of flammable components.

The waste characteristics, physical properties, best estimates for the chemical and radiochemical composition, and the total tank inventory are summarized in Table ES-1 and Table ES-2. These estimates are a summary of the 1995 and 1986 sampling events as shown in Table 4-2. The sludge contains high concentrations of aluminum, iron, nitrate, silicon, sodium, and uranium. These observations are consistent with the operating history of the tank, which includes receipt of aluminum cladding waste from PUREX, uranium recovery waste, and metal waste from the bismuth phosphate process.

[10]Huckaby, J. L., 1995, *Tank 241-C-105 Vapor Sampling and Analysis Tank Characterization Report*, WHC-SD-WM-ER-443, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

CONTENTS

CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TERMS

ANOVA	analysis of variance
CWP	PUREX coating waste
CW	cladding waste
DQO	data quality objective
DSC	differential scanning calorimetry
FIC	Food Instrument Corporation
HDW	Hanford Defined Wastes
HTCE	Historical Tank Content Estimate
IC	ion chromatography
ICP	inductively coupled plasma
MW	metal waste
NCPLX	noncomplexed waste
P	PUREX high level waste
PSN	PUREX supernate wash
PSS	PUREX sludge supernate
PUREX	Plutonium-Uranium Extraction [Plant]
REDOX	reduction oxidation
RPD	relative percent difference
RSN	REDOX supernate
RSST	Reactive System Screening Tool
TBP	Tri-butyl phosphate waste
TGA	thermogravimetric analysis
TOC	total organic carbon
UL	upper limit
UR	uranium recovery
WHC	Westinghouse Hanford Company
WSTRS	Waste Status and Transaction Record Summary

1.0 INTRODUCTION

This tank characterization report presents an overview of single-shell tank 241-C-105 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. The results of the most recent sampling event associated with tank 241-C-105 are presented. In March 1995, two push-mode core samples were obtained for analysis in accordance with the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and the *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994). One push-mode core sample was taken in April 1986 as part of the single-shell tank waste characterization effort. The tank is presently classified as a low heat load tank and it is not on any Watch List, although organic Watch List controls are being applied to the tank pending final evaluation of the secondary analyte results of the 1995 samples (WHC 1995).

Tank 241-C-105 became inactive in 1980 and presently contains sludge from plutonium-uranium extraction (PUREX) cladding waste, uranium recovery waste, and other waste sources. The tank is partially interim isolated as described in Hanlon (1995); therefore, its contents are not likely to change, except for liquid removal for stabilization, until they are removed for pretreatment. The concentrations reported in this document reflect the current composition of the waste based on the 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 the information about the use and contents of tank 241-C-105. When possible, this information will be used to assess issues associated with safety, operations, environmental, and process development activities. This report also provides a reference point for more detailed information about tank 241-C-105.

1.2 SCOPE

The 1986 core sample was taken as part of an earlier waste characterization effort. A single core was recovered and the standard tank waste characterization analyses were performed (Adams 1985). Because of the nature of the waste in tank 241-C-105 (primarily significant quantities of heat-generating radionuclides), additional analyses were requested on this core sample in order to better assess the waste management options for these wastes (Weiss 1987).

The core samples obtained in 1995 were acquired in accordance with the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and the *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994). The samples underwent a safety screening analysis, which includes differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and measurement of the total alpha activity, in accordance with the tank characterization plan (Schreiber 1995). Also included in the safety screening DQO is analysis of the flammable gas in the tank. In addition, lithium analyses by inductively coupled plasma atomic emission spectroscopy were performed to determine if the samples contained hydrostatic head fluid. Bromide analyses were performed on the samples that exceeded the lithium notification limit of 100 micrograms per gram (μg/g). Total organic carbon and cyanide analyses were required for the solids of one sample segment, because an exotherm exceeding the notification limit of 481 joules/gram (dry basis) as specified in the tank characterization plan was found in that segment (Schreiber 1995). Samples were also archived for the Pretreatment Program.

This report does not include any information on vapor space sampling and analysis to determine the composition of the tank headspace gases. The vapor space sampling results are reported in *Tank 241-C-105 Vapor Sampling and Analysis Tank Characterization Report* (Huckaby 1995). The vapor analyses indicated very low concentrations of flammable components.

2.0 HISTORICAL TANK INFORMATION

Tank 241-C-105 is not in active service, and its present waste volume is not expected to change. The most current volume status of the tank is provided in routinely updated reports such as Hanlon (1995). Tank history includes tank design information, waste transfer history, waste temperatures, and level surveillance data.

2.1 TANK STATUS

According to Hanlon (1995), tank 241-C-105 contains 511 kiloliters (kL) or 135 kilogallons (kgal) of noncomplexed waste. The waste depth is approximately 112 centimeters (cm) or 44.2 inches (in.) with reference to the side-bottom of the tank. The tank waste consists of sludge, supernate, and drainable interstitial liquid, and contains no saltcake. Tank 241-C-105 entered service in February 1947 and received metal waste (MW) from the bismuth phosphate process. It is the second tank in a three-tank cascading series. Tank 241-C-105 is actively ventilated and is categorized as sound with partial interim isolation completed in August 1983. Tank 241-C-105 is not on any Watch List, although organic Watch List controls are being applied to the tank pending final evaluation of the secondary analyte results of the 1995 samples (WHC 1995). There are no unreviewed safety questions associated with this tank. The average in-tank waste temperature on July 1, 1995 was 32.7 °C (90.8 °F). The average in-tank vapor temperature on July 1, 1995 was 29.5 °C (85.0 °F).

Tank 241-C-105 was previously listed as a high-heat tank (a tank with a heat load greater than 11,700 watts (W) (40,000 British thermal units per hour [Btu/hr]). Water was therefore added periodically to the tank for cooling purposes. The high-heat load status was re-evaluated in Bander and Stevens (1993) based on a thermal analysis of field data. This analysis concluded that the best-estimate heat generation rate for tank 241-C-105 is approximately 5,860 W (20,000 Btu/hr), with a conservative upper bound of about 7,320 W (25,000 Btu/hr). As a result, the tank was removed from the list of tanks with high-heat loads in July 1993 and water additions to the tank were suspended (Fulton 1993 and Wang 1994).

The approximate volumes of the different waste phases contained within the tank are shown in Table 2-1.

Table 2-1. Summary of Tank 241-C-105 Contents and Status.

Waste form	Volume kiloliters (kilogallons)
Total waste	511 (135)
Supernatant liquid	19 (5)
Drainable interstitial liquid	34 (9)
Drainable liquid remaining	53 (14)
Pumpable liquid remaining	30 (8)
Sludge	492 (130)
Saltcake	0 (0)

2.2 TANK DESIGN AND BACKGROUND

Tank 241-C-105 is one of twelve 2,010 kL (530 kgal) and four 208 kL (55 kgal) tanks that comprise the C Tank Farm located in the north half of the 200 East Area at the Hanford Site (see Figure 2-1). Construction of the C Tank Farm occurred between 1943 and 1944. For more information about the C Tank Farm and single-shell tanks, refer to the *Tank Characterization Reference Guide* (De Lorenzo et al. 1994). These tanks are first-generation tanks, with dished bottoms, and are arranged in four cascades of three tanks each. When the first tank in a cascade became full, waste would flow to the next tank. Tank 241-C-105 is the second tank in a cascade that starts with tank 241-C-104 and ends with tank 241-C-106.

Tank 241-C-105 is a single-shell tank consisting of a carbon-steel liner within a reinforced-concrete shell and dome. It has a diameter of 22.9 meters (m) or 75 feet (ft) and an operating depth of about 5.18 m (17 ft). Figure 2-2 shows the basic design of tank 241-C-105. Instruments, which enter the tank through risers, monitor the temperature and liquid level. Figure 2-3 shows the positions of these risers. Table 2-2 provides a list of tank 241-C-105 risers showing the riser size and use. The waste surface level within the tank is measured with a Food Instrument Corporation (FIC) device. Waste entered the tank through a cascade inlet in the tank sidewall from tank 241-C-104 until mid-1947. The cascade outlet was located in the tank wall opposite the cascade inlet and allowed waste to overflow to tank 241-C-106.

Nine external drywells are associated with tank 241-C-105, and five had activity prior to 1990. The drywells are currently in service, and readings are taken monthly. No activity has been seen in the drywells since 1990.

Figure 2-1. Location of the C Tank Farm.

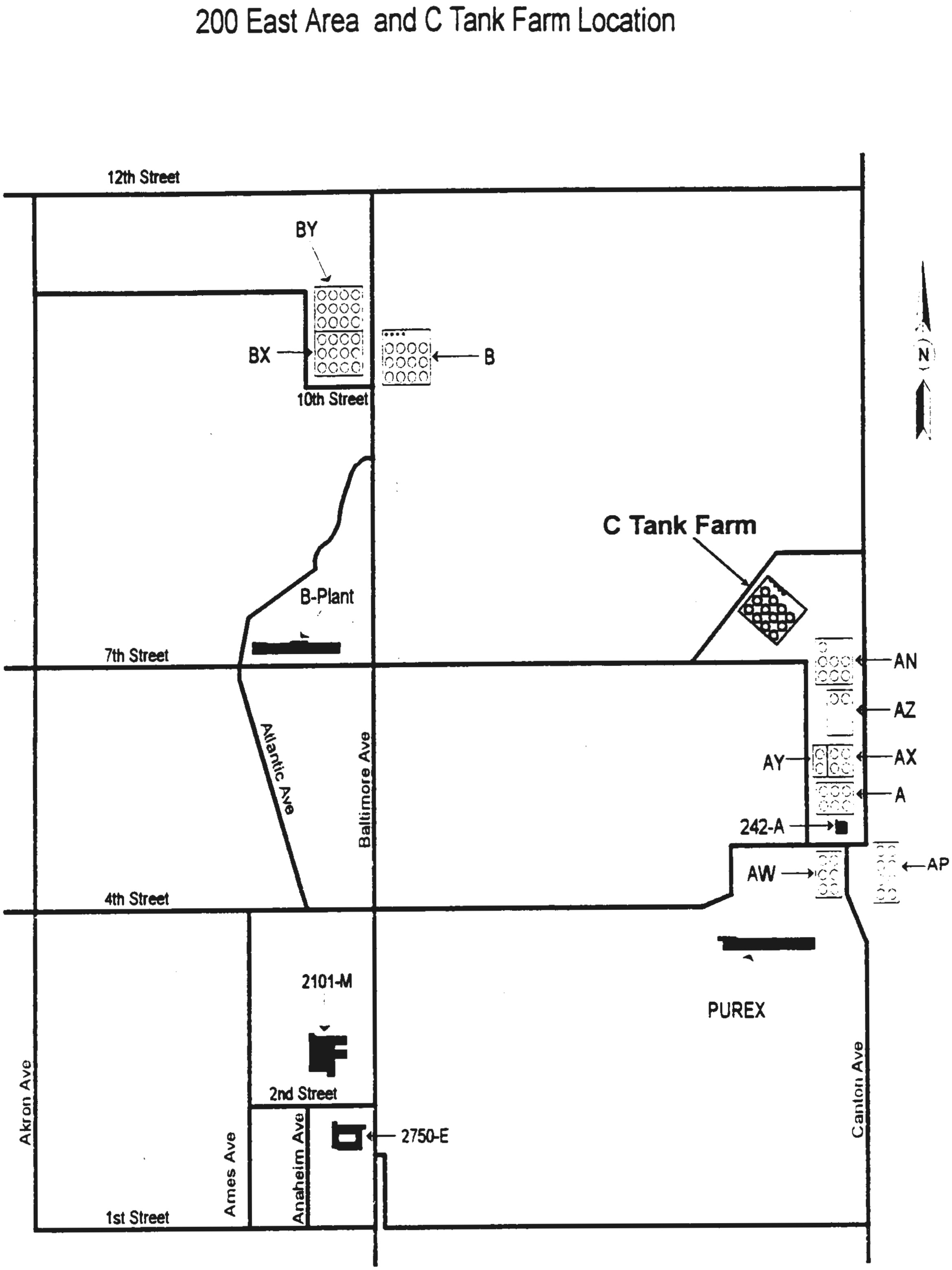


Figure 2-2. Tank 241-C-105 Cross-Section.

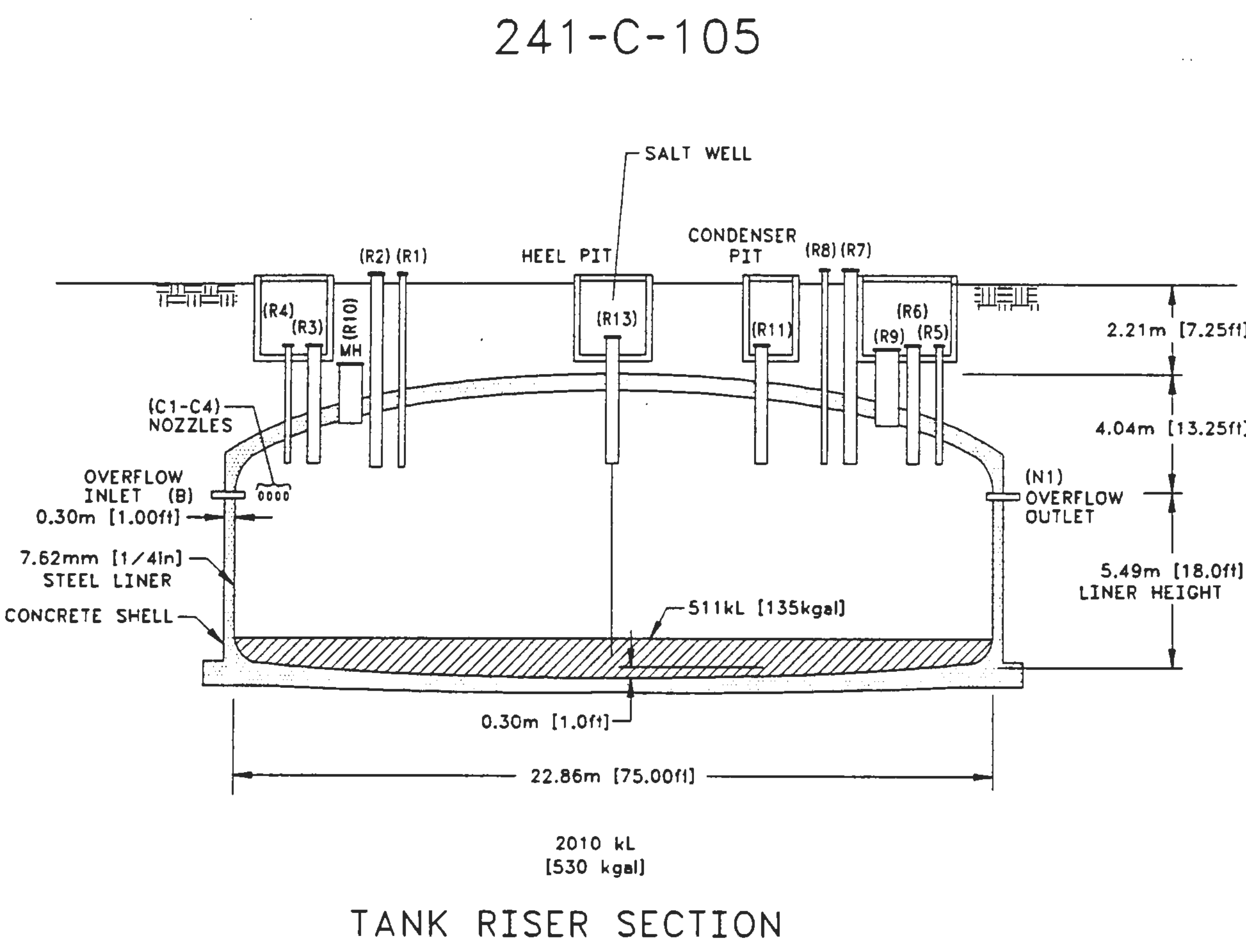


Figure 2-3. Tank 241-C-105 Plan View.

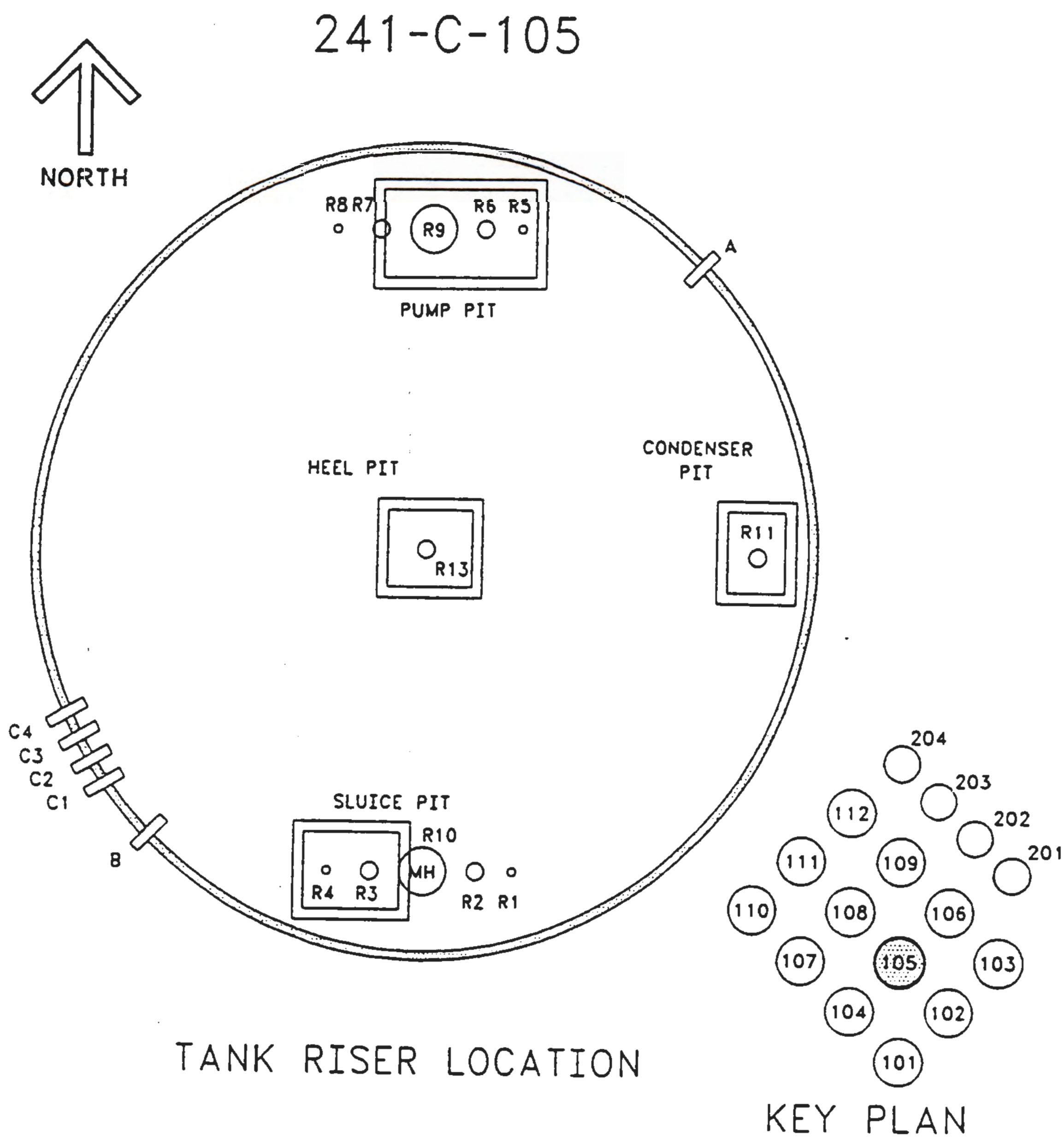


Table 2-2. Tank 241-C-105 Risers.

