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7. Abstract

This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in tank 241-C-204. This report supports the requirements of Tri-Party Agreement Milestone M-44-08.

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Revision 0

Tank Characterization Report for Single-Shell Tank 241-C-202

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Date Published
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Prepared for the U.S. Department of Energy
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EXECUTIVE SUMMARY

This tank characterization report summarizes the information on the historical uses, status, and sampling and analysis results of waste stored in single-shell underground storage tank 241-C-202. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, milestone M-44-08[1].

Tank 241-C-202 is located in the C Tank Farm in the 200 East Area of the Hanford Site. The tank is 6.1 meters (m) (20 feet [ft]) in diameter and has a usable depth of 5.67 m (18.7 ft), and an operating capacity of 208 kiloliters (kL) (55 kilogallons [kgal]). The tank went into service in 1947 and received metal waste and Hot Semi-Works waste until the mid 1950s. From 1956 to 1970, tank 241-C-202 was considered full, and no significant waste additions were made to it. During 1970, the contents of the tank were transferred to tank 241-C-104. There is some indication that 3.8 to 7.6 kL (1 to 2 kgal) of Strontium Semi-Works waste was transferred to the tank in the mid 1970s; however, there are no documents to verify the source or type of this waste. Approximately 3.8 kL (1 kgal) of sludge now remain in the tank. The tank was then classified as inactive. The tank was administratively interim stabilized in 1981 and intrusion prevent was completed in 1982. It was categorized as an assumed leaker in 1988. The tank is not on a Watch List. However, as a result of the 1995 sampling and analysis event, organic Watch List tank controls are currently being applied to tank 241-C-202.

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

A description and the status of tank 241-C-202 are summarized in Table ES-1. This report summarizes one 1995 sampling and analysis event which was performed to satisfy the requirements of the *Tank Safety Screening Data Quality Objective*[2]. The sampling and analysis of sludge waste in the tank was performed in accordance with the *Tank 241-C-202 Tank Characterization Plan*[3].

The fuel and moisture content in tank 241-C-202 exceeded the safety screening data quality objective criteria of 481 joules per gram (J/g) (exothermic) and 17 weight percent, respectively. Exothermic reactions were noted from the differential scanning calorimetry data for auger samples 95-AUG-026 and 95-AUG-027. All sample exotherms were observed in the second transition which occurred above 200 °C (392 °F). These exotherms ranged from 188 J/g to greater than 624 J/g. Only endotherms were observed in the first transition from ambient to 200 °C (392°F). The percent water results for both samples was less than 7 weight percent, significantly less than the minimum required by the safety screening data quality objective criterion. The auger samples were observed to be dry and powdery with no drainable liquid present. Due to an insufficient sample, no supporting analyses, such as total organic carbon, were performed. Based on the limited information available, further sampling and analysis may be required to validate the safety of tank 241-C-202.

[2]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.

[3]Schreiber, R. D., 1995, *Tank 241-C-202 Tank Characterization Plan*, WHC-SD-WM-TP-305, Rev 0, Westinghouse Hanford Company, Richland, Washington.

The total alpha activity, measured at 8.6 microcuries per gram (μCi/g), indicates that the plutonium concentration is below the tank safety limit of 41 μCi/g and is well above the transuranic classification limit of 100 nanocuries per gram (0.1 μCi/g).

No estimate of the chemical and radionuclide concentration and inventory for tank 241-C-202 is available at this time. Tank concentrations and inventory estimates based entirely on metal waste are presented in *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 West Areas*[4]; however, these estimates are considered to be invalid because they do not address Hot Semi-Works and Strontium Semi-Works wastes. As available, updated tank concentration and inventory estimates will be included in this report.

A tank waste heat production estimate, based on heat producing radionuclides such as cesium-137 and strontium-90, will be provided as historical tank content estimates are available. The waste in the tank is currently categorized as a low-heat producer. This is reasonable based on the recent tank waste temperatures; however, the current waste level is lower than the lowest temperature thermocouple.

Tank dome space monitoring or sampling and analysis data for flammable gases will be included when available. Also, this report does not include chemical, radiochemical, or physical testing requirements to support retrieval, pretreatment, or waste disposal activities.

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

Because the fuel and moisture content of tank 241-C-202 exceeded the safety screening data quality objective threshold criteria, potential tank safety issues have been identified. However, poor auger sample recoveries, the absence of supportive analytical data (for example, total organic carbon), and the lack of a valid Historical Tank Content Estimate make it difficult to assign an unsafe classification or place the tank on a Watch List without further sampling and analysis information. Analysis information from tank 241-C-201, which has nearly identical historical transfer records and comparable energetics, moisture content, and total alpha activity as does tank 241-C-202, may be useful in evaluating the safety of tank 241-C-202. This report compares tank 241-C-201 and tank 241-C-202 results from the 1995 auger sampling events.

Table ES-1. Description and Status of Tank 241-C-202.

Tank description	
Type	Single-shell
Constructed	1944
In-service	1947
Diameter	6.1 m (20 ft)
Usable depth	5.67 m (18.7 ft)
Operating capacity	208 kL (55 kgal)
Bottom shape	Dished
Ventilation	Passive breather filter
Tank status (as of May 1995)	
Total waste volume	3.8 kL (1 kgal)
Sludge volume	3.8 kL (1 kgal)
Supernate volume	0.0 kL (0 kgal)
Surface level (manual tape average 1992 to 1995)	19.3 cm (7.6 in.)
Temperature (average 1992 to 1995)	16.1 °C (61 °F)
Integrity (declared in 1988)	Assumed leaker
Watch List	None
Contents	Non-complexed/TRU
Sampling dates	
Auger sampled	May 1995
Service status	
Removed from service	1976
Interim stabilized	August 1981
intrusion prevention	December 1982

Notes:

C	=	Celsius	in.	=	inches
cm	=	centimeters	kgal	=	kilogallons
F	=	Fahrenheit	kL	=	kiloliters
ft	=	feet	m	=	meters
TRU	=	transuranic			

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LIST OF TERMS

DQO	data quality objectives
DSC	differential scanning calorimetry
HDW	Hanford Defined Waste
HS	Hot Semi-Works
HTCE	historical tank content estimate
ICP	inductively coupled plasma spectrometry
MW	metal waste
PUREX	Plutonium Uranium Extraction (Plant)
REDOX	reduction oxidation
RPD	relative percent difference
SSW	Strontium Semi-Works
TCP	tank characterization plan
TGA	thermogravimetric analysis
TLM	Tank Layer Model
TOC	total organic carbon
WHC	Westinghouse Hanford Company
WSTRS	Waste Status Transaction Record Summary

1.0 INTRODUCTION

This tank characterization report overviews single-shell tank 241-C-202 and its waste contents. This report describes the results of one sampling event that occurred in May 1995, in accordance with the requirements of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, milestone M-44-08 (Ecology et al. 1994). An introduction to the history surrounding the generation, storage, and management, information on sampling, analysis, and modeling activities that support the current waste characterization, and a glossary of terminology are provided in De Lorenzo et al. (1994).

1.1 PURPOSE

This report summarizes the best available information about the use and contents of tank 241-C-202. Primarily, this information is to be used to assess issues associated with the safety of waste in the tank. In addition, this report will provide a reference point for future sampling, analysis, and waste characterization activities.

1.2 SCOPE

Auger sampling in May 1995 supported the evaluation of the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) criteria for tank solid/liquid waste. From the auger sampling, only the three primary analyses identified in the *Tank 241-C-202 Tank Characterization Plan* (Schreiber 1995a) were performed: differential scanning calorimetry (DSC) to evaluate fuel content and energetics, thermogravimetric analysis (TGA) to determine the percent water, and total alpha activity analysis to evaluate criticality.

Because of the limited safety screening analysis set, the chemical and radiochemical concentrations for most components are typically estimated from the *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas* (HTCE) (Brevick et al. 1995). However, the HTCE is based on a model that assumes only metal waste (MW) is resident in the tank and, therefore, is considered invalid. Without the HTCE for tank 241-C-202, composition information can only be inferred from the concentration estimates available for tank 241-C-201 (Schreiber 1995b) which has a nearly identical transfer history.

This report contains no information on dome space monitoring or sampling and analysis to determine the presence and composition of flammable gases. This information will be added when available.

1.3 SPECIAL CONSIDERATIONS

Because of the fuel and moisture content of tank 241-C-202 exceeded the safety screening data quality objective threshold criteria, potential tank safety issues have been identified. Analysis information from tank 241-C-201, which has nearly identical historical transfer records and comparable energetics, moisture content, and total alpha activity as tank 241-C-202, may be useful in evaluating the safety of tank 241-C-202. From Table 1-1 and Table 1-2, it is evident that tank 241-C-202 can be considered very similar to tank 241-C-201. The auger sample recoveries for both tanks were similar; however, tank 241-C-201 recovered sufficient sample to perform total organic carbon (TOC). The TOC for tank 241-C-201 was above Operating Specification Document safety criterion (WHC 1995); however, the TOC results did not exceed the *Rich Tank Safety Issue* (Buckley 1995). The Executive Summary from the *Tank 241-C-201 Tank Characterization Report* (Schreiber 1995b) is included in Appendix B.

Table 1-1. Comparison of Tank 241-C-201 and Tank 241-C-202 1995 Auger Sampling Analytical Results

Analysis	Tank241-C-201	Tank 241-C-202
Differential scanning calorimetry (ΔH)	381 to 685 J/g	188 to 624 J/g
Thermogravimetric analysis (water content)	9.8 to 11.5 wt%	5.1 to 6.7 wt%
Total alpha activity	11.9 to 22.9 μCi/g	8.0 to 9.3 μCi/g
Total organic carbon	4.65 average dry wt%	(not measured)

Notes:

ΔH = change in enthalpy
J/g = joules per gram
μCi/g = microcurie per gram
wt% = weight percent

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Total organic carbon	4.65 average dry wt%	(not measured)

Notes:

ΔH = change in enthalpy
J/g = joules per gram
μCi/g = microcurie per gram
wt% = weight percent

Table 1-2. Similarities of Tank 241-C-201 and Tank 241-C-202 Waste Transfers.

Transfer	Waste type	Qtr/Yr	Tank 241-C-201		Tank 241-C-202	
			Xfer vol (kgal)	Tot vol (kgal)	Xfer vol (kgal)	Tot vol (kgal)
In	MW	4Q47	55	55	55	55
Out to C106		2Q53-4Q53	55	0	55	0
		1Q54[1]		0		0
In	SSW	2Q55-4Q56	55	55	55	55
	HS[2]	1Q57-1Q70		55		55
Out to C104		2Q70	54	1	55	0
In	SSW	1Q75	4	4[3]	2	2[3]
	NCPLX[4]	2Q78	--	4		2

Notes:

HS	=	Hot Semi-Works
kgal	=	kilogallon
MW	=	metal waste
NCPLX	=	noncomplexed
SSW	=	Strontium Semi-Works
Qtr/Yr	=	calendar quarter and year; 4Q47 = fourth quarter of 1947
Vol	=	volume
Xfer	=	transfer

[1]Tanks declared EMPTY in first quarter of 1954.

[2]Waste type appears to have been redefined; no volume changes recorded in late 1956 or early 1957.

[3]From 1973 to 1975 volume of tanks gradually increased; no source for volume increase is documented.

[4]Waste appeared to be redefined in 1978, no transfers recorded.

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2.0 HISTORICAL TANK INFORMATION

Tank 241-C-202 historical information includes tank status, design information, waste transfer history, waste temperature, and level surveillance information. The most current volume and temperature status of the tank are provided in routinely updated reports (e.g., Hanlon 1995). Because tank 241-C-202 is not in active service, its present waste volume is not expected to change.

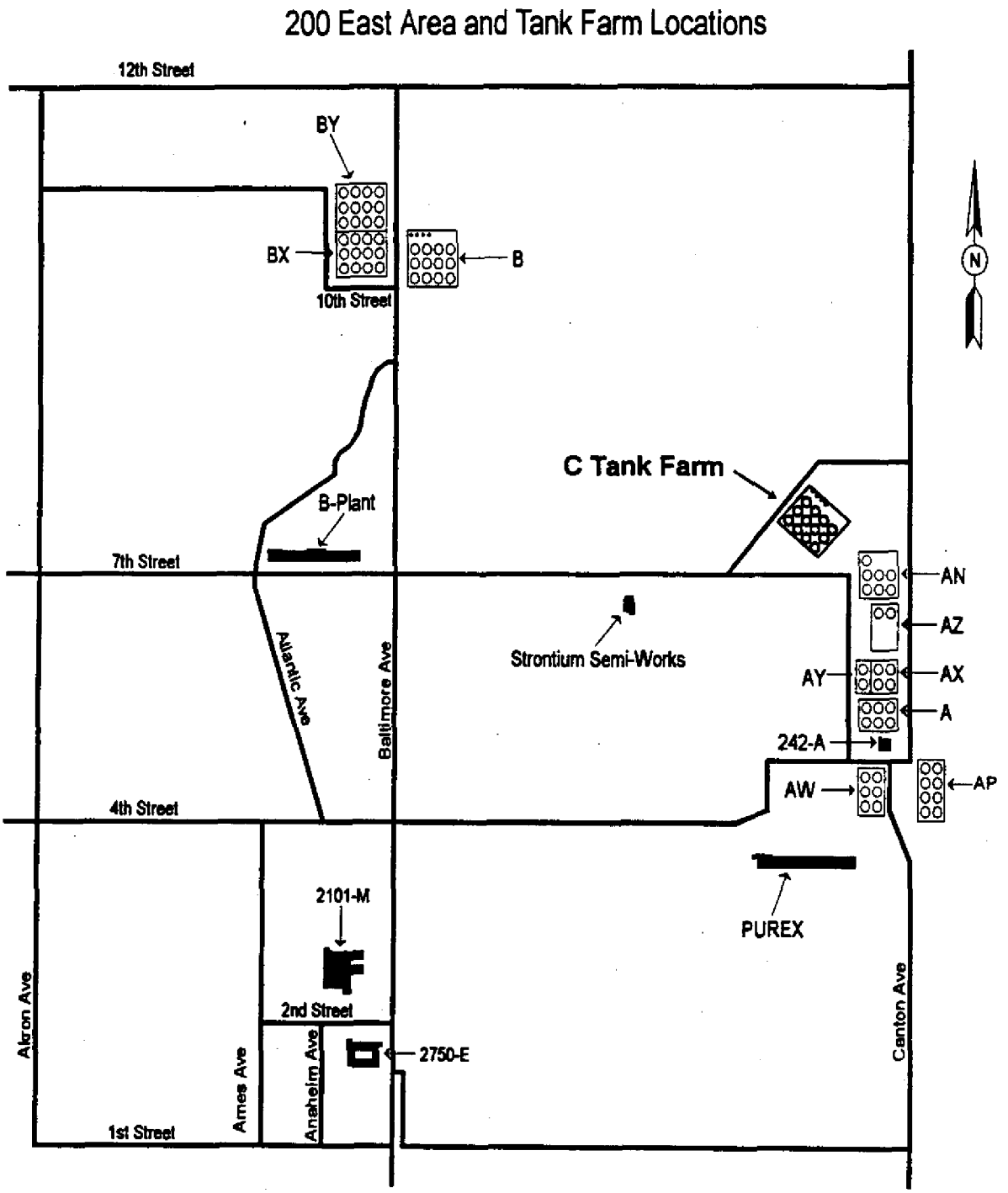
2.1 TANK STATUS

According to Anderson (1990) and Agnew and Brown (1994), prior to 1955, tank 241-C-202 contained MW that originated from the extraction of plutonium using the bismuth phosphate process. The source of the waste was most likely the B-Plant; however, there is not supporting documentation to validate the source. During the second quarter of 1953, supernate from tank 241-C-202 was transferred to tank 241-C-106. Sluicing of MW began in the fourth quarter of 1953 and was completed in January 1954. The historical record suggests that between the first quarter of 1955 and the second quarter of 1956, Hot Semi-Work (HS) and Strontium Semi-Works (SSW) waste was transferred to tank 241-C-202. In 1970, all waste was removed from the tank by transferring it to tank 241-C-104. During the mid 1970s, a small quantity of SSW waste appears to have been transferred to tank 241-C-202; however, there are no supporting documents to substantiate the source, volume, or type of waste. Tank 241-C-202 is categorized as EMPTY, but it is estimated to still contain 3.8 kiloliters (kL) (1 kilogallons [kgal]) of MW, HS, and SSW sludge classified as noncomplexed waste (Hanlon 1995). All 3.8 kL of waste in the tank is considered to be sludge, because there is no visible supernate present in the tank. The waste depth is expected to remain constant at about 19.3 centimeters (cm) (7.6 inches [in.]), since the tank was removed from service in 1976 and classified inactive in 1977. The tank has been stabilized and intrusion prevention has been completed (Welty 1988). Its integrity was categorized as assumed leaker in 1988 and it is not currently on a Watch List. The tank is ventilated with a passive breather filter (WHC 1994).

2.2 TANK DESIGN AND BACKGROUND

Tank 241-C-202 is one of 16 waste storage tanks constituting the C Tank Farm in the 200 East Area of the Hanford Site. Four of the tanks in the C Tank Farm, including tank 241-C-202, have design capacities of 208 kL (55 kgal) and 12 have design capacities of 2010 kL (530 kgal). Construction of the C Tank Farm was begun in 1943 and completed during 1944 (WHC 1994). The C Tank Farm tanks were designed for nonboiling waste with a maximum temperature of 104 °C (220 °F), and as with other first generation tanks, equipment to monitor the waste is sparse. See Figure 2-1 for the location of the C Tank Farm and the *Tank Characterization Reference Guide* (De Lorenzo et al. 1994) for more information about the C Tank Farm and single-shell tanks in general.

Figure 2-1. Hanford Site 200 East Area and C Tank Farm.



Tank 241-C-202 is a single-shell tank consisting of a mild carbon-steel liner within a reinforced concrete shell and dome. The tank has a 6.1-meter (m) (20-foot [ft]) diameter and a 5.67-m (18.7 ft) usable depth; the tank bottom is dish shaped (Brevick et al. 1994). See Figure 2-2 for the basic design of tank 241-C-202. Waste was added to the tank through piping, which penetrates the tank sidewall. Instruments access the tank through risers, and monitor such parameters as temperature and waste level. The position of these risers is shown in Figure 2-3.

2.3 PROCESS KNOWLEDGE

The fill history of tank 241-C-202 can be summarized as three major receiving and transferring campaigns, with the waste designations for the first two campaigns being MW and the final campaign being HS/SSW. From 1947 to 1954, the tank was used to store MW. Historical records suggest the tank contained waste from the HS plant PUREX pilot operations. The majority of waste from the HS plant was transferred in 1955 and early 1956. The tank was considered full in 1956. In 1970, the majority of HS/SSW waste was removed; however, there is some indication that a small quantity of SSW waste was added during the mid 1970s. The tank currently is estimated to contain approximately 3.8 kL (1 kgal) of sludge. The volume of waste transferred to and from this tank, and the volume estimated to remain in storage is summarized in Table 2-1.

Table 2-1. Waste Volumes of Tank 241-C-202[1].

Waste type	Approximate volume received kL (kgal)	Estimated volume remaining kL (kgal)
Metal waste	208 (55)	0 (0)
Metal waste/supernate[2]	167 (44)	0 (0)
Hot Semi-Works waste/Strontium Semi-Works waste	208 (55)	0 (0)
Strontium Semi-Works waste[3]	7.6 (2)	3.8 (1)

Notes:

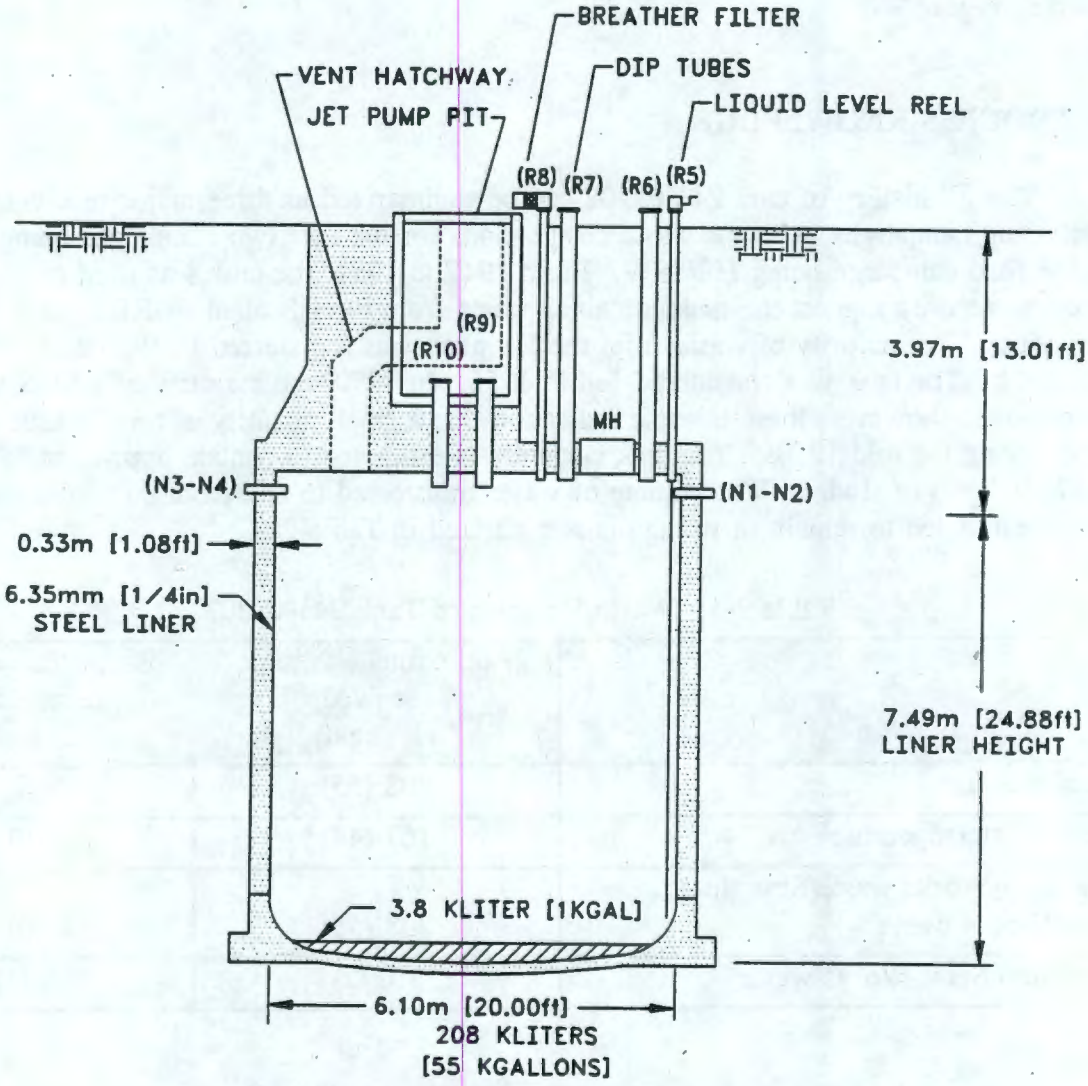
kL = kiloliter.
kgal = kilogallon.

[1]Agnew, S. F., and T. M. Brown, 1994, *Waste Status and Transaction Record Summary for the Northeast Quadrant*, WHC-SD-WM-TI-615, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[2]Although defined as metal waste, this may have been supernate or water used for sluicing.

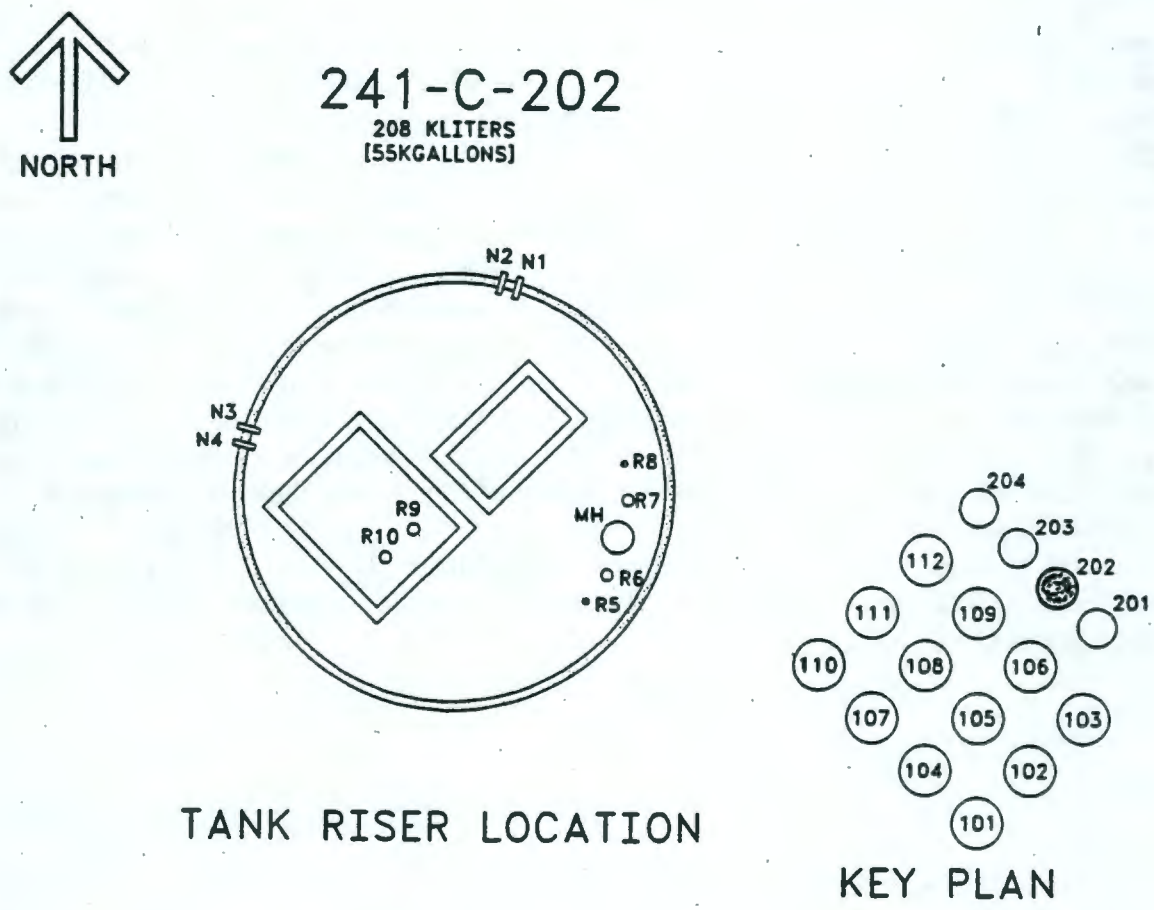
[3]Although transfer records indicate two additions to tank 241-C-202 of 3.8 kL (1 kgal) each, additional documentation substantiating SSW as the source has not been located.

Figure 2-2. Design of Tank 241-C-202.



TANK RISER SECTION

Figure 2-3. Tank 241-C-202 Riser and Equipment Configuration.



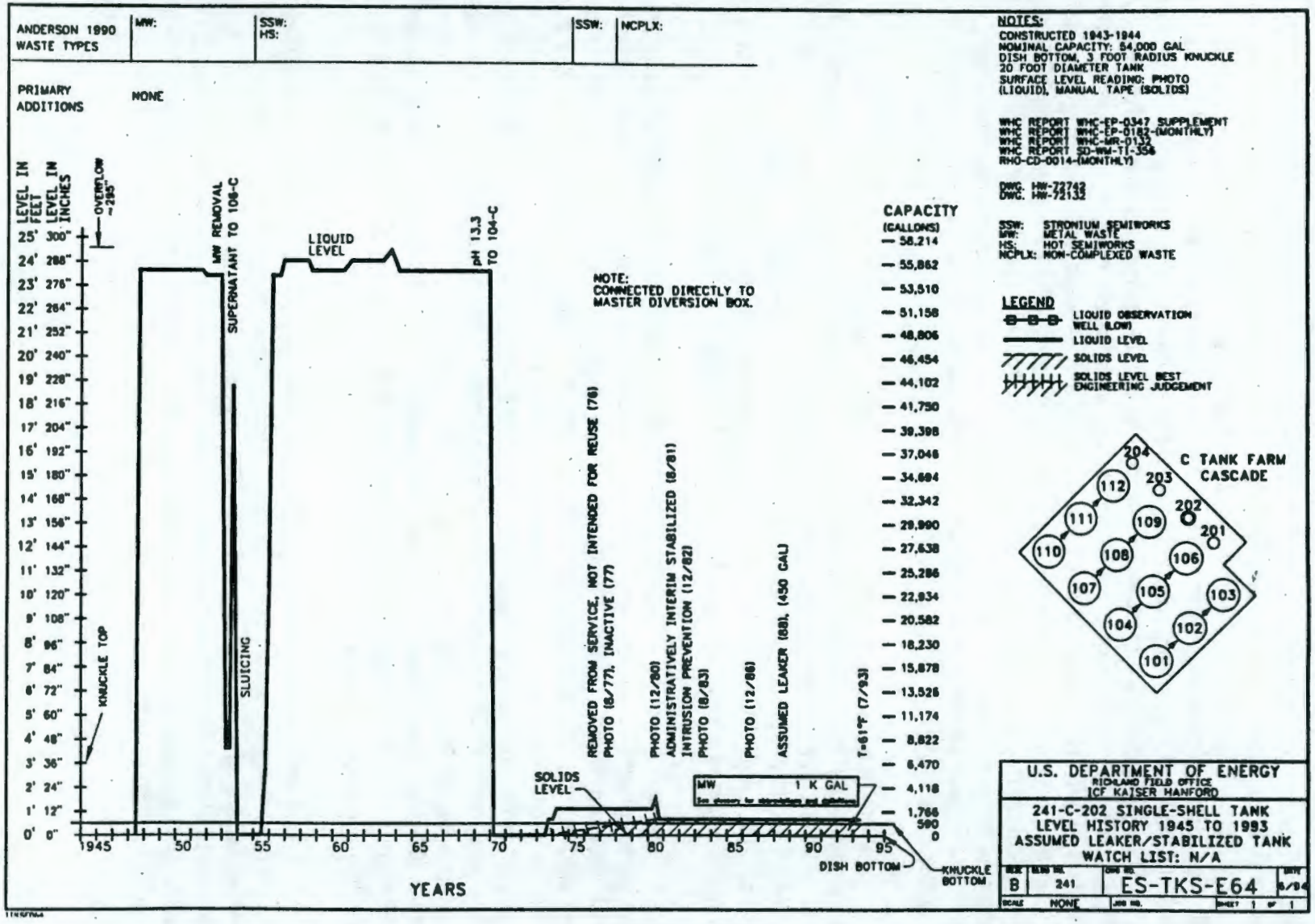
Number	Diameter (inches)	Description and comments
MH	--	Manhole
R5	4	Level monitoring (manual tape)
R6	12	Temperature monitoring (thermocouple tree)
R7	12	Observation port -- 1995 sampling location
R8	4	Breather filter
R9	12	Sludge jet access, weather cover
R10	12	Sluicing access, weather cover
N1	3	Spare
N2	3	Spare
N3	3	Inlet
N4	3	Inlet

2.3.1 Waste Transfer History

The initial waste transferred into tank 241-C-202 in 1947 was MW from the bismuth phosphate, plutonium extraction process. This waste remained in the tank until 1953, at which time the supernate was transferred to tank 241-C-106. During 1953, additional MW was transferred to the tank, and the supernate from this waste was also transferred to tank 241-C-106 in the latter half of 1953. Sluicing of the MW for uranium recovery started in the fourth quarter of 1953 and was completed by January of 1954. Transfers of HS/SSW waste were made to tank 241-C-202 during 1955 and 1956 (Agnew and Brown 1994). During the 1950s, the HS plant was reportedly used as a pilot plant for both the REDOX and PUREX processed (Agnew 1994), with the waste transferred to tank 241-C-202 during 1955 and 1956 most likely being from an early PUREX pilot campaign. During 1970, the tank was emptied by transferring the contents to tank 241-C-104. During the mid 1970s some SSW waste appears to have been transferred to the tank. As indicated in Table 2-1, these transfers total about 7.6 kL (2 kgal). In 1976, the tank was removed from service, and it was classified inactive in 1977. The fill history of this tank is shown in Figure 2-4. Currently, tank 241-C-202 is estimated to contain 3.8 kL (1 kgal) of sludge. The sludge is expected to be primarily from SSW operations and the early PUREX pilot operations; however, MW sludge remaining after the sluicing operation is expected to contribute to the chemical composition.