Riser number	Diameter (inches)	Description and comments
R1	4	Bench mark, temperature probe
R2	12	Air inlet filter/observation port
R3	12	Flange, lead covered, weather covered
R4	4	Recirculating dip leg, weather covered
R5	4	Recirculating dip leg, weather covered
R6	12	Sluicing access, weather covered
R7	12	Lead covered, weather covered
R8	4	Food Instrument Corporation liquid level gauge/pressure gauge
R9	42	Sludge pump, weather covered
R10	42	Manhole, below grade
R11	12	Exhauster riser
R13	26	Distributor jet, weather covered
A	3	Outlet nozzle overflow
B	3	Inlet nozzle overflow
C1	3	Spare
C2	3	Spare
C3	3	Spare
C4	3	Spare

2.3 PROCESS KNOWLEDGE

This section summarizes the transfers into and out of tank 241-C-105 and describes the waste types that comprise these transfers. When the tank went into service, it received metal waste that was generated by the bismuth phosphate process. The tank cascaded to tank 241-C-106 from June 1947 until the fourth quarter of 1947. During the service life of the tank, it received metal waste from the bismuth phosphate process, uranium recovery waste from the uranium recovery process, aluminum cladding waste from PUREX, and supernate from other waste storage tanks in the A, AX, B, BX, C, and TX tank farms. The estimated amounts of waste added and removed from the tank are summarized in Table 2-3. The fill history of this tank is shown in Figure 2-4 (Brevick et al. 1995).

Table 2-3. Tank 241-C-105 Major Transfers (4 sheets).

Year: Qtr	Waste Received by Tank 241-C-105				Waste Transferred out of Tank 241-C-105		
	Transaction source	# T	Waste type	Waste amount kL (kgal)	# T	X TF (Waste Type)	Waste Amount kL (kgal)
1947:1-1947:4	241-C-104	10	MW	4,012 (1,060)	5	241-C-106 (MW)	2,006 (530)
1953:3-1953:4	-	-	-	-	1	Ur Recovery (MW)	1,824 (482)
1954:1	Supernate sluiced	3	SU	1,533 (405)	-	-	-
1954:2	-	-	-	-	1	241-C-104 (MW)	1,715 (453)
1954:3	Unknown	1	TBP	2,067 (546)	-	-	-
1956:1	-	-	-	-	1	241-C-111 (TBP)	1,113 (294)
1956:2	-	-	-	-	1	241-C-112 (TBP)	655 (173)
1956:3	241-C-104	1	CW	1,737 (459)	-	-	-
1957:2	-	-	-	-	1	241-BY-111 (TBP/CW)	500 (132)
1957:3	-	-	-	-	3	241-BY-112 (TBP/CW)	863 (228)
1957:3-1960:2	Unknown	30	CW	9,016 (2,382)	-	-	-
1957:4-1958:4	-	-	-	-	3	241-BY-110 (TBP/CW)	2,718 (718)
1958:4-1959:1	-	-	-	-	2	241-BY-107 (TBP/CW)	1,537 (406)

Table 2-3. Tank 241-C-105 Major Transfers (4 sheets).

Year: Qtr	Waste Received by Tank 241-C-105				Waste Transferred out of Tank 241-C-105		
	Transaction source	# T	Waste type	Waste amount kL (kgal)	# T	X TF (Waste Type)	Waste Amount kL (kgal)
1959:1	-	-	-	-	2	241-BY-108 (TBP/CW)	1,154 (305)
1959:2-1959:3	-	-	-	-	2	241-C-109 (TBP/CW)	1,571 (415)
1959:4	-	-	-	-	2	241-C-111 (TBP/CW)	708 (187)
1963:2	-	-	-	-	1	241-C-102 (TBP/CW)	1,529 (404)
1963:4	241-A-102	1	P	1,541 (407)	-	-	-
1964:1-1967:3	-	-	-	-	2	Steaming (CW/P)	382 (101)
1967:4-1976:2	-	-	-	-	26	B Plant (RSN, P, PSS)	68,342 (18,056)
1968:1-1969:1	241-AX-102	6	PSN	7,210 (1,905)	-	-	-
1969:1	241-A-104	1	P	2,014 (532)	-	-	-
1969:2-1969:3	A FARM	2	P	4,512 (1,192)	-	-	-
1969:4-1970:2	241-A-102	9	P	3,736 (987)	-	-	-
1969:3-1970:2	241-C-103	2	P	4,255 (1,124)	-	-	-
1969:3-1976:1	Unknown	6	WTR	2,562 (677)	-	-	-
1969:4	241-C-106	1	P	666 (176)	-	-	-

Table 2-3. Tank 241-C-105 Major Transfers (4 sheets).

Year: Qtr	Waste Received by Tank 241-C-105				Waste Transferred out of Tank 241-C-105		
	Transaction source	# T	Waste type	Waste amount kL (kgal)	# T	X TF (Waste Type)	Waste Amount kL (kgal)
1969:4	241-C-101	1	P	1,529 (404)	-	-	-
1970:3-1970:4	241-TX-101	2	WTR	394 (104)	-	-	-
1970:3-1970:4	241-TX-101	2	RSN	3,554 (939)	-	-	-
1970:4	241-TX-105	1	RSN	863 (228)	-	-	-
1970:4	241-TX-102	1	RSN	2,578 (681)	-	-	-
1971:1	241-TX-106	1	RSN	2,123 (561)	-	-	-
1971:1	241-TX-106	1	WTR	481 (127)	-	-	-
1971:1	241-C-106	1	PSS	3,142 (830)	-	-	-
1972:1	241-B-103	1	PSS	1,132 (299)	-	-	-
1972:2	241-A-103	1	PSS	1,139 (301)	-	-	-
1972:2	241-A-101	1	PSS	1,453 (384)	-	-	-
1972:3	241-C-104	1	P	129 (34)	-	-	-
1972:3-1976:1	241-AX-103	11	P/PSS	22,668 (5,989)	-	-	-
1972:4	241-BX-104	1	P	537 (142)	-	-	-

Table 2-3. Tank 241-C-105 Major Transfers (4 sheets).

	Waste Received by Tank 241-C-105				Waste Transferred out of Tank 241-C-105		
Year: Qtr	Transaction source	# T	Waste type	Waste amount kL (kgal)	# T	X TF (Waste Type)	Waste Amount kL (kgal)
1976:1	241-AX-104	1	PSS	886 (234)	-	-	-
1979:3	-	-	-	-	1	Adj. solids level	189 (50)
1993:2	-	-	-	-	1	Unknown (NCPLX)	83 (22)

Notes:

CW	=	cladding waste
kgal	=	kilogallons
kL	=	kiloliters
MW	=	metal waste
NCPLX	=	noncomplexed waste
P	=	PUREX high-level waste
PSN	=	PUREX supernate wash waste
PSS	=	PUREX sludge supernate
Qtr	=	quarter
RSN	=	reduction-oxidation (REDOX) supernate
SU	=	supernate (liquid considered free of contamination to the extent it could be pumped to a crib).
# T	=	Number of transfers
TBP	=	tri-butyl phosphate-waste from solvent based uranium recovery operations in the 1950's; renamed "UR" waste
X TF	=	transfer to tank farms
WTR	=	water

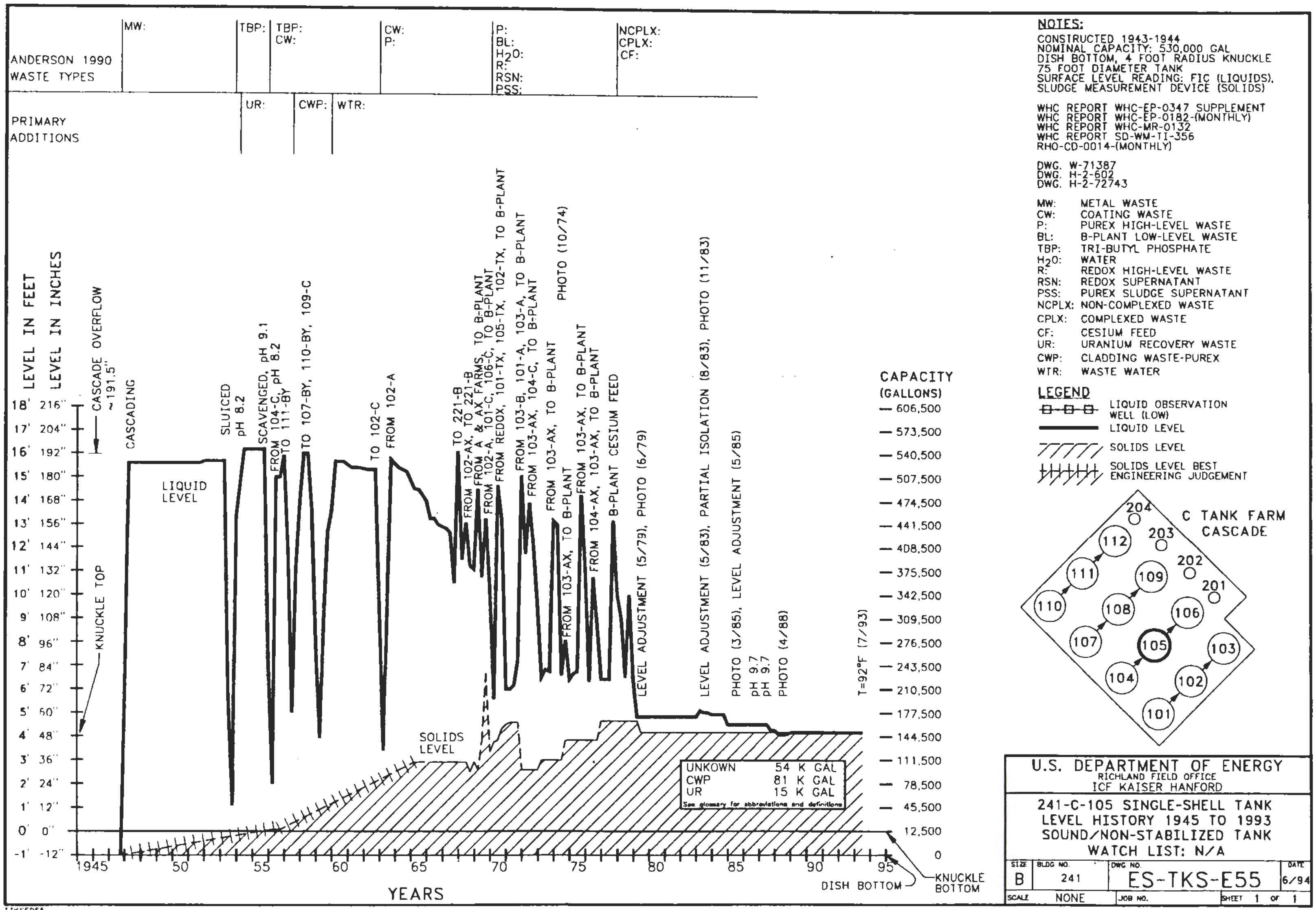


Figure 2-4. Tank 241-C-105 Surface Level History.

2.3.1 Waste Transfer History

The following information was obtained from the document, *History and Status of Tank 241-C-105 and 241-C-106* (Walker 1977).

Tank 241-C-105 was placed in service during the first quarter of 1947. The first waste it received was metal waste (MW) from the bismuth phosphate process. The tank was the second in a cascade that included tanks 241-C-104 and 241-C-106. Metal waste from the extraction process contained all of the uranium, 90 percent of the original fission product activity, and approximately 1 percent of the plutonium. This waste was brought to the neutral point with 50 percent caustic and then treated with an excess of sodium carbonate. The procedure yielded almost completely soluble waste at a minimum total volume. The MW remained in the tank until the third quarter of 1953, when a sluice mining program for recovery of the uranium was started. Virtually no solids were left after the last transfer of the slurry.

The tank was again filled to capacity during July and August 1954 with uranium recovery waste generated during the processing of MW to recover uranium. The treatment involved addition of potassium ferrocyanide ($K_4Fe[CN]_6$) to act as a scavenging agent for cesium. In April 1956, the tank was pumped to a 299 kL (79 kgal) heel, and the record states a sludge volume of 57 kL (15 kgal). This was the first reported solids measurement.

In August 1956, tank 241-C-105 received PUREX coating waste (CWP) enroute to the 241-BY Tank Farm and to other tanks within the 241-C Tank Farm. The tank remained full and static from mid-1960 to the second quarter of 1963, when it was pumped to a 473 kL (125 kgal) heel; there was no record of a sludge measurement. Then, during the last quarter of 1963, the first transfer of PUREX neutralized high-level waste was received from tank 241-A-102. The ending volume was 2,013 kL (532 kgal), and a solids volume of 413 kL (109 kgal) was recorded. A significant liquid level decrease of 91 cm (36 in.) was recorded during the static period between the time of fill and the fourth quarter of 1967. Although "steaming" was indicated as the cause of this waste loss, no documentation of other decrease studies or temperature data are available. A 414 kL (109 kgal) sludge volume was first recorded in 1965 (two years after the PUREX high-level waste transfer).

From 1967 until February 1977, tank 241-C-105 served as a receiver for PUREX supernate wash waste and PUREX sludge supernate from the 241-A and 241-AX tank farms and also from tanks 241-C-103 and 241-C-106. Although administrative controls were applied to prevent/minimize it, some A and AX solids were believed to have been transported to 241-C-105. This material was then pumped to the 221-B Building for cesium recovery processing (Walker 1977). This material is the source of Sr^{90} that contributes to the approximately 5,860 W (20,000 Btu/hr) heat load. The tank was declared inactive in November 1980. A synopsis of the major waste received by tank 241-C-105 is presented in Table 2-4.

Table 2-4. Estimated Total Volumes of Waste Types Received by Tank 241-C-105.

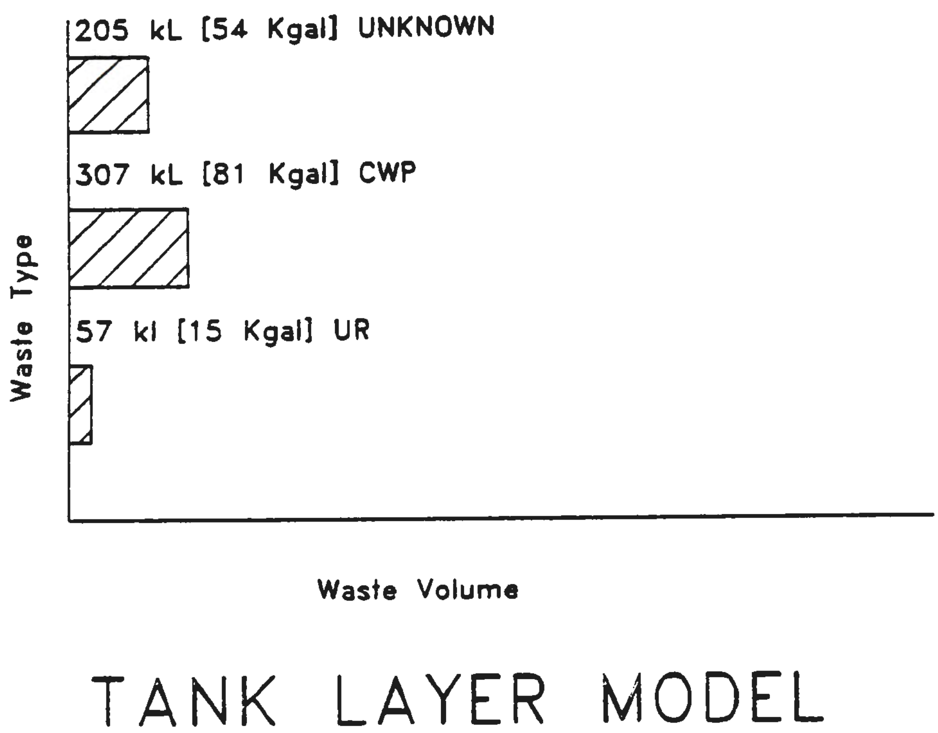
Waste type	Estimated cumulative volume (kilogallons)	Years received
Metal waste	4,012 (1,060)	1947
Supernate	1,530 (405)	1954
Tri-butyl phosphate waste	2,070 (546)	1954
Cladding waste	10,800 (2,840)	1956-1960
PUREX high level waste	30,240 (7,990)	1963-1972
PUREX supernate waste	7,230 (1,910)	1968-1969
Water	10,900 (2,880)	1969-1976
REDOX supernate	9,120 (2,410)	1970-1971
PUREX sludge supernate	19,080 (5,040)	1971-1976

2.3.2 Historical Estimation of Tank Contents

The following is an estimate of the contents for tank 241-C-105 based on historical transfer data. The historical data used to derive the Historic Tank Content Estimate (HTCE) come from the *Waste Status and Transaction Record Summary for the Northeast Quadrant* (WSTRS) (Agnew et al. 1994), *Hanford Defined Wastes: Chemical and Radionuclide Compositions* (HDW) (Agnew 1995a), and the *Tank Layer Model for Northeast, Southwest, and Northwest Quadrants* (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 derived from it. 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 an estimate that requires further evaluation using analytical data.

Based on the HTCE, tank 241-C-105 contains 204 kL (54 kgal) of an unknown waste type, 307 kL (81 kgal) of CWP, and 57 kL (15 kgal) of uranium recovery (UR) waste. Figure 2-5 shows a graphical representation of the estimated waste type and volumes for the tank layers. The UR waste (the bottom waste layer) should contain large quantities of sodium, iron, nitrate, sulfate and uranium. Also present will be quantities of strontium and cesium; therefore, this layer will have an activity that is larger than the CWP waste layer. The CWP is the layer of waste directly above the UR layer and should be rich in aluminum, sodium nitrates, nitrites, and uranium. The amount of uranium for this layer will be less than the UR waste layer. Cesium and strontium are present, but in such quantities that the

Figure 2-5. Tank Layer Model.



activity in this layer will be the lowest of the two known layers. The CWP layer can further be distinguished from the UR layer by the absence of iron (found in the UR layer) and the presence of a significant amount of aluminum (absent in the UR layer). The top waste layer in tank 241-C-105 cannot presently be determined from historic data. Therefore, comparisons with the other waste layers cannot be accomplished at this time. Table 2-5 shows an estimate of the expected waste constituents and their concentrations. This estimate is from the *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas* (Brevick et al. 1995). The estimated heat load seems to be very low compared to the estimates presented in Wang (1994).

2.4 SURVEILLANCE DATA

2.4.1 Surface Level Readings

The waste surface level within tank 241-C-105 is measured with an automatic gauge through riser 8 (see Figure 2-3). The automatic gauge, manufactured by Food Instrument Corporation (FIC), uses a conductivity probe. The gauge is connected electronically to the Computer Automated Surveillance System. A daily reading from the automatic gauge is stored electronically in the Surveillance Analysis Computer System database. For a further discussion of surface level gauges, refer to the *Tank Characterization Reference Guide* (De Lorenzo et al. 1994). The most recent surface level available from the FIC gauge was 112 cm (44.2 in.) on July 1, 1995. A graphical representation of the surface level history is shown in Figure 2-4.

2.4.2 Internal Tank Temperatures

Tank 241-C-105 has a single thermocouple tree with 16 thermocouples to monitor the waste temperature, but it appears that only seven of the thermocouples are functional. Elevations are available for four of the thermocouples. Thermocouple 1 is at 36.6 cm (14.4 in.) from the bottom of the tank. Thermocouple 2 is at 96.3 cm (37.9 in.) from the bottom of the tank. Thermocouple 3 is at 157 cm (61.9 in.) from the bottom of the tank. Thermocouple 6 is at 488 cm (192 in.) from the bottom of the tank (Tran 1993).

The maximum temperature measured in the tank on July 12, 1995, was 33.6 °C (92.5 °F) at thermocouple 1. Thermocouples 1 through 4 have similar temperature readings from 1987 to present. Temperature readings for thermocouples 5, 6, and 7 are limited. Data are available from 1988 to 1989 for thermocouple 5. Thermocouple 6 has data available from 1988 to 1989. Thermocouple 7 has one data point in 1990. Review of the tank 241-C-105 level history indicates that for the time periods stated above, thermocouples 1 and 2 were in or near the solids and thermocouples 3 through 7 were in the vapor space.

Table 2-5. Single-Shell Tank 241-C-105 Historical Inventory Estimate (2 sheets)[1].

Solids composite inventory estimate[2]			
Physical properties			
Total solid waste	8.20E+05 kg (150 kgal)		
Heat load	10.2 W (35 Btu/hr)		
Bulk density	1.44 (g/cc)		
Void fraction	0.799		
Water wt%	70.4		
TOC wt% C (wet)	0		
Chemical constituents	mole/L	ppm (μg/g)	kg
Na^+	2.04	3.26E+04	2.67E+04
Al^{+3}	4.89	9.15E+04	7.50E+04
Fe^{+3} (total Fe)	0.970	3.75E+04	3.08E+04
Cr^{+3}	6.46E-03	233	191
Ni^{+2}	5.16E-02	2.10E+03	1.72E+03
Ca^{+2}	0.107	2.98E+03	2.44E+03
OH^-	19.1	2.25E+05	1.85E+05
NO_3^-	0.763	3.28E+04	2.69E+04
NO_2^-	0.435	1.39E+04	1.14E+04
CO_3^{-2}	0.120	5.00E+03	4.10E+03
PO_4^{-3}	9.32E-03	613	503
SO_4^{-2}	0.101	6.70E+03	5.49+03
Si (as SiO_3^{-2})	1.08E-02	211	173
Cl^-	1.48E-02	364	298
Radiological constituents			
Pu	—	0.798 (μCi/g)	10.9 (kg)
U	0.142 (mole/L)	2.34E+04 (μg/g	1.92E+04 (kg)
Cs	1.77E-03 (Ci/L)	1.23 (μCi/g)	1.01E+03 (Ci)
Sr	1.47E-03 (Ci/L)	1.02 (μCi/g)	835 (Ci)

Table 2-5. Single-Shell Tank 241-C-105 Historical Inventory Estimate (2 sheets)[1].

Notes:

TOC	=	total organic carbon
Btu/hr	=	British thermal units per hour
Ci	=	curies
Ci/L	=	curies per liter
g/cc	=	grams per cubic centimeter
kg	=	kilograms
kgal	=	kilogallons
kW	=	kilowatts
μCi/g	=	microcuries per gram
μg/g	=	micrograms per gram
mole/L	=	moles per liter
ppm	=	parts per million
wt%	=	weight percent

Unknowns in the tank inventory are assigned by the Tank Layer Model.

[1]Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995, *Historical Tank Content Estimate for the Northeast Quadrant of Hanford 200 East Areas*, WHC-SD-WM-ER-349, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

[2] Composite inventory excludes supernatant. Only constituents with values other than zero are shown.

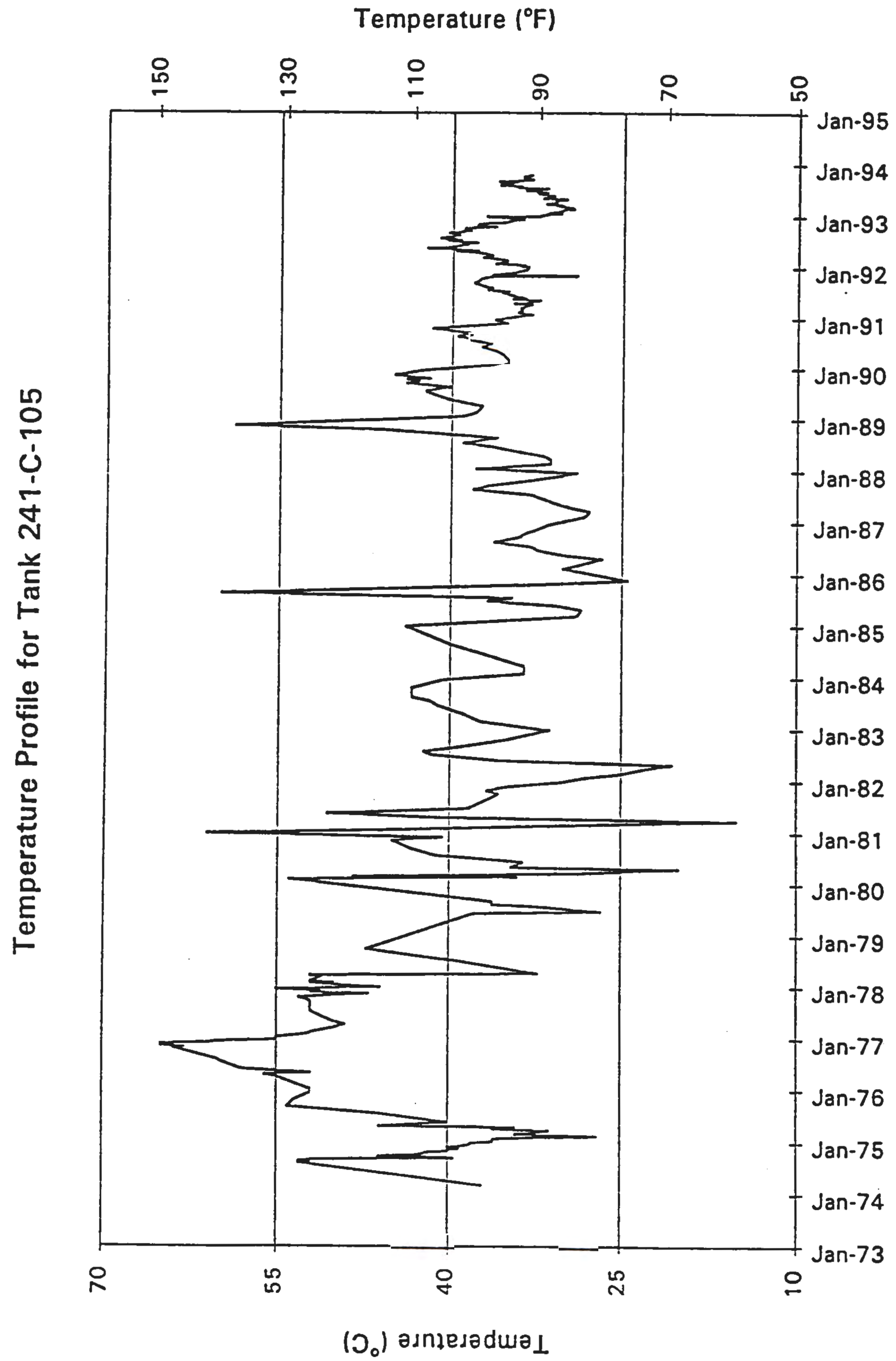
The mean temperature of the first data recorded in August 1974 for thermocouples 1 through 4 is 48 °C (119 °F). The median temperature is 49 °C (120 °F), the minimum temperature is 46 °C (115 °F), and the maximum temperature is 52 °C (126 °F). Prior to 1984 and from mid-1985 until 1993, the temperature was controlled evaporative cooling (water additions to the tank and forced ventilation).

Plots of the available thermocouple readings for tank 241-C-105 are found in the *Supporting Document for the Historical Tank Content Estimate for C Tank Farm* (Brevick et al. 1994). A graphical representation of the weekly high temperatures are found in Figure 2-6.

2.4.3 Tank 241-C-105 Photographs

The interior of tank 241-C-105 was most recently photographed on March 10, 1994 and August 5, 1994. Color copies of the in-tank photographs are located in Appendix A. The tank surface appears to be an orangish-black liquid with a yellow crust formed around the edge of the tank. Old level measurement tapes and other debris can be seen lying on the surface as shown in Figure A-1. Figure A-2 shows the FIC level measuring device which is located in riser 8. This is the same riser from which core 76 was taken. Figure A-3 shows the thermocouple tree located in riser 1. Core 72 was sampled from riser 2, which is in this area. The pictures should be an accurate representation of the current tank contents because there has been no activity in the tank since the photographs were taken. However, evaporation of the liquid pools is enhanced by the active ventilation and it is anticipated that these pools will disappear over time.

Figure 2-6. Tank 241-C-105 Weekly High Temperature Plot.



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3.0 TANK SAMPLING OVERVIEW

This section describes the two sampling and analysis events associated with tank 241-C-105. The most recent sampling event took place in mid-March 1995 when two push-mode core samples were taken and analyzed to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), the *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994), and the *Tank 241-C-105 Tank Characterization Plan* (Schreiber 1995). One core sample was also taken in 1986, and the waste material was analyzed for chemical and radiological constituents.

3.1 DESCRIPTION OF 1995 SAMPLING EVENT

Two samples were taken from tank 241-C-105 using the push-mode core sampler, between March 14, 1995 and March 22, 1995. The first core sample (core 72) was taken from riser 2 on March 14, 1995 and March 15, 1995. The second core sample (core 76) was taken from riser 8 between March 21, 1995 and March 22, 1995. Tank 241-C-105 contains 511 kL (135 kgal) of waste, so three segments were expected from each core. The first segment of each core was expected to contain 16.5 cm (6.5 in.) of waste. The remaining two segments were expected to be full, and to contain 48 cm (19 in.) of waste each (Schreiber 1995). The samples as received contained less solid material than expected. Considerable drainable liquid was present in all segments except segment three of core 72. Segment three of core 72 was 100 percent solid waste. A description of each segment, its mass, and the amount of sample recovered, is presented in Table 3-1. Table 3-2 provides the dates of sampling and sample receipt and extrusion by the laboratory.

The push-mode procedure included the use of a hydrostatic head fluid, composed of water with a lithium bromide tracer, to aid in collection of the core samples. No head fluid blank was provided; however, a field blank was provided (Sasaki 1995a).

With the exception of a marked difference in the liquid content of the samples, no problems in the sample process were noted.

3.1.1 Sample Handling (1995)

The push-mode samples were delivered to the 222-S Laboratory where they were extruded, described, and subsampled. Sampling, delivery, and extrusion dates are provided in Table 3-2. As requested in the pretreatment data quality objective (Kupfer et al. 1994), samples were archived for later analysis when needed by the Pretreatment Program. In addition to the subsamples obtained for the tank safety screening analysis, and the archived pretreatment subsamples, a sample was obtained from the upper half of segment 3, core 72, for a homogenization test. Subsample numbers and masses for the analytical, archival, and homogenization test samples are presented in Table 3-3.

Table 3-1. 1995 Push-Mode Sample Description[1] (2 sheets).

Core/segment/riser	Sample recovered	Description	Drill string dose rate (R/hr)
Core 72, segment 1, riser 2	Solid: 49.5 g Drainable liquid: 23.1 g Liner liquid: 10.8 g	Solids wet and crumbly, did not retain the shape of the sampler. Drainable liquid was black in color. Yellow/olive colored film left in extrusion tray; found to be miscible.	2.5
Core 72, segment 2, riser 2	Solid: 47.9 g Drainable liquid: 70.3 g Liner liquid: 7.51 g	Similar to segment 1. Solids were black and crumbly and did not maintain the shape of the sampler. Drainable liquid was black and had no visible organic phase.	2.5
Core 72, segment 3, riser 2	Solid: 371 g Drainable liquid: 0 g Liner liquid: 0 g	Approximately 35.6 cm (14 in.) of waste extruded. Color ranged from light to dark brown. Sample was soft and moist and retained the shape of the sampler. Lower 12.7 cm (5 in.) of the sample was collected as the lower half; the upper 22.9 cm (9 in.) were collected as the upper half. Small amount of unrecoverable drainable liquid remained on the tray.	2.0
Core 76, segment 1, riser 8	Solid: 16.2 g Drainable liquid: 105 g Liner liquid: 7.60 g	Solids were wet, crumbly, black/grey, did not retain the shape of the sampler, and appeared crystalline. Drainable liquid was black, contained solids, and exhibited no visible organic phase.	2.0

Table 3-1. 1995 Push-Mode Sample Description[1] (2 sheets).

Core/segment/riser	Sample recovered	Description	Drill string dose rate (R/hr)
Core 76, segment 2, riser 8	Solid: 55.5 g Drainable liquid: 165 g Liner liquid: 22.8 g	Black solids, similar in appearance to segments 1 and 2 of core 72. Drainable liquid was black with no visible organic phase.	3.5
Core 76, segment 3, riser 8	Solid: 14.7 g Drainable liquid: 51.8 g Liner Liquid: 32.4 g	Black, sludge versus crystalline. Black drainable liquid, with no organic phase visible.	1.5
Field blank	Drainable liquid: 279 g	Clear liquid.	Not Applicable

Notes:

cm = centimeter
g = gram
R/hr = Roentgen per hour

[1]Sasaki, L. M., 1995, *45-Day Safety Screen Results for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-WP-108, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 3-2. Sample Receipt and Extrusion Information[1].

Core/ segment	Date sampled	Sampler serial number	Date received by laboratory	Date extruded
72/1	3/14/95	94-188	3/15/95	3/23/95
72/2	3/15/95	94-163	3/15/95	3/23/95
72/3	3/15/95	94-167	3/15/95	3/24/95
76/1	3/21/95	94-182	3/23/95	3/29/95
76/2	3/22/95	94-181	3/23/95	3/29/95
76/3	3/22/95	94-185	3/23/95	3/29/95

Note:

[1]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Table 3-3. Subsample Numbers and Masses[1] (2 sheets).

Subsample number[2]	Jar number	Net mass (g)	Analytical test
Core 72, segment 1			
Solid: 673	6840	1.36	DSC, TGA
Solid: 674	6851	1.26	Fusion, total alpha, lithium (ICP)
Drainable liquid: 669	6847	6.52	DSC, TGA, lithium (ICP)
Drainable liquid: 671	6731	16.4	Lithium (ICP)
Core 72, segment 2			
Solid: 681	6841	1.14	DSC, TGA
Solid: 682	6850	1.08	Fusion, total alpha, lithium (ICP)
Drainable liquid: 677	6842	4.67	DSC, TGA, lithium (ICP)
Drainable liquid: 679	6890 (Archived)	48.1	Not applicable
Core 72, segment 3			
Upper half solid: 694	6843	1.62	DSC, TGA
Upper half solid: 675	6844	1.53	Fusion, total alpha, lithium (ICP)
Upper half solid: 695, 696	6848	1.79	Homogenization test, fusion, Lithium (ICP)
Upper half solid: 697	6895 (Archived)	78.7	Not applicable
Lower half solid: 700	6845	1.46	DSC, TGA
Lower half solid: 701	6848	1.38	Fusion total alpha, lithium (ICP)
Lower half solid: 763	6896 (Archived)	75.0	Not applicable
Core 76, segment 1			
Solid: 500	6809	2.53	DSC, TGA
Solid: 501	6806	1.46	Fusion, total alpha, lithium (ICP)
Solid: 502	6876 (Archived)	Not Applicable	Not applicable
Drainable liquid: 504	6804	7.71	DSC, TGA, ICP
Drainable liquid: 514	6744 (Archived)	39.2	Not applicable

Table 3-3. Subsample Numbers and Masses[1] (2 sheets).