9613456.0834

Figure 2-4. Tank 241-C-202 Fill History.



2.3.2 Historical Estimation of the Contents of Tank 241-C-202

Typically, estimates of the contents of single-shell tanks are developed from the Waste Status Transaction Record Summary (WSTRS), the Hanford Defined Waste (HDW) list, and the tank layer model (TLM). The WSTRS is a compilation of available waste transfer and volume status data. The HDW provides the assumed typical composition for about 50 separate Hanford waste types. The TLM is a computer model developed by the Los Alamos National Laboratory to predict the chemical content of Hanford Site waste tanks. The TLM predictions are presented in the historical tank content estimates (HTCE). The TLM derives an estimate of the solid and liquid waste layers residing in a tank based on an analysis of WSTRS transfer records and provides a volumetric and chronological description of the tank inventory based on the designate HDW type. The accuracy of the TLM is dependent on the completeness and accuracy of the transfer history and waste stream composition definitions. In some cases, the available data is incomplete, inaccurate, or unsubstantiated, bringing into question the usefulness of the HTCE results modeled from the transfer data.

A preliminary estimate of the major waste constituents of tank 241-C-202 was developed based on available historical records. For the HTCE, the TLM assumed the sludge in the tank (3.8 kL [1 kgal]) consisted entirely of MW. The current HTCE (Brevick et al. 1995) for solids contained in the tank is presented in Table 2-2 for information only. The table is considered to represent only the MW fraction of the waste; it is not considered a valid estimate for the MW/HS/SSW tank waste contents.

The tank waste MW fraction should contain large quantities of sodium, uranium, carbonate, phosphate, sulfate and hydroxide. There should also be strontium and cesium, with strontium being present in a significant larger quantity. In MW, aluminum, iron, bismuth, nickel, lead and total organic carbon (TOC) should be totally or relatively absent from the waste. However, as indicated earlier, the MW was emptied from the tank, and subsequent transfers of HS waste can be inferred from historical records. If the HS waste is from an early PUREX process, the waste constituents representing the largest concentration fractions may be hydroxide, sodium, sulfate, lead, and TOC, although the actual constituents of the HS pilot waste stream have not been identified yet. However, a high strontium-90 concentration, and to a lesser degree cesium-137 and plutonium-239, are expected to contribute a modest activity.

Based on the best historical information, the sludge waste in tank 241-C-202 is now comprised of waste from an early PUREX pilot operation of the HS plant as well as a MW heel remaining after sluicing operations. The tank characterization report for tank 241-C-201 (Schreiber 1995b) (see Appendix B) can be used to assist in the evaluation of tank 241-C-202 constituents because the historical transfer records and recent analytical results are nearly identical for both tanks.

Table 2-2. Tank 241-C-202 Solids Composition, based on Historical Tank Content Estimate.[1,2]

Physical properties		
Total solid waste	5,700 kg (3.8 kL)	
Bulk density	1.51 (g/ml)	
Water wt%	57.3	
Constituents	Concentration (μg/g)	Inventory (kg)
Na^+	73,800	420
Al^{3+}	--	--
Fe (total)	11,800	67
Cr^{3+}	143	1
Ni^{2+}	785	5
Ca^{2+}	1260	7
OH^-	80,500	460
NO_3^-	5450	31
NO_2^-	--	--
CO_3^{2-}	31,200	178
PO_4^{3-}	29,800	170
SO_4^{2-}	57,600	328
U	161,000	920
Constituents	Concentration (μCi/g)	Inventory (Ci)
Pu-239/240	0.0046	0.03
Cs-137	0.6	3.4
Sr-90	63	360

Notes:

Ci	=	curies	kL	=	kiloliter
g/mL	=	grams per millimeter	μg/g	=	microgram per gram
kg	=	kilograms	μCi/g	=	microcurie per gram
			wt%	=	weight percent

"--" = not present or data unavailable.

[1]Brevick, C. H., L. A. Gaddis, and W. W. Pickett, 1995, *Historical Documentation 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.

[2]The HTCE for tank 241-C-202 assumes that the only waste resident in the tank is MW. Since other waste types (i.e., HS and SSW) appear to represent the majority of the waste currently in the tank, the HTCE is considered valid only for the MW fraction within the tank, and it is presented for information only.

2.4 SURVEILLANCE DATA

2.4.1 Surface-Level Readings

The waste surface level in tank 241-C-202 is measured with a manual tape device through riser 5 (see Figure 2-3). Surface-level measurements are recorded quarterly and input to the Computer Automated Surveillance System (Brevick et al. 1994). Historically, surface-level variations in this tank have been attributed to an irregular surface and debris (e.g., discarded manual tapes) beneath the plummet (Welty 1988).

From 1955 until 1970, the tank was considered full. After the bulk of waste was transferred from the tank in 1970, the tank was placed on inactive status. Historical surface-level data from the Surveillance Analysis Computer System database span 1981 to the present (see Figure 2-5). Over the past three years, except for two suspect, very low readings (8.3 cm [3.25 in.] and 8.9 cm [3.5 in.]), the surface-level readings have ranged from 16.5 cm (6.5 in.) to 22.9 cm (9 in.), averaging 19.3 cm (7.6 in.). Tank 241-C-202 does not have a liquid observation well or drywells.

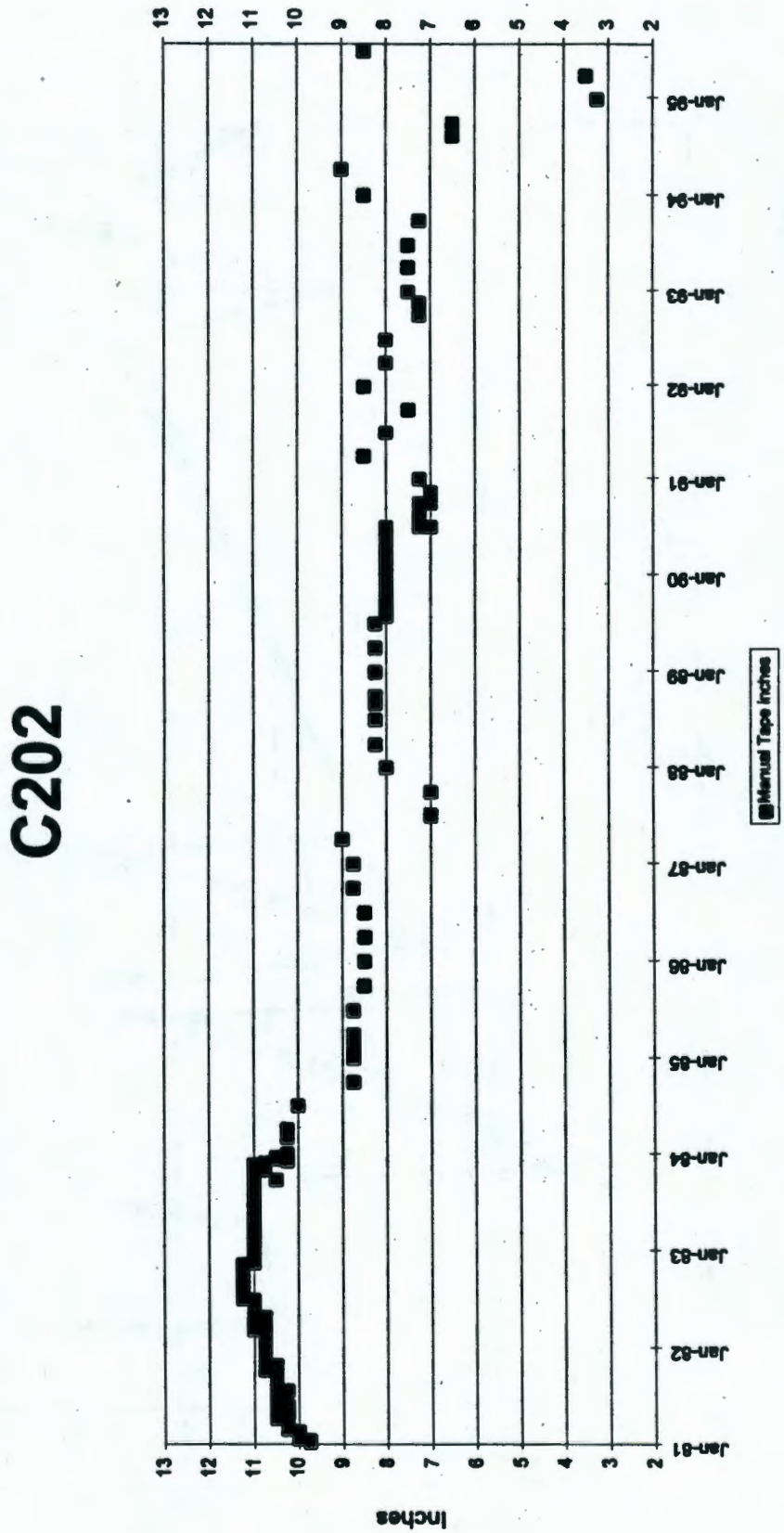
2.4.2 Internal Tank Temperatures

Internal tank temperatures are monitored in tank 241-C-202 with a single thermocouple tree consisting of 11 thermocouples located in riser 6 (Tran 1993). All theromcouples monitor the tank headspace, because the lowest thermocouple is at the 16 in. elevation, which is above the current waste level. Temperature data is available from the Surveillance Analysis Computer System for tank 241-C-202; thermocouples 1, 2, and 8 are recorded daily. The tank temperatures from 1975 to the present are shown in Figure 2-6. Over the past three years, manually recorded measurements indicate temperatures ranging from 12.6 °C (54.7 °F) to 20 °C (68 °F); with the average temperature being 16.1 °C (61 °F). Although there are few temperature readings available after 1984, the readings are similar to those from 1975 to 1984. All temperatures are within the tank design limits (WHC 1994). Tank 241-C-202 is classified as a low-heat load tank; therefore, the tank temperature requires semiannual monitoring only.