Subsample number[2]	Jar number	Net mass (g)	Analytical test
Core 76, segment 2			
Upper half solid: 655	6836	2.68	DSC, TGA
Upper half solid: 656	6837	1.13	Fusion, total alpha, lithium (ICP)
Upper half solid: 659	6886 (Archived)	38.4	Not applicable
Lower half solid: 661	6838	1.8	DSC, TGA
Lower half solid: 663	6839	1.37	Fusion, ICP, total alpha, lithium (ICP)
Drainable liquid: 645	6835	7.63	DSC, TGA, fusion, lithium (ICP) total alpha
Drainable liquid: 652	6885	49.0	Lithium (ICP)
Core 76, segment 3			
Solid: 516	6807	1.19	DSC, TGA
Solid: 517	6808	2.05	Fusion, total alpha, lithium (ICP)
Solid: 518	6748 (Archived)	6.76	Not applicable
Drainable liquid: 520	6805	6.89	DSC, TGA, fusion, total alpha, lithium (ICP)
Drainable liquid: 523			
Drainable liquid: 521	6747 (Archived)	41.6	Not applicable

Notes:

ICP = inductively coupled plasma
DSC = differential scanning calorimetry
TGA = thermogravimetric analysis

g = gram

[1]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[2]All sample numbers are preceded with 'S95T000' which was omitted for space considerations.

3.1.2 Sample Analysis (1995)

Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) were both conducted under a nitrogen blanket, and both used a combination of Mettler and Perkin-Elmer instruments. Total alpha was analyzed using an alpha proportional counter. Secondary analyses (total organic carbon, cyanide, and bromide) were required by Schreiber (1995) to be performed on selected samples. Cyanide and total organic carbon were required to be run on core 72, segment 2 as a consequence of a DSC result exceeding the notification limit of 481 joules/gram. Normally a reactive systems screening tool (RSST) (an adiabatic scanning calorimeter) analysis is also required when the energetics limit is exceeded. However, an RSST analysis was not performed because, according to Sasaki (1995b), radiation exposure from the required large quantities of the very radioactive material would compromise the As-Low-As-Reasonably-Achievable principle for exposure of workers, and only one of the three analyses performed on core 72, segment 2 exhibited an exothermic reaction that exceeded the notification limit (Schreiber 1995). Bromide analysis by ion chromatography was required because the lithium analysis by ICP exceeded the notification limit of 100 micrograms per gram.

The quality control procedures, discussed further in Section 5, were performed in accordance with the tank characterization plan (Schreiber 1995). Analytical procedures and methods are listed in Table 3-4. The procedure references are listed at the end of Section 7.0.

Table 3-4. Analytical Methods and Procedures.

Analyte	Method	Procedure
Energetics	Differential scanning calorimetry	LA-514-113 (Mettler) LA-514-114 (Perkin-Elmer)
Percent water	Thermogravimetric analysis	LA-560-112 (Mettler) LA-514-114 (Perkin-Elmer)
Total alpha	Alpha proportional counting	LA-508-101
Total organic carbon	Hot persulfate oxidation followed by coulometry	LA-342-100
Cyanide	Spectrophotometry	LA-695-102
Bromide	Ion chromatography	LA-533-105
Lithium	Inductively coupled plasma	LA-505-151

3.2 DESCRIPTION OF 1986 SAMPLING EVENT

On April 11, 1986 a three segment push-mode core sample was taken from tank 241-C-105. The sample was taken as part of the single-shell tank waste characterization effort during fiscal year 1986 (Weiss 1987). The core sample was taken from riser 3. At the time of the sampling the FIC indicated a liquid level of 138 cm (54.5 in.), and 5.08 cm (2 in.) were added for the dish bottom to give an equivalent waste level of 144 cm (56.5 in.). Each segment taken exhibited 100 percent recovery. The sampler read 1,800 to 2,000 mrads through the drill string (Weiss 1988).

3.2.1 Sample Handling (1986)

Segments were received at the Westinghouse Hanford Company 222-S Laboratory and extruded in a shielded hot cell. After extrusion, each segment was weighed, photographed, and measured while still in the hot cell. The breakdown of the segments and their sample identification are shown in Table 3-5.

Table 3-5. Core 1 (Riser 3) Segment Breakdown for Tank 241-C-105[1].

Segment	ID number	Matrix	Sample recovered	Description
1	1211	NA	Total: 185.8 g Solid: 17.6 g Liquid: 140 mL	The bulk sample was black with few solids.
2	1212	NA	Total: 262.0 g Solid: 176.5 g Liquid: 74 mL	The bulk sample was black with the solids being "sloppy".
3	1213	NA	Total: 375.8 g Solid: 347.6 g Liquid: 20 mL	The solids gradually changed color from brown on the bottom end to light gray on the top end. However, the interior of the solids was white.
	C1XDOOXX	drainable liquid	NA	Combined liquid from sample ID #'s 1211, 1212 and 1213 for a total volume of 234 mL. The liquid was bright yellow.
	C1XCOOXX	core composite	NA	Combined portions of the solids of sample ID #'s 1211, 1212, and 1213 in the hot cell with a masher. The resultant solids were dark brown, almost black.

Note:

[1]Weiss, R. L., 1988, *Transmittal Package for 241-C-105 Waste Tank Characterization*, SD-RE-TI-204, Rev. 0, Rockwell Hanford Operations, Richland, Washington. 1988

NA	=	Not applicable
g	=	gram
mL	=	milliliter

3.2.2 Sample Analysis (1986)

The sample analyses were performed on the composite sample generated for the core. The composite was formed by blending weight fractions (of the total core weight recovered) of each core segment. The sample was washed with water, centrifuged, and the water was analyzed for a set of water soluble analytes. The leftover sludge was then treated with an HCl acid solution, centrifuged, and the leachate was analyzed for chemical and radiochemical constituents. Any material not dissolved by the acid was combined with an HNO_3-HF-HCl solution at elevated temperatures in a pressure reactor before the remaining analytes were identified. All separable liquids from the segments in each core were combined to form the drainable liquid fraction. Table B-1 gives a list and the results of the analytes requested for tank 241-C-105 (Weiss 1987 and Weiss 1988).

4.0 ANALYTICAL RESULTS

4.1 OVERVIEW

This section summarizes the analytical results from the sampling events described in Section 3.0 and provides concentration and inventory estimates for measured analytes. The data used for these estimates were obtained from the 1986 and 1995 sampling events (Weiss 1987, Weiss 1988 and Sasaki 1995b). Other than water additions, material has not been transferred to, or pumped from, the tank since 1976; therefore, the data obtained in 1986 and 1995 are considered to be best estimates of tank contents.

The samples collected for tank 241-C-105 in 1995 are based on the DQO process. The DQO that governs the sampling and subsequent sample analysis is the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). This DQO was developed to allow rapid classification of the tanks containing high-level radioactive waste and to resolve tank safety issues. For tank 241-C-105, the DQO specifies that sampling will take place with the following analytical results to be obtained from the samples: weight percent water by thermogravimetric analysis (TGA), energetics by differential scanning calorimetry (DSC), total alpha activity, and flammable gas concentration. In addition to the safety screening requirements, an inductively coupled plasma (ICP) spectrographic analysis for lithium was performed to determine the extent of hydrostatic head fluid contamination during the sampling event. The TGA, DSC, total alpha, and ICP results are presented within this document as indicated in Table 4-1. A tank characterization plan (Schreiber 1995) was generated prior to the 1995 sampling event to outline the characterization process to be followed for tank 241-C-105.

In addition to the primary analyses requested in the tank characterization plan, secondary analyses were performed. These secondary analytes include the aforementioned lithium and total organic carbon (TOC), cyanide, and bromide.

Table 4-1. Analytical Data Presentation Tables.

Analysis	Tabulated result location
Tank 241-C-105 characterization summary	Table 4-2
Total alpha	Table 4-3
Thermogravimetric analysis	Table 4-4
Differential scanning calorimetry	Table 4-5
Total organic carbon	Table 4-6
Cyanide	Table 4-7
Lithium by inductively coupled plasma	Table 4-8
Bromide by ion chromatography	Table 4-9
1986 sample results	Appendix B

The best estimates regarding the chemical and radiochemical composition of the sludge in tank 241-C-105 are listed in Table 4-2. They are derived from the core sample taken from the tank in 1986 (Weiss 1987 and Weiss 1988). The data resulting from this core are presented in Appendix B. The concentrations of the solids and liquid appear in the Table B-1. Projected inventory values were derived for each reported analyte from its solid and liquid concentrations using a solid volume of 492 L (130 kgal) and liquid volume of 19 L (5 kgal) for the tank in the following equations.

Solids:

Projected Inventory (kg) = [μg/g][1.55 g/mL][1000 mL/L][492,000 L][1 kg/1E+09 μg]

Projected Inventory (Ci) = [μCi/g][1.55 g/mL][1000 mL/L][492,000 L][1 Ci/1E+06 μCi]

Liquids:

Projected Inventory (kg) = [μg/mL][1000 mL/L][19,000 L][1 kg/1E+09 μg]

Projected Inventory (Ci) = [μCi/mL][1000 mL/L][19,000 L][1 Ci/1E+06 μCi]

where:

Ci	=	curies
g/mL	=	grams per milliliter
kg	=	kilogram
L	=	liter
μCi	=	microcuries
μCi/g	=	microcuries per gram
μg	=	microgram
μg/g	=	micrograms per gram

The waste in tank 241-C-105 was found to be 39.6 percent water by calculating a nonweighted mean and 40.0 percent water by calculating a weighted mean from the 1995 TGA data. No estimates of variability have been done on the percent water estimate. The table includes percent water from the 1995 TGA data. The mass loss from the 1986 data was not used because the temperature was increased to 400 °C (752 °F), which means vapors other than water could have evaporated and contributed to the mass loss.

Table 4-2. Tank 241-C-105 Characterization Summary[1]. (2 sheets)

Analyte	Solids concentration	Liquid concentration	Projected inventory
Metal	µg/g	µg/mL	kg
Al	61,800	9.02	47,100
Ba	2,560	2.66	1,950
Bi	625	101	479
B	12.3	3.7	9.45
Cd	158	NR	120
Ca	7,790	4.15	5,940
Cr	943	1,120	740
Co	10.3	NR	7.85
Cu	155	3.62	118
Fe	10,600	3.29	8,080
Pb	898	123	687
Mg	3,690	5.67	2,810
Mn	2,470	13.6	1,880
Ni	2,150	6.15	1,640
P	2,530	2,560	1,980
K	1,110	1,570	869
Si	39,900	103	30,400
Ag	67	20.5	51.5
Na	71,800	115,000	57,000
Sr	184	NR	140
U	9,830	966	7,510
Zn	154	NR	117
Zr	715	364	552
Anions	µg/g	µg/mL	kg
NO_3^-	10,500	34,300	8,660
Organics	µg/g	µg/mL	kg
TOC	999	2,870	817

Table 4-2. Tank 241-C-105 Characterization Summary[1]. (2 sheets)

Analyte	Solids concentration	Liquid concentration	Projected inventory
Physical properties			
Density	NR	1.23 g/mL	
pH	NR	9.69	
Bulk Density	1.55 g/mL	NR	
% Water[2]			40.0
Radionuclides	μCi/g	μCi/mL	Ci
^{241}Am	1.51	0.006	1,150
^{14}C	0.0007	0.003	0.591
^{137}Cs	147	442	121,000
^{60}Co	0.73	0.017	557
^{129}I	0.0001	NR	0.076
$^{239/240}$Pu	0.85	0.155	650
^{90}Sr	864	5.12	659,000
^{99}Tc	0.10	0.258	81.2
Total Gamma	182	448	147,000

Notes:

μCi/g	=	microcuries per gram
μCi/mL	=	microcuries per milliliter
μg/g	=	micrograms per gram
μg/mL	=	micrograms per milliliter
NR	=	Not reported

[1]Weiss, R. L., *Reissue of Letter 65453-87-050*, (internal memorandum 65453-87-074, to Distribution, May 28), Westinghouse Hanford Company, Richland, Washington.

[2]Sasaki, L. M, 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev 1, Westinghouse Hanford Company, Richland, Washington..

4.2 TOTAL ALPHA ANALYSES

Analyses for total alpha activity were performed on samples using an alpha proportional counter according to procedure LA-508-101, Rev. D-2. All total alpha results were below the safety screening DQO notification limit of 41 microcuries per gram (μCi/g). The results for tank 241-C-105 ranged from 0.142 to 2.00 μCi/g. Five of the eight samples exceeded the precision criteria (relative percent difference [RPD] above 10 percent). However, the results were less than five percent of the action limit for total alpha and reruns were not requested or performed.

Table 4-3 presents the results for total alpha activity. The table lists the sample numbers and the locations from which the samples were derived. The result column is a simple mean of an original sample and its duplicate. These results are a specific concentration of the analyte at different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. This information may be obtained from Sasaki (1995a, 1995b) and is summarized in Section 5.1.2.

Table 4-3. Tank 241-C-105 Analytical Data: Total Alpha[1].

Analyte	Sample number	Sample location	Sample identification	Sample Result	Duplicate Result	Combined Mean
Radionuclide						
		Core:Seg	Portion of segment	μCi/g	μCi/g	μCi/g
Total Alpha	S95T000674	71:1	upper ½	2.42	1.31	1.86
	S95T000682	71:2	upper ½	2.01	1.87	1.94
	S95T000695	72:3	upper ½	0.861	0.902	0.881
	S95T000701		lower ½	1.20	1.30	1.25
	S95T000501	76:1	lower ½	0.163	0.191	0.177
	S95T000656	76:2	upper ½	0.994	1.71	1.35
	S95T000663		lower ½	1.32	2.67	2.00
	S95T000517	76:3	lower ½	1.32	1.08	1.20

Notes:

μCi/g = microcuries per gram
Seg = segment

[1]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108. Rev. 1, Westinghouse Hanford Company, Richland, Washington.

4.3 THERMODYNAMIC ANALYSES

Tank 241-C-105 push-mode samples were analyzed according to *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and *Tank 241-C-105 Tank Characterization Plan* (Schreiber 1995).

4.3.1 Thermogravimetric Analysis

Weight percent water by thermogravimetric analysis (TGA) was performed under a nitrogen atmosphere using procedure LA-560-112, Rev. A-2. The results ranged from 4.44 to 42.2 weight percent water for the solids and 59.6 to 76.8 weight percent water for the drainable liquid phase.

The mean results for two samples (S95T000694 and S95T000661) were less than the DQO notification limit of 17 percent water. These samples were the upper half of the solids from core 72, segment 3 and the lower half solids from core 76, segment 2. The weight percent water of these two samples averaged 13.5 and 4.44 percent water, respectively. However, neither of these samples displayed an exothermic reaction during the DSC analyses. Note in Table 3-1 that there was considerable drainable liquid recovered from core 76, segment 2, but none from core 72, segment 3.

A third sample (S95T000655) from the upper half solids for core 76 segment 2 was also less than the notification limit. The original sample result was 30.7 weight percent, while its duplicate result was 12.5 weight percent, yielding an average of 21.6 weight percent. A rerun of this sample resulted in an average weight percent water of 29.9. TGA plots of the samples that exceeded the notification limit are presented in Appendix C.

The results for the TGA analysis for tank 241-C-105 are listed in Table 4-4. The first two columns lists the location from which the sample was obtained and the portion of the sample that was analyzed. The third column lists the sample number assigned to the sample by the laboratory. The fourth and fifth columns list the analytical results for the sample and its corresponding duplicate sample. The last column is a simple mean of the sample result and its duplicate result.

Table 4-4. Thermogravimetric Analysis Results for Tank 241-C-105[1].

Sample location	Portion of segment	Laboratory sample number	Result	Duplicate	Mean
Core:Seg			$\%H_2O$	$\%H_2O$	$\%H_2O$
72:1	upper ½	S95T000673	33.3	36.6	34.9
	drainable liquid	S95T000669	59.9	59.4	59.6
72:2	upper ½	S95T000681	37.9	36.5	37.2
	drainable liquid	S95T000677	72.2	72.3	72.2
72:3	upper ½	S95T000694	12.9[2]	14.1[2]	13.5[2]
	lower ½	S95T000700	21.0	19.5	20.3
76:1	lower ½	S95T000500	42.8	41.6	42.2
	drainable liquid	S95T000504	61.8	62.0	61.9
76:2	upper ½	S95T000655	30.7	12.5[2]	21.6
	lower ½	S95T000661	4.54[2]	4.33[2]	4.44[2]
	drainable liquid	S95T000645	65.1	60.9	63.0
76:3	lower ½	S95T000516	21.5	20.6	21.1
	drainable liquid	S95T000520	77.2	76.3	76.8

Notes:

Seg = segment

[1]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[2]Less than the 17 weight percent water notification limit.

4.3.2 Differential Scanning Calorimetry

In differential scanning calorimetry (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, a gas such as nitrogen is passed over the waste material to remove any gases being released. The onset temperature for an endothermic (characterized by or causing the absorption of heat) or exothermic (releasing, as opposed to absorbing heat) event from a DSC analysis is determined graphically.

Analyses by DSC were performed using either procedure LA-514-113, Rev. B-1 under a nitrogen purge on a Mettler DSC 20 instrument or procedure LA-514-114, Rev. B-0 on a Perkin-Elmer DSC 7 instrument.