2.4.3 In-Tank Photographs

The interior of tank 241-C-202 was last photographed in 1986 (Hanlon 1995) (see Appendix A). The photographs show a yellow sludge surface without liquid. The surface is speckled with black spots, and there is a black residue on the lower portion of the tank wall. An old, discarded manual tape is visible, and the debris may be an old thermocouple tree. Rubber hoses, which may be the sluicing equipment, also appear to be present. Although the tank was categorized as an assumed leaker in 1988 (Brevick et al. 1995), it is likely the tank has remained the same since there is no visible supernate in the tank.

Figure 2-5. Tank 241-C-202 Surface Levels 1981 to 1995.



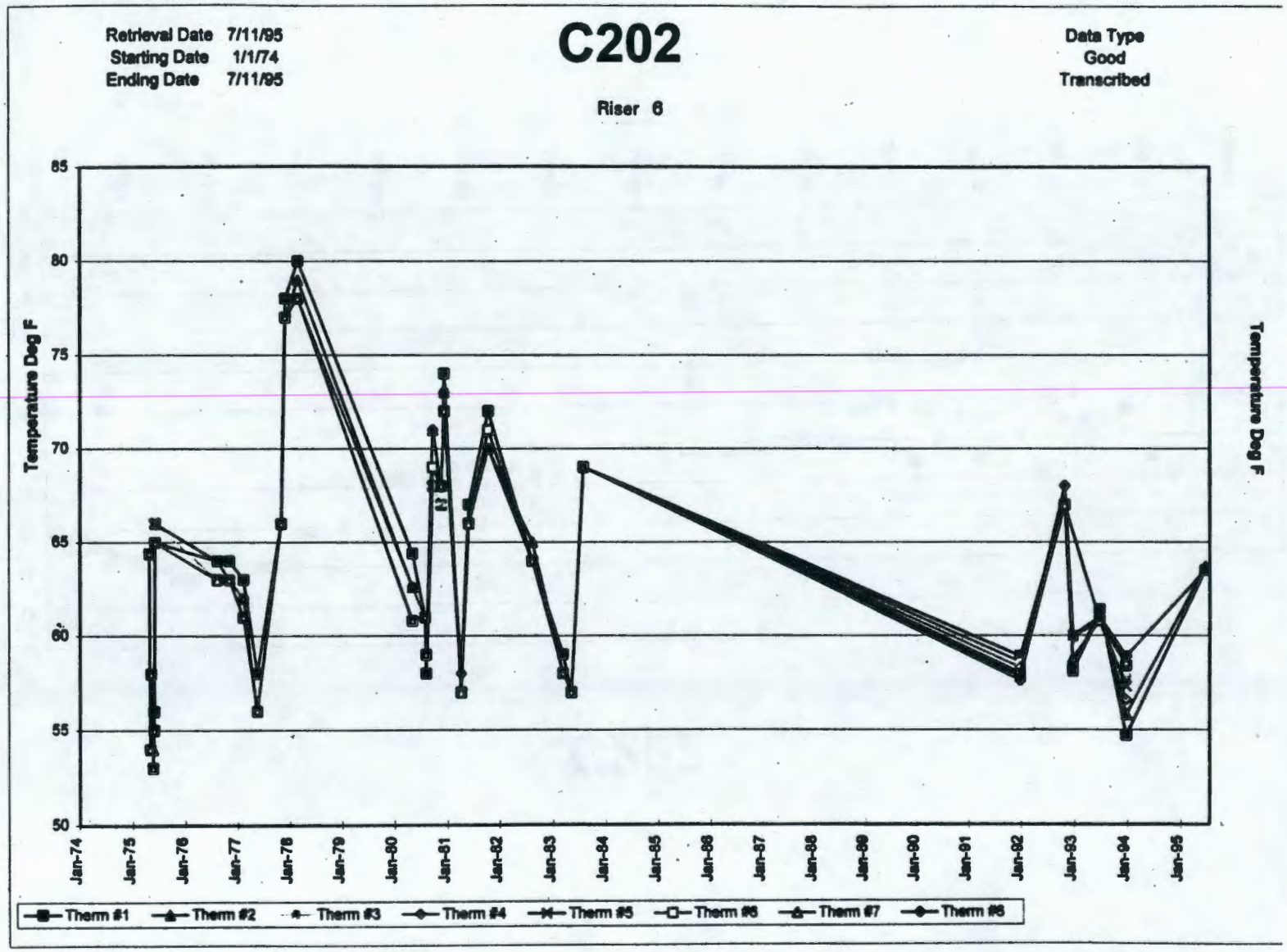


Figure 2-6. Tank 241-C-202 Temperature History 1975 to 1995.

3.0 TANK SAMPLING OVERVIEW

This section describes the sampling and analysis events for tank 241-C-202. Tank samples were taken in 1995 using the auger sampling system. For more information about sampling procedures, refer to the *Tank Characterization Reference Guide* (De Lorenzo et al. 1994).

3.1 DESCRIPTION OF 1995 AUGER SAMPLING EFFORT

On May 5, 1995, two auger core samples, consisting of one segment each, were taken from tank 241-C-202. The samples were taken and prepared for analysis in accordance with the *Tank 241-C-202 Tank Characterization Plan* (TCP) (Schreiber 1995a).

Using a 20-inch auger sampler, auger samples 95-AUG-026 and 95-AUG-027 were taken through riser 7 because of the limited availability of risers adequate for auger sampling. Auger sample 95-AUG-026 was taken from the east coordinate of riser 7; sample 95-AUG-027 from the west coordinate (Baldwin 1995).

3.1.1 Auger Sample Handling (1995)

The auger core samples were extruded by the 222-S Laboratories on May 9, 1995. Each auger sample was expected to contain about 20 cm (8 in.) of waste. However, very limited samples (i.e., no segment length was measurable) were obtained for the auger cores: 95-AUG-026 recovered about 6 grams and 95-AUG-027 about 2.5 grams. The color and texture of the samples were similar; grey and light brown to black solids intermixed with yellow solids. The auger samples were very dry and powdery, and no residue adhered to the auger. There was no drainable liquid present. The primary difference in the sample descriptions was the number and size of the solid inclusions (95-AUG-026 containing a rock).

Table 3-1 lists Labcore numbers, riser numbers, field sample numbers, cask numbers, sample dates, dose rates through the drill string, laboratory jar numbers, and solid mass extruded in grams.

Table 3-1. Tank 241-C-202 Auger Sample Event and Extrusion Data[1]

Labcore sample number	Riser number	Sample number	Cask serial number	Sample date	Dose rate through drill string mR/hr	Lab jar number	Mass (g)
S95T000900	7 East	95-AUG-026	1001C	5/5/95	3.5	6980	6.34[2]
S95T000901	7 West	95-AUG-027	1008C	5/5/95	2.5	6578	2.48

Notes:

g = grams
mR/hr = milliroentgens per hour

[1]Data from Baldwin (1995)

[2]Only 5.39 g remained for analysis after pulverizing and removing a single rock.

Baldwin, J. H., 1995, *45-Day Safety Screen Results and Final Report for Tank 241-C-202, Auger Sample 95-AUG-026 and 95-AUG-027*, WHC-SD-WM-DP-132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

3.1.2 Auger Sample Analysis (1995)

The two 1995 auger samples (95-AUG-026 and 95-AUG-027) were analyzed in accordance with the tank 241-C-202 TCP requirements (Schreiber 1995a) by the 222-S Laboratory (Baldwin 1995). The analyses included DSC, TGA, and total alpha activity analysis. After manual homogenization, all analyses were performed on whole segments. A laboratory sample handling and analysis flow diagram is shown in Figure 3-1. Although some safety screening DQO criteria were exceeded, the required secondary analyses (for example, total organic carbon) were not performed because the sample quantity was inadequate. A list of analytical methods and procedure numbers is provided in Table 3-2.

3.2 OTHER SAMPLING EVENTS

There are no records of other sampling events for tank 241-C-202 prior to the 1995 safety screening sampling.

Table 3-2. Analytical Methods and Procedures[1].

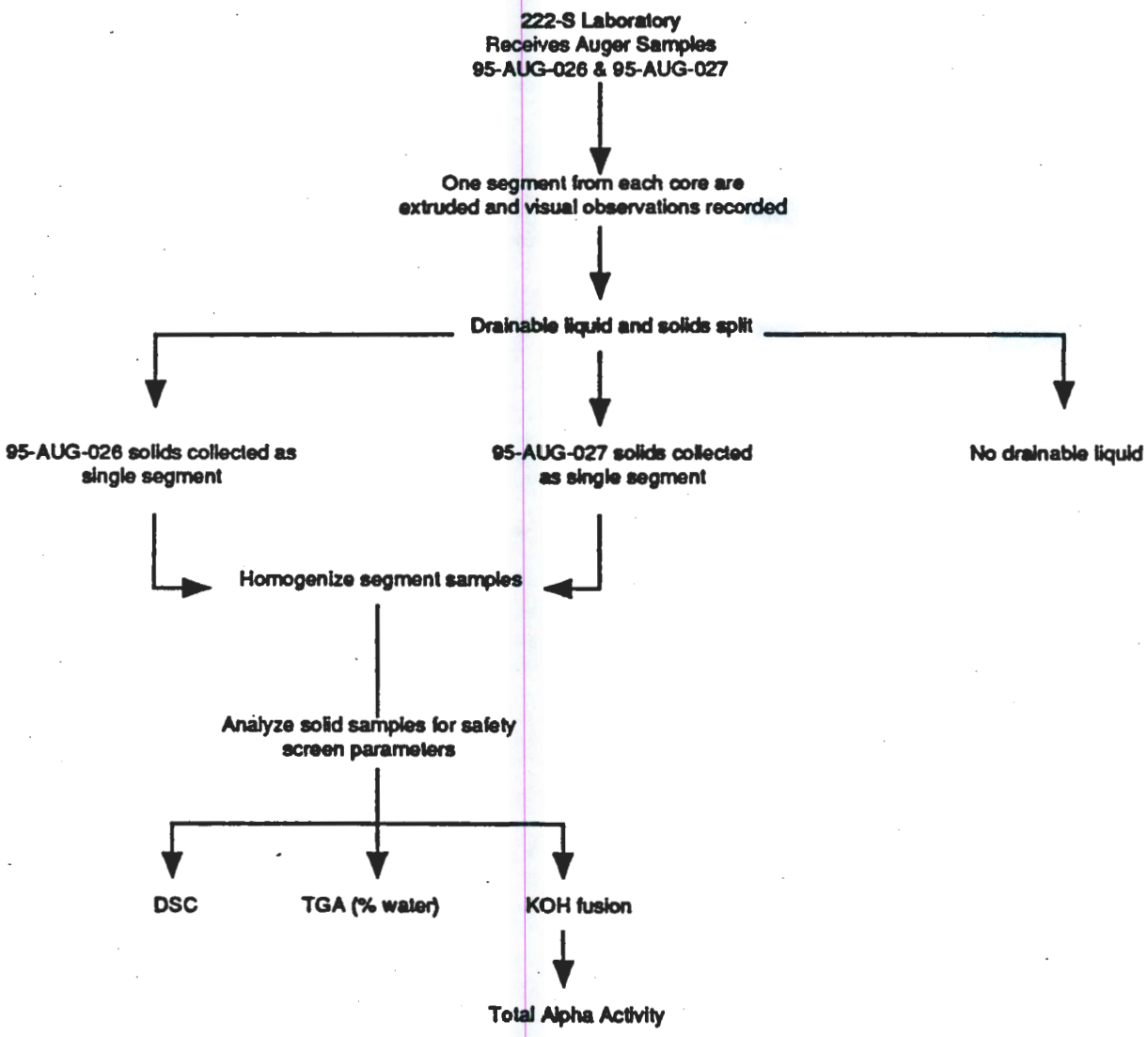
Analyte	Method	Procedure
Energetics	Differential scanning calorimetry	LA-514-113 Rev. B-1 (Mettler system)
Percent water	Thermogravimetric analysis	LA-560-112 Rev. A-2 (Mettler system)
Total alpha	Alpha proportional counter	LA-549-141 Rev. C-3 (Fusion digestion) LA-508-101 Rev. D-2 (Alpha proportional counter)

Note:

[1]Procedures from Baldwin (1995)

Baldwin, J. H., 1995, *45-Day Safety Screen Results and Final Report for Tank 241-C-202, Auger Sample 95-AUG-026 and 95-AUG-027*, WHC-SD-WM-DP-132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Figure 3-1. Tank 241-C-202 Sample Handling and Analysis Flow Diagram.



4.0 ANALYTICAL RESULTS

4.1 OVERVIEW

The sampling and analysis requirements for tank 241-C-202 are based on the DQO process. The *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) governs the sampling and subsequent sample analyses for this tank. This DQO was developed to allow rapid classification of the tanks containing high-level radioactive waste into specific categories associated with safety issues. For tank 241-C-202, the DQO requires the following analyses to be performed on the tank solid/liquid contents: TGA, DSC, and total alpha activity. Analytical results supporting the governing DQO are indicated in Table 4-1.

Table 4-1. Analytical Data Presentation Tables.

Analysis	Results location
Total alpha activity	Table 4-2
Thermogravimetric analysis	Table 4-3
Differential scanning calorimetry	Table 4-4

The analytical data tables present results recorded on the raw laboratory data sheets found in *45-Day Safety Screen Results and Final Report for Tank 241-C-202, Auger Samples 95-AUG-026 and 95-AUG-027* (Baldwin 1995).

4.2 TOTAL ALPHA ACTIVITY ANALYSIS

Total alpha activity measurements were performed on manually homogenized solid whole segments for auger samples 95-AUG-026 and 95-AUG-027. Because of low segment recoveries, neither auger sample was subdivided into half segments as requested by the TCP. Duplicate samples were formed from each whole segment, then prepared for analysis by undergoing fusion digestion. As shown in Table 4-2, all total alpha activity results are below the safety screening DQO criterion of 41 μCi/g (see also Table 5-1, footnote 3). The "Average" column averages the values from original and duplicate analyses. The projected tank inventory for total alpha activity is based on 5,700 kg of waste (Brevick et al. 1995).

Table 4-2. Tank 241-C-202 Total Alpha Activity[1].

Analysis sample number (location)	Sample type	Results (μCi/g)	Average (μCi/g)	Projected inventory[2] (Ci)
S95T000903 (95-AUG-026 whole segment 1)	Original	7.99	7.97	
	Duplicate	7.94		
S95T000905 (95-AUG-027 whole segment 1)	Original	10.20	9.32	
	Duplicate	8.43		
Tank average			8.64	49.2

Notes:

Ci = curies
μCi/g = microcuries per gram

[1]Data from Baldwin (1995).

[2]Projected inventory is based on an estimated 5,700 kilograms of tank waste and is computed using the following equation:

Tank average total alpha activity (μCi/g) x 1000 g/kg x 5,700 kg x 0.000001 Ci/μCi

Baldwin, J.H., 1995, *45-Day Safety Screen Results and Final Report for Tank 241-C-202, Auger Sample 95-AUG-026 and 95-AUG-027*, WHC-SD-WM-DP-132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

4.3 PHYSICAL MEASUREMENTS

Tank 241-C-202 auger core samples were analyzed according to the previously mentioned DQO and TCP; therefore, density, percent solids, particle size, and rheology were not requested or performed. The TGA estimates the weight percent water, and is used to interpret the DSC results. The results of both the TGA and DSC are discussed in the following sections and summarized in Tables 4-3 and 4-4.

4.3.1 Thermogravimetric Analysis Results

Thermogravimetric analysis measurements, conducted in a nitrogen atmosphere, were used to determine percent water on all samples. All TGA analyses were performed in duplicate. Like the total alpha activity analyses, TGA analyses were performed on whole solid segments from auger samples 95-AUG-026 and 95-AUG-027. All samples were analyzed using a Mettler Thermal Analysis system. The weight percent water of the sample and duplicate for both auger samples was significantly less than the 17 percent criterion

specified by the safety screening DQO (Babad and Redus 1994). In accordance with the TCP requirement (Schreiber 1995a), immediate notification of the low water results was made. Table 4-3 lists the results of the TGA.

For all solid sample results, the first transition occurs between 25 °C (77 °F) and 190 °C (374 °F) and is most likely associated with loss of free water and dissociation of bonded water molecules. To allow the TGA results to address the DQO requirement, this weight loss is considered to represent the weight percent water in the sample. The second transition for the solids occurs at a much higher temperature, 190 °C (374 °F) to 380 °C (716 °F). This loss, which is about three times greater than the loss attributed to water, may be caused by the dissociation of organic/metal-organic complexes or the loss of covalently held water. Because HS PUREX waste may be predominant, the loss may represent oxidation of waste organic (e.g., kerosene, tributyl phosphate, or dibutyl phosphate) with nitrate decomposition supplying the oxidant.

Table 4-3. Tank 241-C-202 Solid Thermogravimetric Analysis[1].

Sample number (location)	Run	First transition (range 25-190 °C)		Second transition (range 190-380 °C)	
		Wt% loss	Mean Wt% loss	Wt% loss	Mean Wt% loss
S95T000902 (95-AUG-026 whole segment 1)	1	5.39	5.14	16.2	13.9
	2	4.88		11.5	
S95T000904 (95-AUG-027 whole segment 1)	1	6.96	6.73	15.5	15.8
	2	6.49		16.1	
Tank average		5.93		14.8	

Notes:

°C = degrees Celsius
wt% loss = weight percent water

[1]Data from Baldwin (1995).

Baldwin, J. H., 1995, *45-Day Safety Screen Results and Final Report for Tank 241-C-202, Auger Sample 95-AUG-026 and 95-AUG-027*, WHC-SD-WM-DP-132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

4.3.2 Differential Scanning Calorimetry Results

The results of the DSC analysis are provided in Table 4-4. Differential scanning calorimetry was conducted in a nitrogen atmosphere, and all analyses were performed in triplicate. All auger samples were analyzed using a Mettler Thermal Analysis system. The temperature range, temperature at maximum enthalpy change, and the magnitude of the enthalpy change (J/g) are provided for each transition. Like the TGA solid results, all DSC scans showed two distinct transitions. The first transition represents the endothermic reaction for the evaporation of free and interstitial water. The second transition represents an exothermic reaction and most likely represents structural changes of multiple metal-organic or organic compounds. Exotherms for the 95-AUG-026 and 95-AUG-027 samples, adjusted to dry weight basis, exceeded the notification limit of 481 J/g. However, neither the duplicates nor triplicates for the auger samples exceeded the notification criterion. All DSC exothermic enthalpy changes are reported as greater than (>) values, because the exotherms continued above 500 °C, and the baseline could not be reestablished. This behavior was also observed on tank 241-C-201 (Schreiber 1995b) (see Appendix B).

Table 4-4. Differential Scanning Calorimetry Results (Dry Weight) for Tank 241-C-202[1]

	First transition			Second transition		
Run	Range °C	Peak °C	ΔH J/g	Range °C	Peak °C	ΔH J/g
S95T000902 95-AUG-026 Whole Segment						
1	37 - 202	117	162 (endothermic)	206 - >490	368	> 539[2] (exothermic)
2	42 - 162	117	71 (endothermic)	295 - >490	366	> 188[2] (exothermic)
3	42 - 150	115	86 (endothermic)	200 - >490	304	> 320[2] (exothermic)
S95T000904 95-AUG-027 Whole Segment						
1	38 - 200	113	183 (endothermic)	204 - >490	360	> 624[2] (exothermic)
2	40 - 210	113	229 (endothermic)	305 - >490	364	> 227[2] (exothermic)
3	40 - 190	117	229 (endothermic)	300 - >490	356	> 317[2] (exothermic)

Notes:

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

[1]Data from Baldwin (1995).

[2]Reported exothermic values are estimated to be minimums; DSC baseline could not be reestablished.

Baldwin, J.H., 1995, *45-Day Safety Screen Results and Final Report for Tank 241-C-202, Auger Sample 95-AUG-026 and 95-AUG-027*, WHC-SD-WM-DP-132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

This section compares current analytical results to historical information and programmatic requirements, and evaluates sampling and analysis factors impacting interpretation of the data. These factors are used to assess the overall quality and consistency of the data and to identify any limitations in using the data originally reported in Baldwin (1995). Because there was only one sampling event, comparison with other data sets was not possible.

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

The goal is to evaluate the sampling and analysis factors impacting interpretation of the data and to identify limitations in using the data. However, in this case, evaluation of data consistency is not possible because of the limited sample recoveries and the few analytes measured. There is insufficient data to assess trends, to compare results of more than one method, or to perform mass and charge balance calculations.