Although exotherms were observed in seven of the 13 waste samples, only one exceeded the 481 joules per gram (J/g) notification limit (on a dry-weight basis). The initial DSC run on the upper half solids sample from segment 2 of core 72 (S95T000681) registered an exotherm of 524 J/g (dry-weight basis). However, the duplicate and triplicate analyses of this sample did not measure exotherms greater than the DQO limit (170 and 109 J/g [dry-weight basis], respectively). Plots for these three DSC runs are provided in Appendix C.

Two exotherms were reported for the drainable liquid from core 76, segment 2 (S95T000645). The first exotherm was 17.7 J/g (wet-weight basis) observed at about 366 °C (691 °F) and the second was 7.8 J/g (wet-weight basis) at about 412 °C (774 °F).

The DSC results for tank 241-C-105 are given in Table 4-5. The temperature at maximum enthalpy change and the magnitude of the enthalpy change in J/g (wet weight basis) are provided for each transition. The first transition represents the endothermic reaction associated with the evaporation of free and interstitial water. The second transition could represent the energy (heat) required to remove the bound water from hydrated compounds such as aluminum hydroxide or to melt salts such as sodium nitrate. The exotherms in the third transition provide an estimate of the fuel content of the waste (on an "as-received" or wet weight basis).

Table 4-5. Differential Scanning Calorimetry Results for Tank 241-C-105[1] (2 sheets).

Sample number	Sample location	Run	Peak °C	ΔH J/g[2]	Peak °C	ΔH J/g[2]	Peak °C	ΔH J/g[2]
Solids								
S95T000673	72:1 upper ½	1	112	850	253	78.6	320	-276
		2	126	844	253	82.3	324	-155
		3	108	949	253	177	374	-199
S95T000681	72:2 upper ½	1	117	781	---	---	320	-329
		2	109	781	285	182	386	-107
		3	116	925	286	248	364	-68.6
S95T000694	72:3 upper ½	1	100	386	287	710	---	---
		2	107	310	281	723	---	---
S95T000700	72:3 lower ½	1	116	479	275	593	---	---
		2	117	454	280	575	---	---
S95T000500	76:1 lower ½	1	115	1,010	---	---	306	-274
		2	111	756	---	---	412	-249
S95T000655	76:2 upper ½	1	121	722	283	291	---	---
		2	119	656	287	344	460	19.4
		3	122	736	282	301	---	---
S95T000651	76:2 lower ½	1	121	1,350	282	270	---	---
		2	103	606	283	247	390	154
		3	124	700	284	290	---	---
S95T000516	76:3 lower ½	1	109	547	276	460	---	---
		2	111	665	278	473	---	---

Table 4-5. Differential Scanning Calorimetry Results for Tank 241-C-105[1] (2 sheets).

Sample number	Sample location	Run	Peak °C	ΔH J/g[2]	Peak °C	ΔH J/g[2]	Peak °C	ΔH J/g[2]
Drainable liquids								
S95T000669	72:1	1	112	1,290	256	25.0	411	-9.04
		2	120	1,340	256	22.8	411	-12.3
		3	118	1,380	256	22.6	408	-9.10
S95T000677	72:2	1	113	1,610	---	---	406	-3.51
		2	113	1,520	---	---	401	-3.79
S95T000504	76:1	1	122	1,350	253	7.56	402	-8.49
		2	122	1,370	252	20.1	401	-9.74
S95T000645	76:2	1	113	1,440	253	26.7	365	-17.7[3]
		2	113	1,380	253	28.9	366	-17.0[4]
S95T000520	76:3	1	116	1,770	148	10.2	---	---
		2	115	1,750	142	12.6	---	---

Notes:

ΔH = change in enthalpy
°C = degrees celsius
J/g = joules per gram

[1] Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[2]All DSC values reported are on an "as received" or wet-weight basis.

[3]The first run of sample S95T000645 had an additional exotherm of -7.8 J/g at 412 °C.

[4]The second run of sample S95T000645 had an additional exotherm of -7.8 J/g at 414 °C.

4.4 SECONDARY ANALYSES

4.4.1 Total Organic Carbon

Analysis for TOC is required by the tank characterization plan if a DSC result exceeds the notification limit. Because the DSC notification limit was exceeded on the upper half solids sample from core 72, segment 2 (S95T000681), a TOC secondary analysis was performed on this sample. The TOC analysis was performed by hot persulfate oxidation and coulometric detection using procedure LA-342-100, Rev. A-1. Primary, duplicate, and triplicate samples were analyzed with a mean result of 6,520 μg/g. All the TOC results were at least four times lower than the notification limit of 30,000 μg/g (dry weight basis). A statistical evaluation done on the TOC results reveals an upper limit of 7,568 μg/g with 90 percent confidence that the TOC is below this upper limit. Table 4-6 presents the TOC results for core 72, segment 2 in tank 241-C-105.

Table 4-6. Tank 241-C-105 Analytical Data: TOTAL ORGANIC CARBON[1].

Analyte	Sample number	Sample location	Sample result	Duplicate result	Triplicate result	Combined mean
		Core:Seg	μg/g	μg/g	μg/g	μg/g
TOC	S95T001046	72:2 upper ½	5,460	6,760	7,340	6,520

Notes:

μg/g = micrograms per gram
Seg = segment

[1] Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

4.4.2 Cyanide

An analysis for cyanide is also performed when a DSC result exceeds the notification limits. The cyanide analysis for tank 241-C-105 was performed by microdistillation and spectrophotometric determination using procedure LA-695-192, Rev. C-0. The analysis resulted in a mean cyanide value of 46.8 μg/g, which is a factor of 1,000 below the notification limit and within a factor of five of the method detection limit. Table 4-7 presents the cyanide results.

Table 4-7. Tank 241-C-105 Analytical Data: CYANIDE[1].

Analyte	Sample number	Sample location	Portion of segment	Sample result	Duplicate result	Combined mean
		Core:Seg		μg/g	μg/g	μg/g
CN^-	S95T000907	72:2	upper ½	42.6	50.9	46.8

Notes:

μg/g = micrograms per gram
Seg = segment

[1]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

4.4.3 Hydrostatic Head Fluid

A hydrostatic head fluid of water with a lithium bromide tracer was used during the push-mode core sampling activity of tank 241-C-105. Lithium analyses were required by the tank characterization plan to determine if the samples were contaminated with the hydrostatic head fluid used during sampling operations. Bromide analyses were required for those samples with lithium concentrations in excess of the notification limit.

Lithium analyses were performed by inductively coupled plasma atomic emission spectroscopy (procedure LA-505-151, Rev. D-2) in order to determine if sample contamination by the introduction of the hydrostatic head fluid occurred during the sampling process. Results ranged from less than 10.0 μg/g to 1,110 μg/g. Five samples, three drainable liquid samples (core 72, segment 2; core 76, segment 2; and core 76, segment 3) and two solid samples (core 72, segment 2 upper half and core 76, segment 3 lower half), exceeded the notification limits of 100 μg/g or 100 micrograms per milliliter (μg/mL). Lithium concentrations for these samples ranged from 154 to 1,110 μg/mL.

Bromide analyses were performed on the five samples which exceeded the lithium notification limit. Bromide analyses were performed by ion chromatography (IC) using procedure LA-533-105, Rev. C-2. Average results ranged from 2,170 to 13,300 μg/mL. All results exceeded the notification limit of 1,200 μg/g or 1,200 μg/mL.

The concentration of lithium bromide in the hydrostatic head fluid was 0.3 molar (26,100 μg/g), assuming a hydrostatic head fluid density of 1 g/mL). The results indicate that the percent moisture results reported for these five samples are compromised; the actual moisture content of these samples should be lower than the values reported (Sasaki 1995b). There is no agreed upon method of back-calculating the percent water if LiBr contamination is found. A method of doing this is being developed and will be incorporated in a revision of this document after it has been developed.

Tables 4-8 and 4-9 display the results of the analyses for lithium and bromide, respectively.

Table 4-8. Tank 241-C-105 Analytical Data: LITHIUM[1].

Analyte	Sample number	Sample location	Sample identification	Sample result	Duplicate result	Combined mean
Lithium solid		Core:Seg		μg/g	μg/g	μg/g
ICP.Li	S95T000673	72:1	upper ½	< 45.6	< 52.7	< 49.2
	S95T000682	72:2	upper ½	257[2]	184[2]	221[2]
	S95T000934	72:3	upper ½	< 52.4	< 51.0	< 51.7
	S95T000701		lower ½	1.20	1.30	1.25
	S95T000501	76:1	lower ½	< 69.4	< 71.7	< 70.6
	S95T000656	76:2	upper½	< LDL	< 80.3	< 80.3
	S95T000663		lower ½	< 82.3	< 82.1	< 82.2
	S95T000517	76:3	lower ½	351[2]	327[2]	339[2]
Lithium drainable liquid				μg/mL	μg/mL	μg/mL
ICP.Li	S95T000670	72:1	drainable liquid	< 10.0	< 10.0	< 10.0
	S95T000678	72:2	drainable liquid	748[2]	733[2]	740[2]
	S95T000505	76:1	drainable liquid	< 10.0	< 10.0	< 10.0
	S95T000648	76:2	drainable liquid	157[2]	151[2]	154[2]
	S95T000523	76:3	drainable liquid	1,110[2]	1,110[2]	1,110[2]

Notes:

<	=	less than
< LDL	=	less than the lower detection limit
μg/g	=	micrograms per gram
μg/mL	=	micrograms per millimeter
Seg	=	segment

[1]Sasaki, L. M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[2]This value exceeds the notification limit of 100 μg/g or 100 μg/mL.

Table 4-9. Tank 241-C-105 Analytical Data: BROMIDE[1].

Analyte	Sample number	Sample location	Sample identification	Sample result[2]	Duplicate result[2]	Combined mean[2]
Bromide solid		Core:Seg		μg/g	μg/g	μg/g
IC.Br-	S95T000908	72:2	upper ½	2,800	2,840	2,820
	S95T000915	76:3	lower ½	4,210	4,050	4,130
Bromide drainable liquid				μg/mL	μg/mL	μg/mL
IC.Br-	S95T000911	72:2	drainable liquid	8,570	8,640	8,610
	S95T000912	76:2	drainable liquid	2,090	2,250	2,170
	S95T000913	76:3	drainable liquid	13,200	13,300	13,300

Notes:

μg/g = micrograms per gram
μg/mL = micrograms per milliliter
Seg = segment

[1]Sasaki, L.M., 1995, *90-Day Safety Screen Results and Final Report for Tank 241-C-105, Push-Mode, Cores 72 and 76*, WHC-SD-WM-DP-108, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

[2]All values exceed the notification limit of 1,200 μg/g or 1,200 μg/mL.

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

This section evaluates the overall quality and consistency of the available results for tank 241-C-105 and assesses and compares 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.

5.1.1 Field Observations

According to Schreiber (1995), the waste was expected to consist mostly of solid material. The samples, however, contained considerable liquid. Only core 72, segment 3 was entirely solid. This is consistent with the below-specification thermogravimetric percent water result for that segment. The existence of a comparatively dry segment in waste that is on average quite moist indicates a high degree of heterogeneity of the waste.

With the exception of contamination of the samples with hydrostatic head fluid, no events or conditions were noted that could impact the quality or usefulness of the data.

5.1.2 Quality Control Assessment

An attempt is always made to quantify the different sources of error possible during the chemical analysis of a sample. When these errors are summarized, they give a strong indication of data reliability. If one or more of the error estimates are outside the acceptable limits, the accuracy of the concentration estimate is in question. Possible sources of error include sub-sampling of heterogeneous material, sample contamination, matrix interferences, analytical method error, and poor instrument calibration. Error estimates are determined from the analysis of standards, spike recoveries, blank contamination, and sample duplicate evaluation.

No statistical analysis of the 1986 data was possible since the data consisted of only one core sample and no replicated analyses. The data package for the 1995 core samples did provide some quality control information. It is discussed in the following paragraphs.

The appropriate standards, spikes, blanks, and duplicates for quality control measures were performed on the 1995 push-mode sampling safety screening and homogenization test analytes. The tank characterization plan (Schreiber 1995) established a criterion of $\pm$ 10 percent for the accuracy and precision of the data.

The standard results provide an estimate of the accuracy of the analysis. If a standard is above or below the criterion, then the analytical results may be biased high or low, respectively. For the sludge results, all of the standards conducted on percent water, lithium, bromide, TOC, cyanide, and homogenization test metals were in the acceptable range. Two of three standards for total alpha were outside the limits (89.5 percent and 110 percent), as was one of five standards for DSC (116 percent), indicating that the analytical results may be somewhat biased for these two analytes. For the drainable liquid, none of the standards for any of the analytes were outside the limits. As with standards, the spikes estimate the accuracy of the analysis. The analytical results may be biased high or low depending on whether the spike is above or below the criterion. Spikes are not applicable to the TGA and DSC methods. Regarding the sludge results, the single spikes conducted for bromide and for cyanide were within the limits, and the single spike for TOC was outside the limits (118 percent). Five of eight spikes were outside the limits for both total alpha and lithium, with the results ranging from 82.6 percent to 115 percent for total alpha and 85.8 percent to 92.0 percent for lithium. The single spike conducted for bromide and all five spikes for lithium in the drainable liquid were within the criterion.

Evaluation of blanks was applicable to all analytes except percent water and DSC. Neither bromide nor alpha activity was detected in the blanks. Cyanide and TOC were both detected in the blanks; but at less than one-tenth of the analytical result. Activity for lithium was detected in all of the blanks, but in every case the analytical result or detection limit was three orders of magnitude or greater than the blank. Thus, contamination of the samples with the above analytes was not a problem.

The precision requirements are calculated by the relative percent difference (RPD) between primary and duplicate samples. All samples for percent water met the 10 percent criterion but one (84.3 percent); a rerun of this sample resulted in an acceptable RPD. The precision results for DSC were fairly poor. Of the seven exotherms observed, four resulted in RPDs above the criterion, ranging from 13.7 percent to 102 percent. Five of eight samples exceeded the precision criterion for total alpha, ranging from 15.8 percent to 67.7 percent. The single RPDs calculated for cyanide (17.7 percent) and TOC (21.3 percent) were both above the limits. All five RPDs conducted on bromide were within the limit. All five lithium samples were below the required 10 percent but one, which had an RPD of 33.0 percent.

In summary, the most serious questions regarding data reliability were raised by the RPD precision results. This was especially true for the DSC and total alpha values. The quality control information for the remainder of the analytes indicated that the analytical results should be reasonably good.

5.1.3 Data Consistency Checks

Comparisons of different analytical methods, such as the comparison of phosphorus and phosphate results or the comparison of total alpha and the sum of the individual radionuclide activities, were not possible with the data available.

5.1.3.1 Mass and Charge Balance. The principal objective in performing a mass and charge balance is to determine if measurements are consistent. In calculating the balance, only the solid phase analytes from core 1 of the 1986 sampling event were considered because it was the only core with extensive anion data. Therefore, this consistency check is applicable only to the core 1 solid phase analytes in Appendix B and only those that were detected at a concentration of 7,000 micrograms per gram (μg/g) or greater.

With the exception of sodium, all cations listed in Table 5-1 were assumed to be present in their most common hydroxide or oxide forms, and the concentrations of the assumed species were calculated stoichiometrically. There may be some argument about whether certain species are hydroxides or oxides, but the difference in molecular weight has a minimal effect on the overall mass balance. Although smaller concentrations of other forms of the species are probably present in the waste, they are not included in order to keep the mass-charge balance calculations simple and consistent.

Because precipitates are neutral species, all positive charge was attributed to the sodium cation. All anions listed in Table 5-2 were assumed to be present as soluble or insoluble sodium salts and were expected to balance the positive charge.

The concentrations of the assumed species in Table 5-1, the anionic species in Table 5-2, and the percent water were used to calculate the mass balance. The mass balance was calculated from the formula below. The factor 0.0001 is the conversion factor from μg/g to weight percent.

$$\begin{aligned}\text{Mass balance} &= \text{\% Water} + 0.0001 \times \{\text{Total Analyte Concentration}\} \\ &= \text{\% Water} + 0.0001 \times \{Al(OH)_3 + CaO + FeO(OH) + SiO_2 \\ &\quad + Na^+ + U_3O_8 + NO_3^-\}\end{aligned}$$

The total analyte concentrations calculated from the above equation was 386,000 μg/g. The mean weight percent water obtained from the thermogravimetric analysis reported in Section 4.3.1 is 40.0. This value was derived from the 1995 core sample results. The mass balance obtained from adding the percent water to the total analyte concentration is 78.2 percent (see Table 5-3). A perfect mass balance would have yielded a balance of 100 percent.

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

<u>Total cations</u> (microequivalents) = $Na^+/23.0$
The total cation charge, 3,120 micromole per gram (μmol/g), is calculated in Table 5-1.

<u>Total anions</u> (microequivalents) = $NO_3^-/62.0$
The total anion charge, 169 μmol/g, is calculated in Table 5-2.

Table 5-1. Cation Mass and Charge Data.

Analyte	Concentration ($\mu g/g$)	Assumed species	Concentration of assumed species ($\mu g/g$)	Charge ($\mu mol/g$)
Aluminum	61,800	$Al(OH)_3$	179,000	0
Calcium	7,790	CaO	10,900	0
Iron	10,600	FeO(OH)	16,900	0
Silicon	39,900	SiO_2	85,300	0
Sodium	71,800	Na^+	71,800	3,120
Uranium	9,830	U_3O_8	11,600	0
Totals			375,000	3,120

Notes:

$\mu g/g$ = micrograms per gram
$\mu mol/g$ = micromoles per gram

Table 5-2. Anion Mass and Charge Data.

Analyte	Concentration ($\mu g/g$)	Charge ($\mu mol/g$)
Nitrate	10,500	169
Totals	10,500	169

Notes:

$\mu g/g$ = micrograms per gram
$\mu mol/g$ = micromoles per gram

Table 5-3. Mass Balance Totals.

	Concentrations µg/g
Total from Table 5-1	375,000
Total from Table 5-2	10,500
Water	396,000
Total	781,500

Note:

µg/g = micrograms per gram

The ratio of total cation microequivalents to total anion microequivalents (+/-) was 35.7; a perfect charge balance would yield a ratio of 1.00.

The mass and charge balance results demonstrate poor agreement among the 1986 Core 1 analyses. This is likely caused by the lack of anions evaluated in the analyses.

5.2 COMPARISON OF DATA SOURCES

5.2.1 Comparison of 1995 and 1986 Data

The only analyte measured in both the 1986 and 1995 core samples was TOC. Because the waste composition of the tank did not change due to significant transfer activity between the sampling events, a comparison should be possible. The TOC reported for the 1986 core sample was 999 µg/g in the solid and 2,870 µg/mL in the liquid (Weiss 1987). TOC was analyzed only in core 72, segment 2 upper 1/2. The mean TOC was 6,520 µg/g (Sasaki 1995b). A possible source of the difference is the degree to which the samples were representative of the waste.

5.2.2 Comparison of the 1986 Data to the Historical Tank Content Estimates

Analyses that compare the 1986 analyses (Weiss 1987) and the historical tank content estimates (Brevick et al. 1995) are listed in Table 5-4. The table demonstrates that there is good agreement (RPD $<$ 75 percent) for aluminum and nickel.

Table 5-4. Comparison Between 1986 Data and Historical Tank Content Estimate for Major Analytes.

Analyte	Solids concentration from 1986 data	Historical tank content estimate[1]	Relative percent difference[2]
Metals	(μg/g)	(μg/g)	%
Na	71,800	32,600	75.1
Al	61,800	91,700	39.0
Fe	10,600	37,600	112
Ni	2,150	2,100	2.35
Ca	7,790	2,980	89.3
Anions	(μg/g)	(μg/g)	%
NO_3^-	10,500	32,900	103
Radionuclides	(uCi/g)	(uCi/g)	%
^{137}Cs	147	1.23	197
^{90}Sr	864	1.02	200

Notes:

uCi/g = microcuries per gram
μg/g = micrograms per gram

[1]Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas*, WHC-SD-WM-ER-349, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

[2]RPD = the absolute value of column 2 minus column 3, divided by the mean of the two, times 100.

5.2.3 Comparison of the 1995 Data to the Historical Tank Content Estimate

The safety screening analyses from the 1995 push-mode sampling effort yielded only two analytes that could be compared with the HTCE given in Section 2.3.2; thus, a comprehensive comparison cannot be made. The mean calculated for the 1995 total alpha results was straightforward, but the calculation of the mean for percent water was more complicated. Because the HTCE estimate is based on the sludge with drainable liquid intact, the 1995 estimated mean for percent water had to combine the individual results from the sludge and drainable liquid analyses. This was done by weighting each of the six segments equally, and weighting the sludge and drainable liquid within a segment according to how many grams of each were recovered. As a note, the percent water analytical result of 48.6 is probably biased high from the contamination of several samples by hydrostatic head fluid, as mentioned in Section 4.4.3. Table 5-5 lists the results along with the RPDs for the two analytes. Although water was added to this tank for cooling until 1993, the HTCE result for percent water seems to be high for tank 241-C-105 waste that is considered to be mostly sludge.

Table 5-5. Comparison of Safety Screening Results and HTCE Estimates.

Analyte	Analytical result[1]	HTCE result[2]	RPD[3]
Percent water	48.6	70.4	37
Total alpha (μCi/g)	1.33	0.798 (Pu only)	50

Notes:

HTCE = Historical Tank Content Estimate

[1]From 1995 safety screening results.

[2]From Table 2-5.

[3]Relative percent difference = the absolute difference of a and b, divided by their mean.

5.3 TANK WASTE PROFILE

With reference to the core sample taken in 1986, no vertical subsegments were formed for chemical analysis; therefore, no statements on the vertical disposition of the waste based on chemical analyses can be made.

The few analytes tested in the 1995 core samples do not permit a very good assessment of the distribution of waste in tank 241-C-105. Only two analytes from the safety screening results provided enough data with which to make a fair comparison of tank homogeneity (Sasaki 1995b). This makes it difficult to verify any trends in the disposition of the waste.

A statistical procedure known as the analysis of variance (ANOVA) was conducted on the percent water and total alpha sludge data to determine if there were any horizontal or vertical differences in their concentrations. The ANOVA generates a p-value which is compared with 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, there is not sufficient evidence to conclude that the samples are significantly different from each other.

The results of the ANOVA test indicated that there were no differences between the two cores for percent water (p-value = 0.724) or total alpha (p-value = 0.326). In contrast, there were differences between the three segments for both percent water (p-value = 0.002) and total alpha (p-value = 0.023). These differences cannot be accounted for by analytical variability alone. However, these vertical differences do not reveal any consistent, identifiable trend. The visual descriptions of the samples (Table 3-1) did not consistently match with the analytical results, and so provided little insight regarding moisture distribution. This makes any meaningful comparison with the statistical results impossible, and any general statement about tank homogeneity difficult.

5.4 COMPARISON OF ANALYTICAL DATA AND TRANSFER HISTORY INFORMATION

The 1986 and 1995 analytical results agree with what would be expected from the historical uses of tank 241-C-105. The analytical results show high concentrations of aluminum, iron, silicon, sodium, uranium, nitrate, cesium, and strontium. The UR waste added to the tank should contain high concentrations of sodium, iron, nitrate, sulfate, and uranium. Quantities of cesium and strontium should also be present in this waste. The CWP waste should be rich in aluminum, sodium, nitrate, nitrite, and uranium. Cesium and strontium are also present in this waste type. The high concentrations of cesium and strontium are expected because some A and AX solids were believed to have been transferred to tank 241-C-105 during the time that the tank served as a receiver for PSN waste and PSS waste from 241-A and 241-AX tank farms.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

Tank 241-C-105 is classified as a non-Watch List tank; therefore, the only data quality objective (DQO) applicable to this tank is the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The pretreatment program did request that samples be taken and archived for further use; however, because analyses were not performed on these samples, they are not discussed in this section. This section details the data needs as defined in the safety screening DQO (Babad and Redus 1994), and determines whether tank 241-C-105 has been appropriately categorized concerning safety issues. The 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 safety of the tank is warranted.

5.5.1 Safety Evaluation

The primary analytical requirements identified in the safety screening DQO (Babad and Redus 1994) are energetics, moisture content, total alpha activity, and flammable gas concentration. The 1995 push-mode sampling event met all the requirements of the tank characterization plan (Schreiber 1995). Two widely spaced risers were sampled, and all of the required analytes were measured.

The waste fuel energy value was determined by DSC. One exothermic reaction was observed on the primary sample from core 72, segment 2 upper half solids. The duplicate, triplicate, and the average were below the limit. Proper notification was made, and secondary analytes (cyanide, total organic carbon) were measured. Table 5-6 lists the limits and results for the DSC analysis. A statistical analysis of the core 72, segment 2 upper half

Table 5-6. Safety Screening DQO Primary Decision Variables and Criteria for Tank 241-C-105.

Safety issue	Primary decision variable	Decision criteria threshold	Sample location	Analytical value
Ferrocyanide/ organic	Total fuel content	> 481 J/g (> 115 cal/g)	72:2 upper 1/2	524 J/g[1]
			All other exothermic reactions were less than the decision criteria threshold.	
Organic	Percent Moisture	< 17 wt%	72:3 upper 1/2	13.5 % (mean)
			76:2 upper 1/2	12.5 % (dupl.)
			76:2 lower 1/2	4.44 % (mean)
			All other moisture measurements were greater than the decision criteria threshold[2].	
Criticality	Total alpha	> 40.5 μCi/g (> 1 g/L)[3]	76:2 lower 1/2	2.00 μCi/g
Flammable gas	Flammable gas	N/A	---	---

Notes:

cal/g	=	calories per gram
g/L	=	grams per liter
J/g	=	joules per gram
μCi/g	=	microcuries per gram

[1]Any exothermic reaction determined by DSC must be reported on a dry-weight basis as shown in the following equation, using the weight percent water for that sample point from the thermogravimetric analysis.

$$\text{Exotherm (dry wt)} = \frac{[\text{exotherm (wet wt) x } 100]}{(100 - \%\text{ water})}$$

[2]The percent water results which failed to meet the DQO limit are reported. See Table 4-4 for all TGA results.

[3]Although the actual decision criterion listed in the DQO is 1 g/L, total alpha activity is measured in μCi/g rather than g/L. To convert the notification limit for total alpha into a number more readily usable by the laboratory, it was assumed that all alpha decay originates from ^{239}Pu. Using the average bulk density value from Brevick et al. (1994) of 1.52 g/ml, the decision criterion may be converted to 40.5 μCi/g as shown:

$$\left(\frac{1\ g}{L}\right)\left(\frac{1\ L}{10^3\ mL}\right)\left(\frac{1}{density}\frac{mL}{g}\right)\left(\frac{0.0615\ Ci}{1\ g}\right)\left(\frac{10^6\ \mu Ci}{1\ Ci}\right) = \frac{61.5}{density}\frac{\mu Ci}{g}$$

solids DSC results was done. A mean of 268 J/g was calculated with 87.5 percent confidence interval. This is not within the 90 percent confidence interval specified in the safety screening DQO (Babad and Redus 1994).

A statistical analysis was also done on the DSC data for all of the solid segments in both of the core samples. The 90 percent confidence interval upper limit (UL) on the mean for the DSC data is:

$$\hat{\mu} + t_{(a-1)} * \sqrt{\hat{\sigma}^2_{\hat{\mu}}}$$

where:

$\hat{\mu}$	=	ordinary sample mean and
$\hat{\sigma}^2_{\hat{\mu}}$	=	variance of the sample mean
$t_{(a-1)}$	=	a quantile from Student's t distribution with (a-1) degrees of freedom
a	=	number of core samples
$t_{(1)}$	=	equal to 3.078 for a one-sided 90% confidence interval

The variance components in $\hat{\sigma}^2_{\hat{\mu}}$ were estimated using restricted maximum likelihood estimation methods (Harville 1977). Table 5-7 gives the upper limit (UL) to the 90 percent confidence interval for DSC. If the upper limit is less than 481 J/g, then we reject the null hypothesis that DSC is greater than or equal to 481 J/g. Since the upper limit is equal to 397 J/g, we are 90 percent confident that DSC is not greater than or equal to 481 J/g.

Table 5-7. 90 Percent One-Tailed Confidence Interval Limit for Solids DSC.

Analyte	Units	$\hat{\mu}$	$\hat{\sigma}^2_{\hat{\mu}}$	UL
DSC	J/g	149	6,522	397

Note:

J/g = joules per gram

Large amounts of moisture reduce the potential for propagating exothermic reactions in the waste. The percent water content of the waste was determined by TGA. Three samples failed to meet the minimum required moisture in accordance with the safety screening DQO (Babad and Redus 1994): core 72, segment 3 upper half solids; core 76 segment 2 lower half solids; and core 76 segment 2 upper half solids. Table 5-6 lists the limits and the results for the TGA analysis. As discussed in Section 4.4.3 the lithium bromide results indicate that the percent moisture for five of the samples (core 72, segment 2 upper 1/2; core 76, segment 3 lower 1/2; core 72, segment 2 drainable liquid; core 76, segment 2 drainable liquid, and core 76, segment 3 drainable liquid) are compromised. The actual moisture content of these samples should be lower than the values reported

(Sasaki 1995b). There is no agreed-upon method of back-calculating the percent water if lithium bromide contamination is found. A method of doing this is being developed and will be incorporated in a revision of this document.

The potential for criticality can be assessed from the total alpha data. None of the individual samples from the 1995 data contained alpha activity greater than 2.00 μCi/g, and the mean result was 1.33 μCi/g. This was well below the notification limit of 40.5 μCi/g, or 1 g/L, as specified in the safety screening DQO (see footnote 3 of Table 5-6).

The flammability of the gas in the headspace of the tank is another safety screening consideration. Analysis of the tank headspace is discussed in Huckaby (1995). The vapor analyses indicated very low concentrations of flammable components.

The results of the secondary analyses were well below the detection limits. Table 5-8 lists the limits and results of the secondary analyses. As statistical analysis was done on the TOC results. An UL of 7,568 μg/g was calculated with 90 percent confidence that the average is below this limit.

Table 5-8. Safety Screening DQO Secondary Decision Variables and Criteria for Tank 241-C-105.

Safety issue	Secondary decision variable	Decision criteria threshold	Sample location	Analytical value
Organic	Total organic carbon	> 30,000 μg/g	72:2 upper 1/2	6,520 μg/g
Ferrocyanide	Cyanide	> 39,000 μg/g	72:2 upper 1/2	46.8 μg/g

Note:

μg/g = micrograms per gram

Another factor used in assessing the safety of tank waste is the heat generation and temperature of the waste. Heat is generated in the tanks primarily from radioactive decay. No radiological results were obtained for the 1995 sampling event, but Bander and Stevens (1993) estimates a heat generation rate of 5,860 W (20,000 Btu/hr) with an upper-bound heat generation rate in tank 241-C-105 of 7,320 W (25,000 Btu/hr). This is well below the high-heat load tank criteria of 11,700 W (40,000 Btu/hr). If the cesium and strontium results from the 1986 analyses (Table 4-2) are used, a heat generation rate can be calculated as shown below.

Heat Load (^{137}Cs) = [121,000 Ci][4.8 x 10^{-3}]
= 580 W

Heat Load (^{90}Sr) = [659,000 Ci][6.8 x 10^{-3}]
= 4,480 W

Total Heat Load = 5,060 W

The total heat load calculated from the 1986 analytical results is 5,060 W (17,300 Btu/hr). This result is reasonably close to the heat generation rate estimated in Bander and Stevens (1993). Since an upper temperature limit is exhibited (Section 2.4.2), it may be concluded that any heat generated from radioactive sources throughout the year is dissipated.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This report is based on a sampling events that took place in March of 1995. The sampling event and subsequent analyses were based on the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), and the *Tank 241-C-105 Tank Characterization Plan* (Schreiber 1995).

Two of the segments exhibited moisture content less than the notification limit, and one sample of one segment exhibited energetic values more than the notification limit as listed in Babad and Redus (1994) and Schreiber (1995). Subsequent reanalyses (duplicate and triplicate) of energetics resulted in values that were well within specification. The average energetics of this segment was within the notification limit with 87.5 percent confidence. The 90 percent confidence interval upper limit on the mean for all of the solids DSC data was 397 J/g. The analyses of cyanide and total organic carbon as secondary analytes, as required by Schreiber (1995), showed no out-of-specification results. A statistical analysis of the TOC data shows a 90 percent upper confidence level of 7,568 μg/g which is well below the notification limit of 30,000 μg/g. The moisture results were not reanalyzed, due to the small relative percent difference between the original and the duplicate results. Analysis of lithium to detect hydrostatic head fluid contamination showed lithium above the notification limit in five of the samples. Analysis of bromide as a secondary analyte corroborated the lithium analysis. The contamination was severe enough to bias the percent water results for these segments above their actual values (Sasaki 1995b), but the magnitude of the bias was not specified. The samples that were contaminated by hydrostatic head fluid did not exhibit low percent water results. There is no agreed-upon method of back-calculating the percent water if lithium bromide contamination is found. A method of doing this is being developed and will be incorporated in a revision of this document. It should be noted that information on vapor space sampling and analysis to determine the composition of the tank head space gases was not evaluated in this report. The vapor analysis reported in Huckaby (1995) indicated very low concentrations of flammable components.

The large differences in the percent water results and the differences in the physical description of the segments imply a high degree of heterogeneity of the waste. Additional sampling and analysis may show a distinctly varied waste form.

Organic Watch List controls were applied to tank 241-C-105 as a result of the high energetic value and pending final evaluation of the secondary analyte results (WHC 1995). Because there is a high confidence that the DSC is below the safety screening limit, and the TOC results support the conclusion that this tank is safe, it is suggested that the organic Watch List controls be taken off tank 241-C-105.

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APPENDIX A

WASTE TANK 241-C-105 IN-TANK PHOTOGRAPHS

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Figure A-1. March 1994 Tank 241-C-105 Waste Photograph.

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Figure A-2. March 1994 Tank 241-C-105 Waste Photograph.