5.1.1 Field Observations

No occurrences or conditions in the field were noted that could adversely impact data quality or the successful completion of required safety screening DQO solid waste material analyses. However, the two auger samples required were obtained from the same riser (approximately opposite the inlet). Two samples from the same riser do not provide quality information about the lateral distribution of waste in the tank. Considering the shallow depth of the waste, this may not be critical. The laboratory operations noted that recoveries of extruded auger samples were significantly lower than anticipated. The total recovery of only about 9 grams out of a tank containing 5,700,000 grams, makes it difficult to evaluate tank homogeneity, and casts doubt that the auger samples can effectively be used to evaluate the tank material. Both auger samples were dry, powdery solids, and the color and texture of the different segments extruded were similar, consisting of grey/light brown to black solids intermixed with yellow solid.

It should be noted that a sample labeled 95-AUG-026 was also processed for tank 241-C-201 (Schreiber 1995b). Auger samples from tanks 241-C-201 and 241-C-202 were received by the laboratory on different dates and extruded at different times, with each sample being given a unique laboratory identification number (for tank 241-C-202, see Table 3-1). The unique laboratory number provides traceability for all processing and analytical work conducted by the laboratory. Therefore, the receipt of two auger samples labeled 95-AUG-026 should not compromise the evaluation of the data obtained for tank 241-C-202.

5.1.2 Quality Control Assessment

The appropriate blanks, duplicates, spikes, and standards for quality control measures were performed on the 1995 core sampling analyses (TGA, total alpha activity, and DSC). The TCP (Schreiber 1995a) established a criteria of ± 10 percent for the accuracy and precision of the data.

The control standard results and spiked sample results provide an estimate of the accuracy of the analysis. If a control standard or spike is above or below the accuracy criterion, then the analytical results may be biased high or low, respectively. The control standards conducted on TGA (percent water), total alpha activity, and DSC were in the acceptable recovery criterion of 90 to 110 percent. Spikes were performed only on the total alpha activity analysis, because they are not applicable to DSC and TGA methods. The spike performed on 95-AUG-026 was within the acceptable recovery criterion of 90 to 110 percent. However, the spike performed on 95-AUG-027 was slightly low, recovering at 88.8%. The poor recovery may be attributed to the presence of solids on the sample mount. Because the sample results are about five times lower than the action limits, the single, slightly low spike recovery did not necessitate further testing, and does not impact the validity of the total alpha activity results.

Evaluation of analytical preparation blanks is only applicable to the total alpha activity. The fusion batch preparation blank was below the detection limit for total alpha activity, indicating contamination was not a problem.

The precision requirements are estimated by the relative percent difference (RPD) between primary and duplicate samples. No RPDs were calculated for DSC because the exotherm detected could not be quantified (i.e., only greater than values are reported). However, the poor reproducibility of the triplicate DSC scans suggests that homogeneity of the samples is inadequate to provide quality data on very small sample sizes. The RPDs for TGA (percent water) and total alpha activity were less than the 10 percent criterion, except for the total alpha activity for 95-AUG-027. The RPD for 95-AUG-027 was 19 percent, with sample and duplicate values being 10.2 μCi/g and 8.4 μCi/g, respectively. However, the analytical data reliability is not seriously impacted by the laboratory's analytical precision.

Correlation of analytical results from different methods can be used to assess the accuracy of the results. Assuming that the primary reaction between ambient and 200 °C is the vaporization of water, the correlation of the TGA and DSC should provide similar results. For sample 95-AUG-0026, the DSC change in enthalpy (ΔH) average is 106 J/g and the TGA ΔH average is 116 J/g [i.e., (0.0514 g_{water}/g_{sample}) (2257 J/g_{water})]. For sample 95-AUG-027, the DSC and TGA ΔH averages are 214 J/g and 152 J/g [i.e., (0.0673 g_{water}/g_{sample})(2257 J/g_{water})], respectively. Considering the very small samples sizes used for the TGA and DSC analysis, the correlation is considered to be reasonably good.

In summary, the accuracy and precision of the data based on the quality control information provided was reasonably good, with the possible exception of the single low spike recovery for total alpha activity. If the 9-gram sample recovered from the tank is assumed to be representative (an assumption which is statistically difficult to support), the quality of the analytical data should be adequate to assess the safety screening DQO safety criteria.

5.2 TANK WASTE PROFILE

Tank 241-C-202 is not in a cascade series with any other tanks, and the single riser from which data are available is approximately across from the tank inlet. Based on the safety screening data from the 1995 auger sampling, trends in composition changes within the riser cannot be adequately evaluated, due primarily to the extremely poor auger recoveries and the shallow depth of the residual waste. However, when comparing the two auger samples are compared, the analytical results for each of the tests are essentially identical. This is to be expected for samples taken in close proximity to one another from the same riser.

5.3 COMPARISON OF ANALYTICAL AND TRANSFER HISTORY INFORMATION

Because of the few analyses required for safety screening characterization, and the unavailability of a valid HTCE, comparisons of the analytical results from the 1995 sampling event with the HTCE have not been performed. Once an updated, valid HTCE becomes available, comparison of the safety screening analyses and the HTCE will be included in this report.

5.4 EVALUATION OF PROGRAM REQUIREMENTS

The 1995 auger sampling was performed to meet the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) DQO; therefore, only the safety program requirement can be assessed. Insufficient data exist to evaluate operational, environmental, or process development programmatic requirements.

5.4.1 Safety Evaluation

The safety screening DQO (Babad and Redus 1994) establishes decision criteria and notification limits for concentrations of analytes of concern. The decision criteria are used to determine if a tank has been appropriately categorized concerning safety issues, or if further investigation into the tank's safety is warranted. If results from one of the safety screening DQO primary analyses exceed any of the decision criteria, further analyses are required to assure the safety of the tank. The primary analyses identified in the safety screening DQO are energetics, total alpha activity, percent water content, and flammable gas concentration.

Table 5-1 lists the safety issues, applicable analytes, their notification limits, and the pertinent 1995 auger sampling analytical results.

The waste fuel energy value was evaluated by DSC. Exotherms were observed on both of the 1995 auger samples, the largest being >624 J/g. From this data, a potential waste fuel energy value of 330,000 Btu/hr is estimated. No supporting TOC analyses were performed to assist in evaluating potential fuel sources. Based on the historical waste types (specifically HS/SSW) transferred to the tank, reasonably high TOC results would be anticipated. This is supported by the tank 241-C-202 DSC data and the DSC/TOC data from tank 241-C-201 (Schreiber 1995b), which contains similar waste.

Large amounts of water reduce the potential for propagating exothermic reactions in the waste. The TGA performed on the 1995 core samples demonstrated that the sludge waste is less than 7 weight percent water, and that no drainable liquid was present. The low water content from TGA analyses is significantly below the 17 percent safety screening DQO criterion. This, coupled with the exotherms measured by DSC, may raise a tank safety issue.

The potential for criticality can be assessed from the total alpha activity data. Both samples 95-AUG-026 and 95-AUG-027 exhibited relatively high total alpha activity, that is, from 8 to 10 μCi/g. This concentration exceeds the transuranic classification limit of 0.1 μCi/g, but is below the notification limit of 1 g/L (41 μCi/g) specified in the safety screening. (See Table 5-1, footnote 3.) Considering that the vertical distribution of total alpha activity in the waste cannot be determined from the minimal samples retrieved during the May 1995 auger sampling, total alpha activity may be postulated to increase with depth. Because the values for total alpha activity are within five times the safety screening DQO notification limit, more representative samples may be required to validate the tank average alpha activity.

Another factor in assessing the safety of tank waste is the heat generation, primarily from radioactive decay and temperature of the waste. No radiological analyses other than total alpha activity were performed on safety screening samples, and the HTCE does not represent all waste types resident in the tank. Therefore, no attempt has been made to estimate the heat generation from radionuclides.

Flammability of the gas in the dome space of the tank is another safety screening consideration. This report does not include any dome space monitoring or sampling and analysis information for evaluation. This report will be updated with the flammable gas monitoring/analysis information as soon as it is available.

Table 5-1. Safety Screening Data Quality Objectives Decision Variables and Criteria for Tank 241-C-202.

Safety issue	Primary decision variable	Decision criteria threshold	Analytical value[1]
Ferrocyanide/ organic	Total fuel content	> 481 J/g (exothermic)	624[2] (exothermic)
Organic	Percent moisture	< 17 wt%	5.1 wt%
Criticality	Total alpha	> 41 μCi/g[3]	10.2 μCi/g
Flammable gas	Flammable gas	> 25% LFL all flammable gases	no data[4]

Notes:

cal/g = calories per gram
g/L = grams per liter
J/g = joules per gram
LFL = lower flammability limit
μCi/g = microcuries per gram
wt% = weight percent

[1]When results are outside the decision criterion threshold, values presented are those most exceeding the threshold criterion. For results within the decision threshold, values are those nearest the threshold.

[2]Value is an estimate because DSC baseline was not reestablished; 624 J/g is considered a minimum value.

[3]Although the actual decision criterion listed in the DQO is 1 g/L, total alpha is measured in μCi/g rather than g/L. To convert the notification limit for total alpha to μC/g, all alpha decay was assumed to originate from ^{239}Pu. Using an estimated tank density of 1.50 g/ml and using the specific activity of 0.0615 Ci/g for ^{239}Pu, the decision criterion may be converted to 41 μCi/g as shown:

$$(1\ g/L) \times (10^{-3}\ L/ml) \times (1/1.50\ ml/g) \times (0.0615\ Ci/g) \times (10^{6}\ \mu Ci/Ci) = 41\ \mu Ci/g$$

[4]Tank 241-C-202 TCP dome space monitoring/analysis data for flammable gases is not available.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

It is questionable whether the sludge waste in tank 241-C-202 has been adequately sampled and analyzed for the purposes of safety screening in accordance with the requirements listed in *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The following are justifications for further sampling and analysis:

1. Only a single riser was sampled, albeit with some effort to space the two samplings as far apart as possible. Sampling from only one riser does not meet the requirements of the safety screening DQO.

2. Recoveries for the auger samples were meager, at best, and concern exists whether they adequately represent the tank contents. Although the waste is only about 19 cm (7.6 in.) deep, sampling of the upper 1 cm (0.4 in.) or less is not representative.

3. Both DSC and TGA (percent water) exceeded the safety screening DQO criteria, and due to limited sample availability, no additional analytical tests were performed to assist in evaluating safety issues.

4. The concentration of the waste has not been adequately estimated (i.e., the HTCE is invalid), primarily due to the absence of documentation for the actual waste types in the tank.