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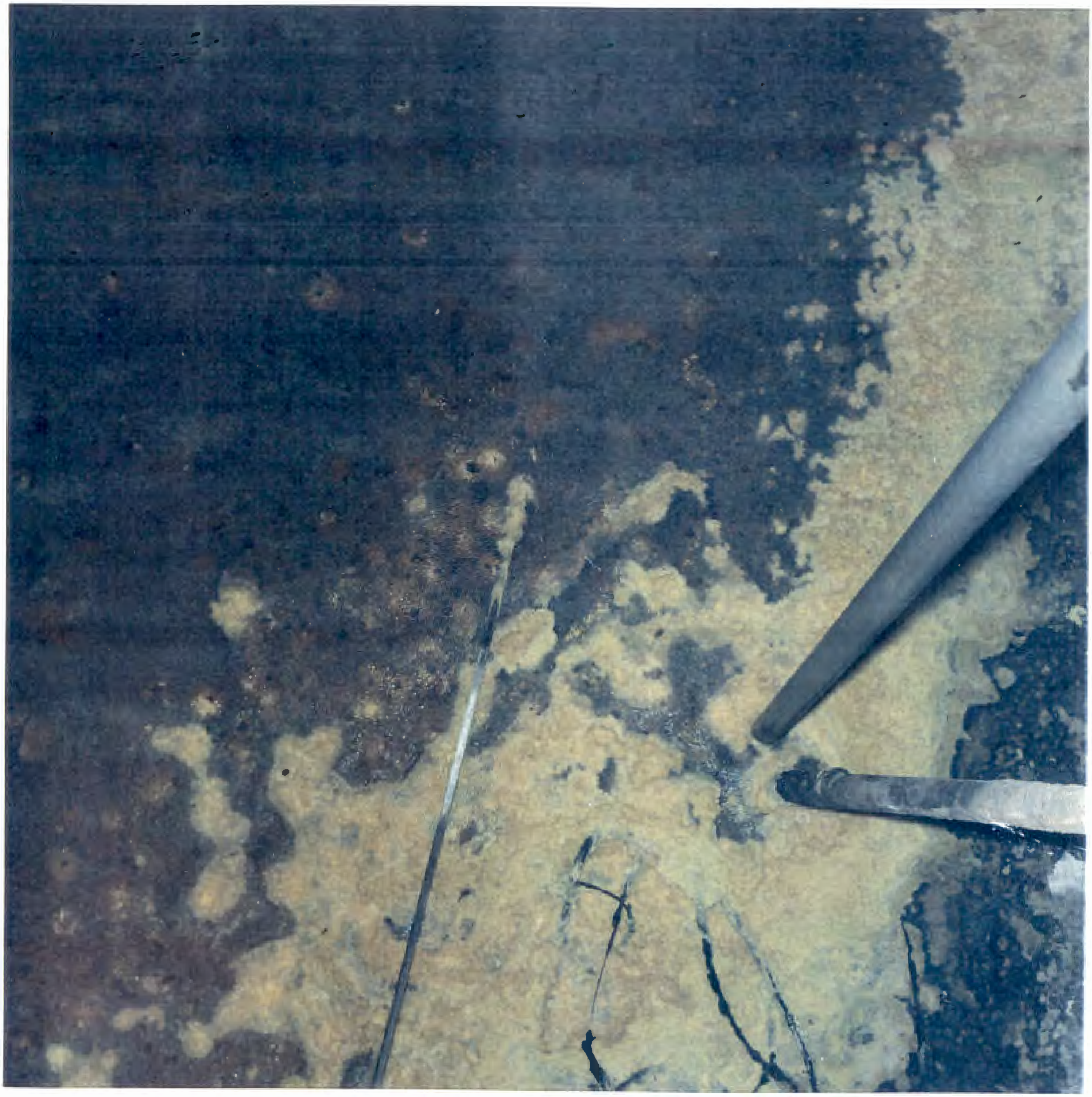
Figure A-3. August 1994 Tank 241-C-105 Waste Photograph.



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APPENDIX B

WASTE TANK 241-C-105 COMPONENT ANALYSIS (1986 SAMPLING EVENT)

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Table B-1. Waste Tank 241-C-105 Component Analysis[1].

Property	Sludge	Liquid
Physical data		
Density	NR	1.23 g/mL
pH	NR	9.69
Mass loss to 400 °C	37,700 μg/g	69.8 percent
Mass loss to 1000 °C	58,900 μg/g	11.5 percent
Bulk density	1.55 g/mL	NR
Particle size	26.8 μm mean population	
Viscosity	NR	4.03 cP
Chemical analysis		
Metal	μg/g	μg/mL
Aluminum	61,800	9.02
Barium	2,560	2.66
Bismuth	625	101
Boron	12.3	3.7
Cadmium	158	NR
Calcium	7,790	4.15
Chromium	943	1,120
Cobalt	10.3	NR
Copper	155	3.62
Iron	10,600	3.29
Lead	898	123
Magnesium	3,690	5.67
Manganese	2,470	13.6
Nickel	2,150	6.15
Phosphorus	2,530	2,560
Potassium	1,110	1,570
Silicon	39,900	103
Silver	67	20.5
Sodium	71,800	115,000
Strontium	184	NR
Uranium	9,830	966
Zinc	154	NR
Zirconium	715	364

Table B-1. Waste Tank 241-C-105 Component Analysis[1].

Ion/total carbon	$\mu g/g$	$\mu g/mL$
Nitrate	10,500	34,300
Total organic carbon	999	2,870
Radiological analysis		
Radionuclide	$\mu Ci/g$	$\mu Ci/L$
^{241}Am	1.51	0.006
^{14}C	7.0E-04	0.003
^{137}Cs	147	442
^{60}Co	0.73	0.017
^{129}I	0.0001	NR
$^{239/240}Pu$	0.85	0.155
^{90}Sr	864	5.12
^{99}Tc	0.10	0.258

Notes:

cP	=	centiPoise
g/mL	=	gram per milliliter
$\mu g/g$	=	microgram per gram
$\mu Ci/g$	=	microcurie per gram
$\mu Ci/mL$	=	microcurie per milliliter
$\mu g/mL$	=	microgram per milliliter
μm	=	micrometer (micron)
NR	=	Not reported

[1]Weiss, R. L., 1987, *Reissue of Letter 65453-87-050*, (internal memorandum 65453-87-074 to Distribution, May 28), Westinghouse Hanford Company, Richland, Washington.

APPENDIX C

DIFFERENTIAL SCANNING CALORIMETRY AND THERMOGRAVIMETRIC ANALYSIS PLOTS FROM 1995 SAMPLING EVENT

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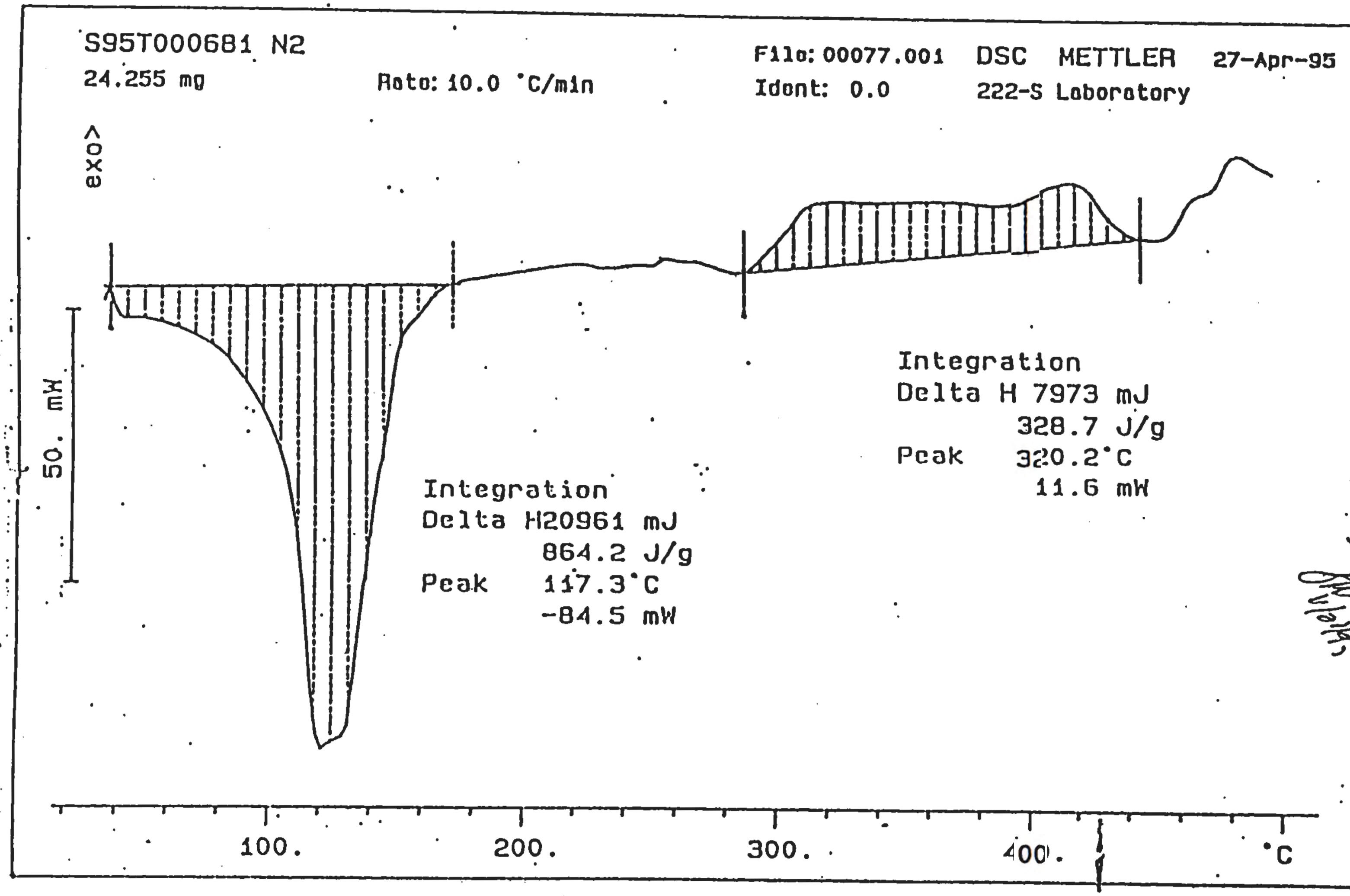

Figure C-1. DSC Plot for Upper Half of Core 72, Segment 2.

WHC-SD-WM-DP-108 REV 0

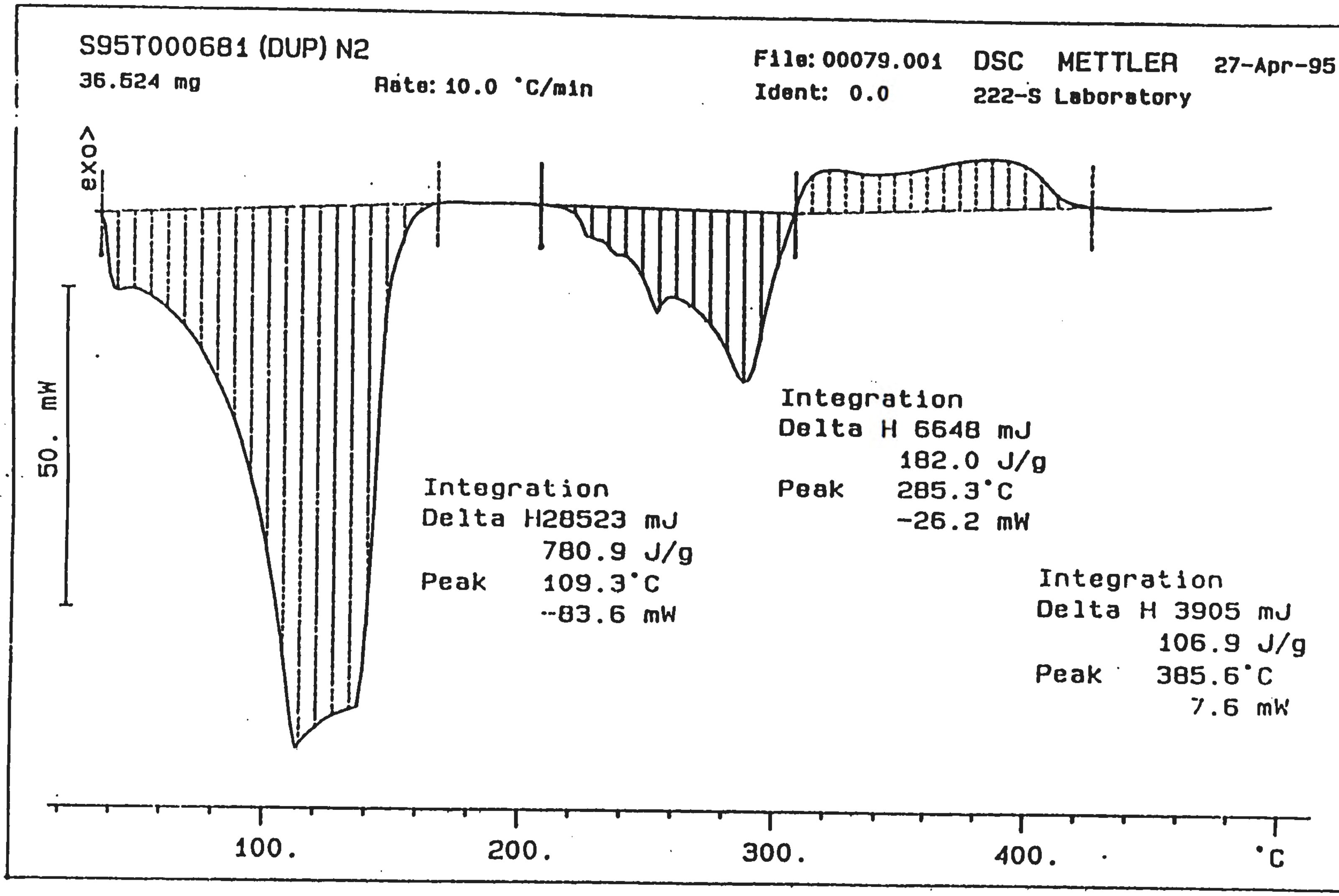

Figure C-2. DSC Plot for Upper Half of Core 72, Segment 2 (Duplicate).

WHC-SD-WM-DP-108, REV 0

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~~WHC-SD-WM-DP-108, REV.0~~

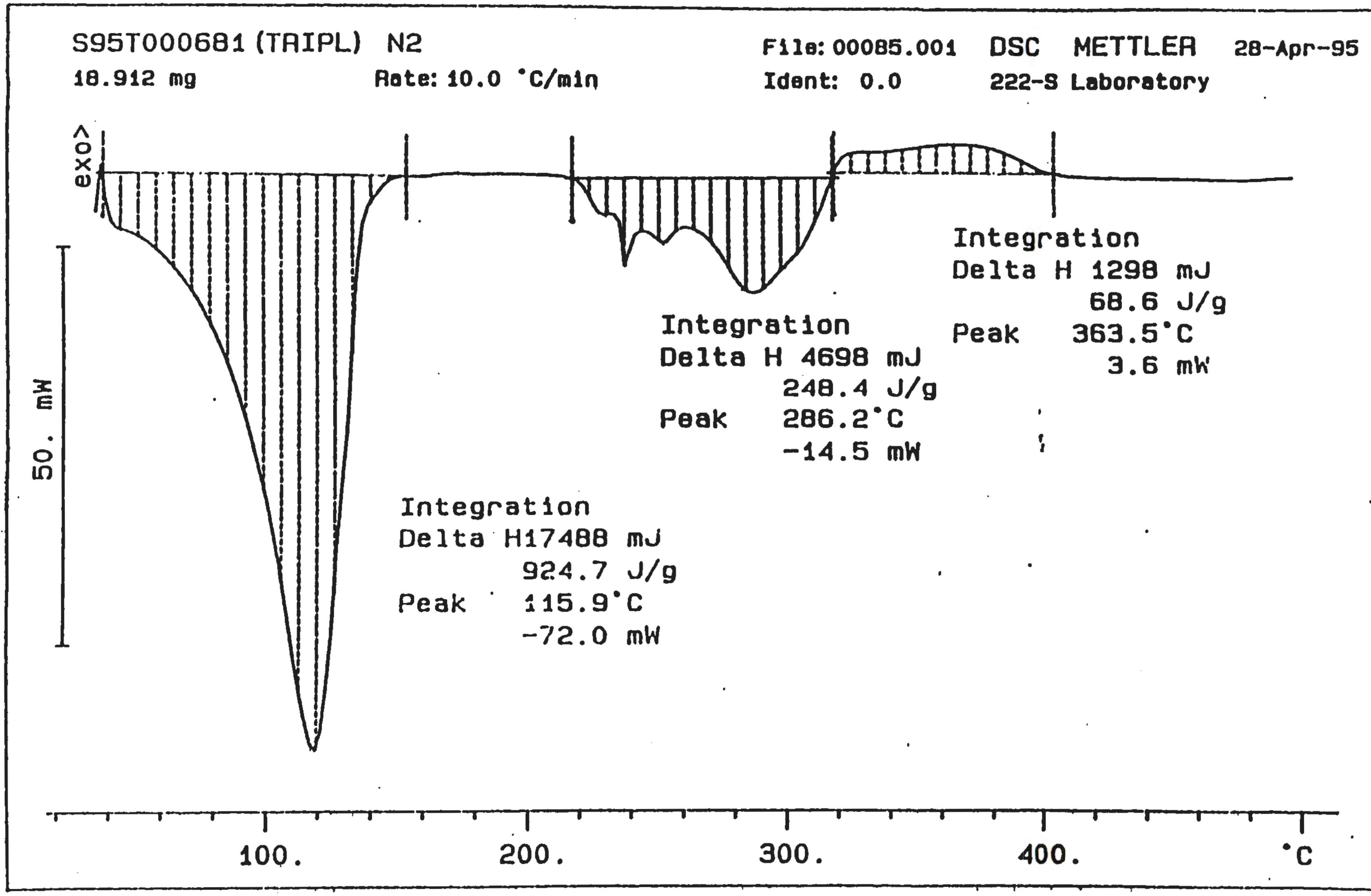
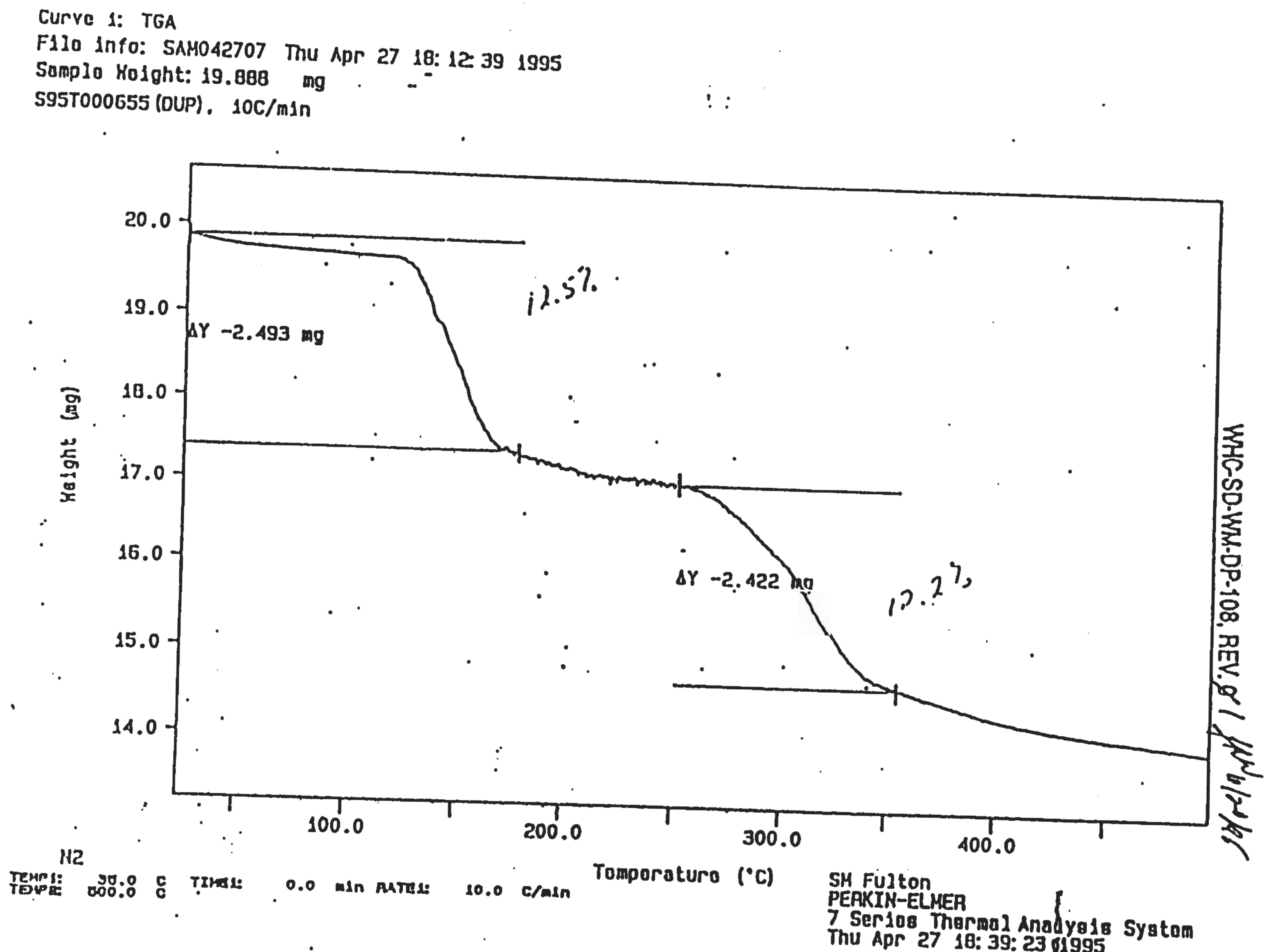


Figure C-3. DSC Plot for Upper Half of Core 72, Segment 2 (Triplicate).



WHC-SD-WM-DP-108, REV. 01

Figure C-4. TGA Plot for Upper Half of Core 76, Segment 2 (Duplicate).

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WHC-SD-WM-DP-108, REV. 0

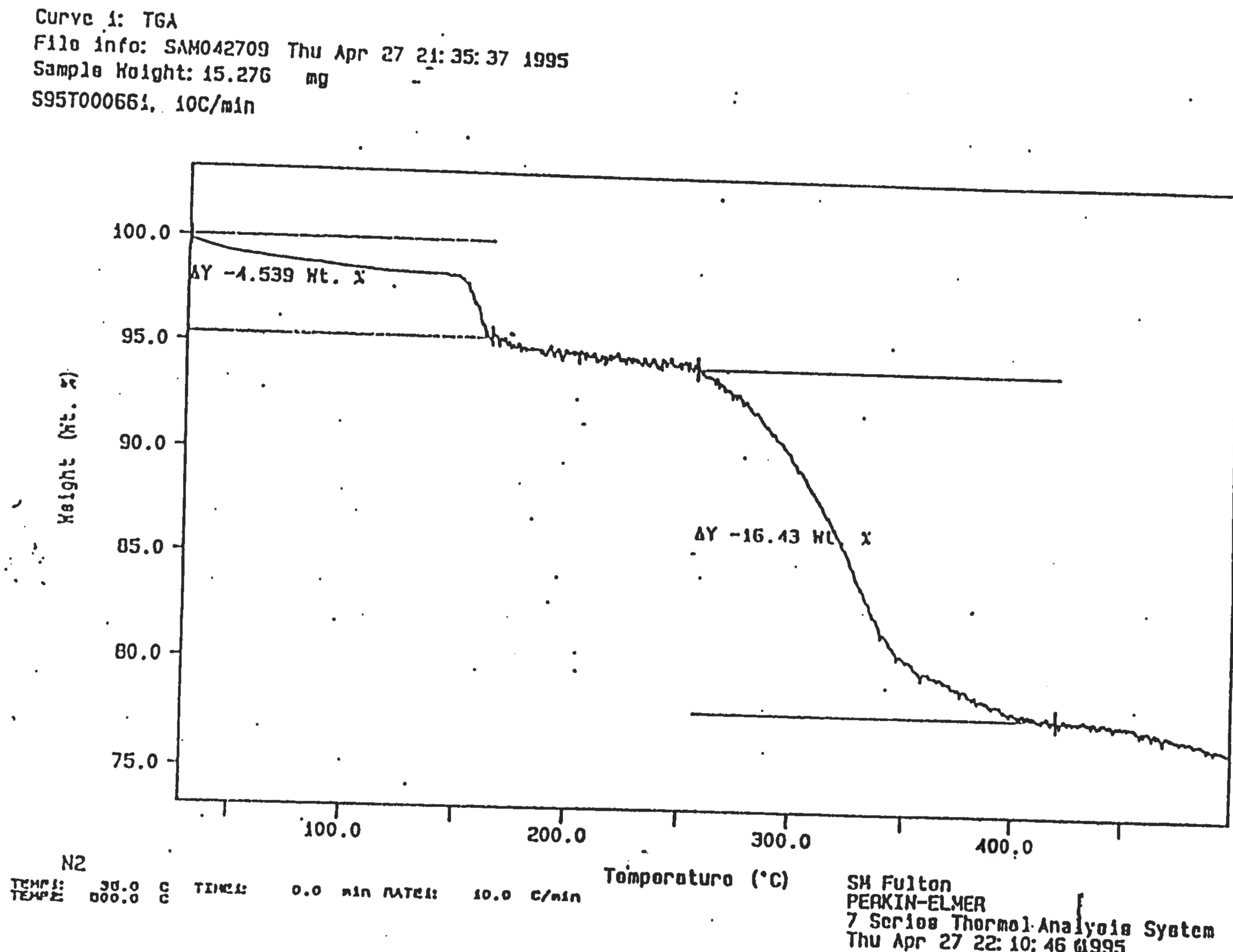

Figure C-5. TGA Plot for Lower Half of Core 76, Segment 2.

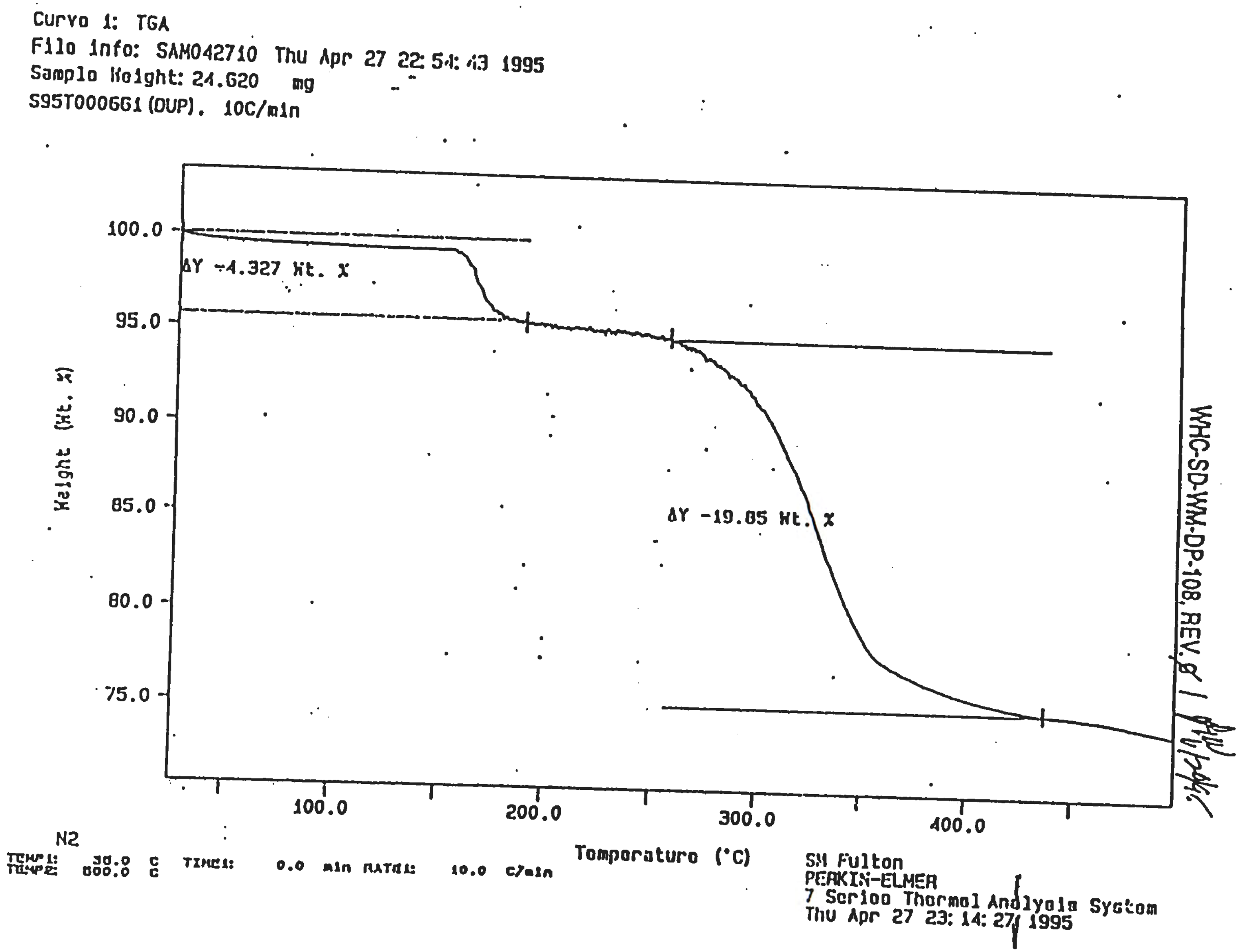

Figure C-6. TGA Plot for Lower Half of Core 76, Segment 2 (Duplicate).

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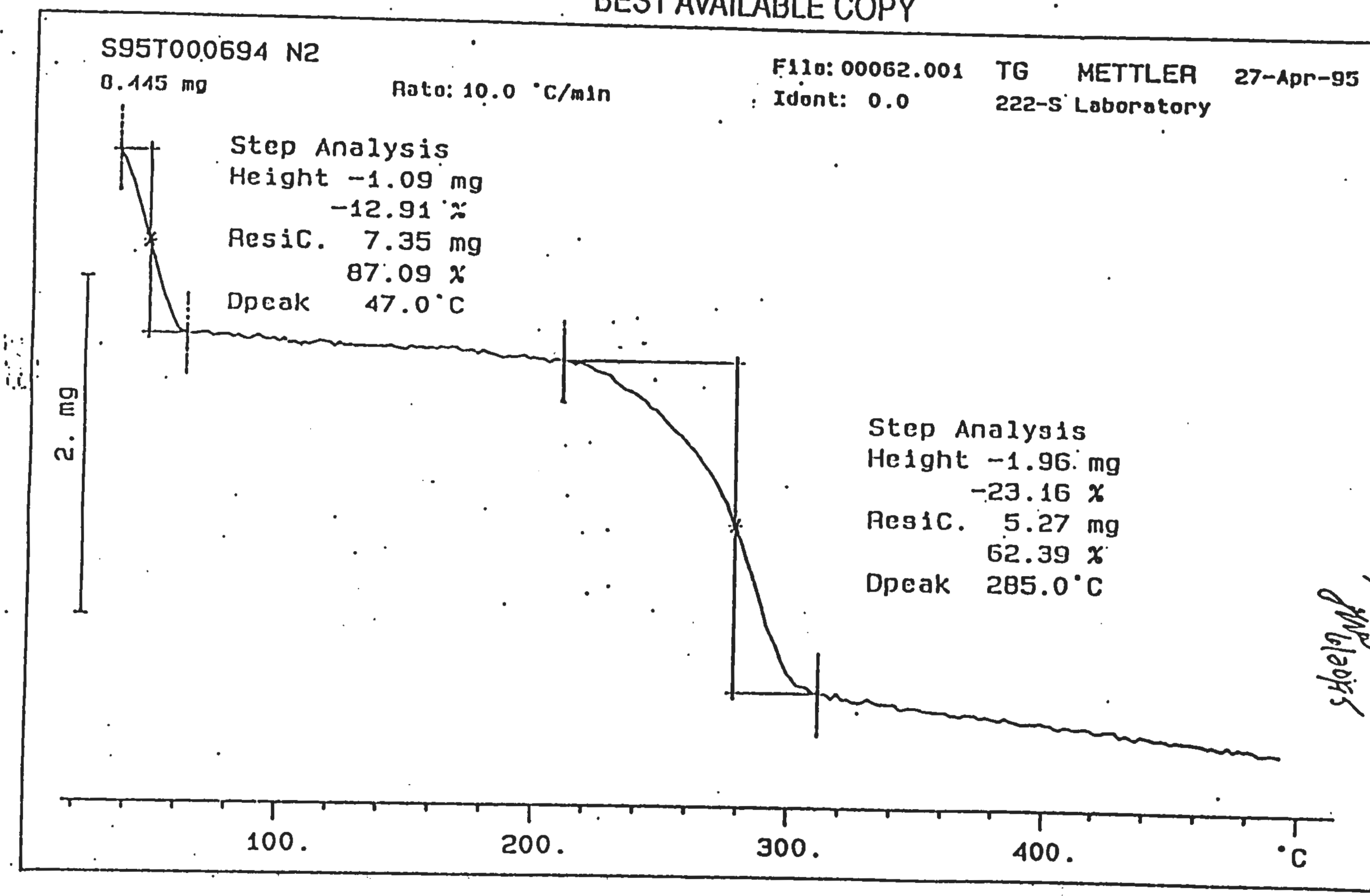

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JWP 6/6/95

Figure C-7. TGA Plot for Upper Half of Core 72, Segment 3.

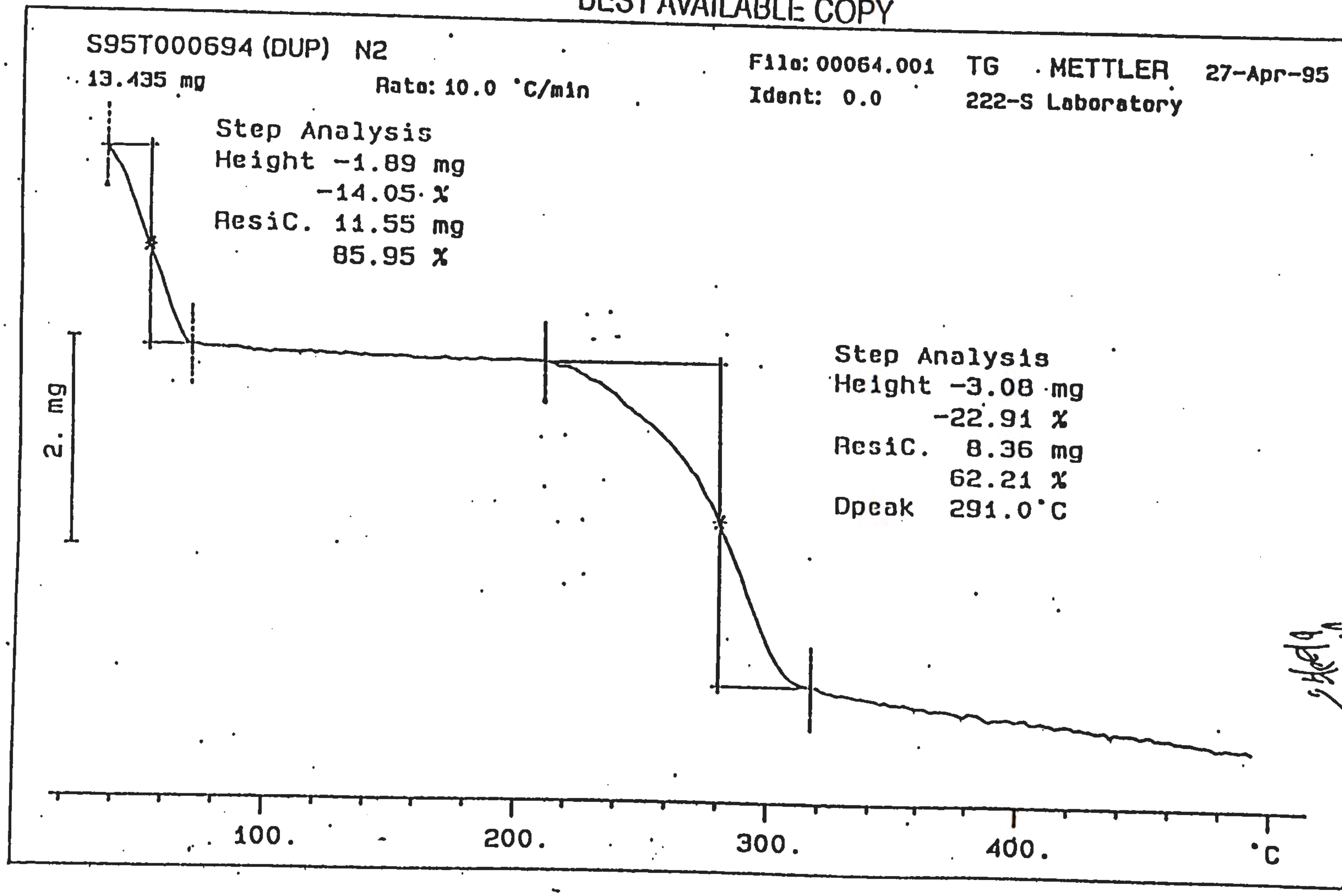

Figure C-8. TGA Plot for Upper Half of Core 72, Segment 3 (Duplicate).

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