5. Total alpha activity is within a factor of four of the DQO decision criterion. Because auger sample recoveries are poor, the vertical distribution of the alpha-emitting radionuclides has not been adequately addressed.

Because the DSC and TGA (percent water) results for tank 241-C-202 exceeded the safety screening DQO criteria, a tank safety issue has been identified. Therefore, organic Watch List tank controls have been implemented for tank 241-C-202 until the tank safety issue can be resolved or validated.

6.2 RECOMMENDATIONS

1. Reevaluation of the waste types for the TLM should be performed and an updated HTCE generated. The TLM should specifically address HS and SSW waste types, in addition to the MW previously modeled and presented in Brevick et al. (1995). The analytical data from samples 95-AUG-026 and 95-AUG-027 should be compared to the updated HTCE to assess the validity of the HTCE.

2. Although the sampling for tank 241-C-202 is not considered to provide representative samples from the tank, information from the samples retrieved from tank 241-C-201 (samples 95-AUG-025 and 95-AUG-026) may be useful in evaluating tank 241-C-202 composition. Historical records (Anderson 1990, Agnew and Brown 1994) suggest that similar, if not identical, wastes were transferred into tanks 241-C-201 and 241-C-202 within the same time period. Therefore, it is recommended that analytical data from both tanks be compared, and used together to address the safety screening DQO criteria prior to initiating additional sampling activities.

3. Based on the recoveries demonstrated by both auger samples, an alternate sampling method should be employed for future sampling activities involving tanks with "dry" waste. An alternative to another sampling method is to review both the auger sampler design and the auger sampling procedure for adequacy.

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APPENDIX A

PHOTOGRAPH OF TANK WASTE FOR SINGLE-SHELL TANK 241-C-202

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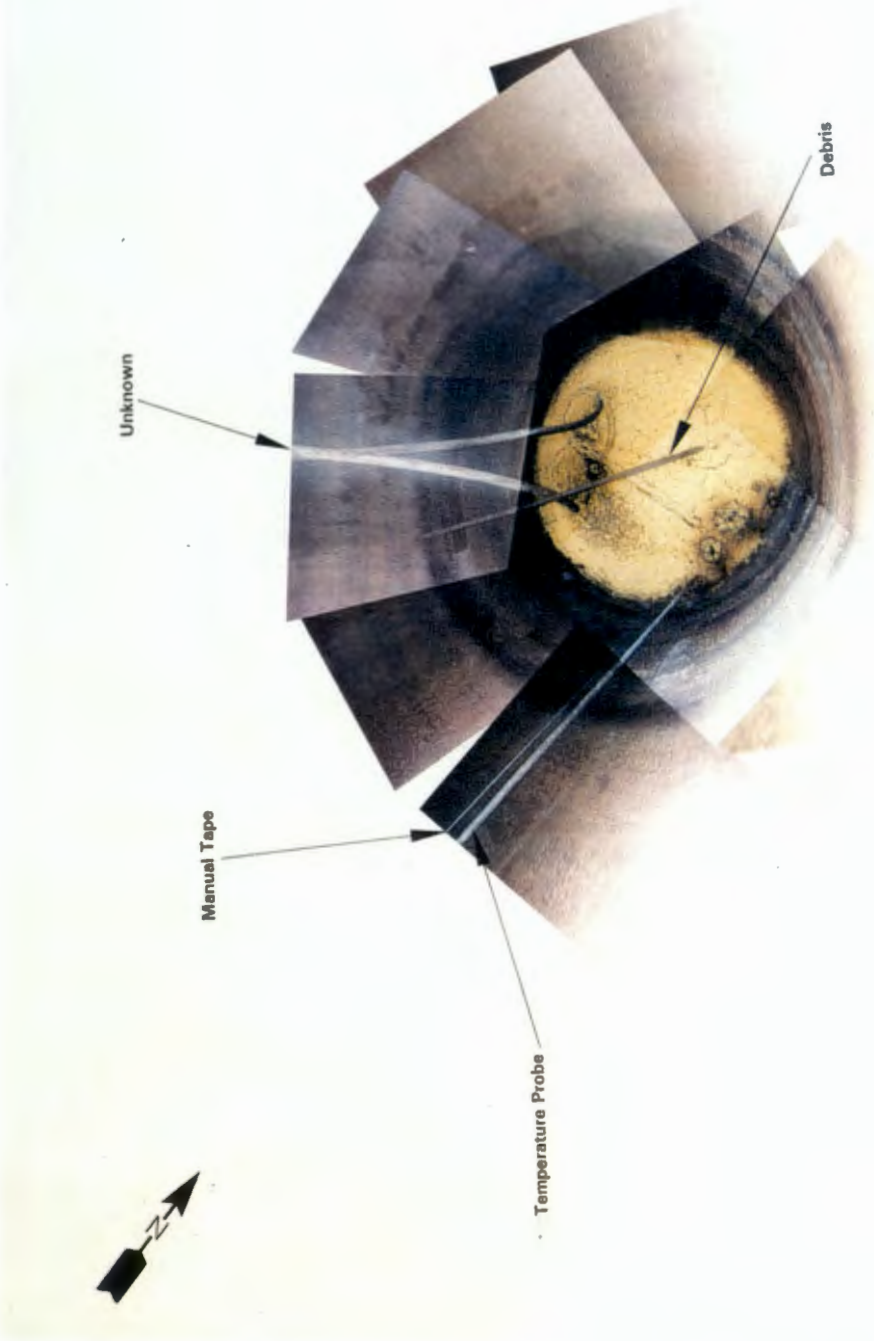
Figure A-1. Tank 241-C-202 In-Tank Photograph.



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APPENDIX B

EXECUTIVE SUMMARY FROM SINGLE-SHELL TANK 241-C-201 TANK CHARACTERIZATION REPORT

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EXECUTIVE SUMMARY

This tank characterization report summarizes information on the historical uses, present status, and the sampling and analysis results of waste stored in the single-shell underground storage tank 241-C-201. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*, milestone M-44-08 (Ecology et al. 1994).

Tank 241-C-201 is located in the C-Tank Farm in the Hanford Site 200 East area. The tank went into service during 1947 and initially was used to store metal waste from the bismuth phosphate process. This waste subsequently was removed, and strontium semi-works waste was added beginning in the second quarter of 1955. In 1970, a large transfer of supernatant to tank 241-C-104 occurred, leaving approximately 4 kiloliters (kL) (1 kilogallons [kgal]) of waste material in the tank. The tank was then removed from service in 1976 and classified as inactive in 1977. Tank 241-C-201 is said to presently contain approximately 8 kL (2 kgal) of noncomplexed waste. Tank 241-C-201 was interim stabilized in March 1982, and intrusion prevention was completed in December 1982. The tank is classified as an assumed leaker. Currently, the tank is not on a watch list.

Tank 241-C-201 is described and its status summarized in Table ES-1. This report summarizes one recent auger sampling and analysis event that was performed to satisfy the requirements of the *Tank Safety Screening Data Quality Objectives* (Babad and Redus 1994). All requested analyses on the sludge material were performed. In addition to this event, one sampling and analysis event from 1978 is used to support this report's conclusions.

Results from the 1995 auger sampling and analysis event indicate that high levels of fuel are present in tank 241-C-201 (the fuel energy content results by differential scanning calorimetry were above 481 joules/gram on a dry weight basis). Further, the moisture level of the sludge is below the 17 percent safety-screening criteria (Babad and Redus 1994). Because the fuel energy content notification limit was exceeded, secondary analysis for total organic carbon was performed. It was found that the total organic carbon content in tank 241-C-201 was approximately 4.6 weight percent (on a dry weight basis), which exceeded the Operating Specification Document (OSD) safety criterion of 3 weight percent (WHC 1995). However, these results did not exceed the criterion of 5 weight percent stated in *Data Quality Objective to Support Resolution of the Organic Fuel Rich Tank Safety Issue* (Buckley 1995). Based on the OSD requirements, interim measures and controls are in place pending a final determination of watch list status by engineering personnel.

Tank waste heat production estimates were available from historical tank content estimate model predictions of heat producing radionuclides (cesium-137 and strontium-90) and tank temperature surveillance records. Based on these model predictions, the heat generated by the radioactivity in the tank is estimated to be 670 watts, which would categorize this tank as a low-heat producer. Insufficient analyses were performed on the 1995 auger samples to confirm this estimate, although the 1978 data supports this conclusion. The temperature of the tank has been consistently less than 21 °Celsius (69 °Fahrenheit) since 1992. This temperature reading represents the temperature in the vapor space, not the sludge waste. The total alpha activity levels in the sludge were measured in 1995 to be in

the range of 11.9 to 21.2 microcuries/gram, or about half of the criticality safety criterion (Babad and Redus 1994).

This report does not include any tank head-space vapor screening information as required by Babad and Redus (1994), nor does it contain the sufficient chemical, radiochemical, or physical data necessary to support successful pretreatment, retrieval, or disposal activities.

An estimate of the concentration and tank inventory for chemical and radiochemical components in the waste is summarized in Table ES-2. These estimates are based on the Hanford defined waste reference (Agnew 1994) and the revised historical tank content estimate information provided in Appendix A of this report, and represents information regarding both metal waste and strontium semi-works waste, the two waste types stored in tank 241-C-201.

Table ES-1. Description and Status of Tank 241-C-201.

Tank 241-C-201	
Tank description	
Type:	single-shell
Constructed:	1943-1944
In-service:	1947
Diameter:	6.1 m (20 ft)
Usable depth:	7.2 m (23 ft, 7 in)
Operating capacity:	208 kL (55 kgal)
Bottom shape:	dished
Ventilation:	passive
Tank status	
Total waste volume (April 1995):	approx. 8 kL (2 kgal)
Sludge volume (April 1995):	approx. 8 kL (2 kgal)
Supernatant volume (April 1995):	0 kL (0 kgal)
Manual tape surface level (range, past yr):	28 cm (11 in.) to 31 cm (12 in.)
Temperature (range, last three years):	15 °C (59 °F) to 21 °C (69 °F)
Integrity category:	assumed leaker
Watch list classification:	non-watch list
Sampling dates	
Auger sampling date:	April 1995
Sludge sampling date (type unknown):	1978
Service status	
Removed from service:	1976
Interim stabilized:	March 1982
Intrusion prevention completed:	December 1982

Table ES-2. Historically Estimated Concentrations for Analytes Present in Tank 241-C-201. (2 sheets)

Single-Shell Tank 241-C-201			
Physical Properties			
Total Waste	1.03E+04 kg	(2.00E+00 kgal)	
Heat Load	0.67 kW	(5.01E+02 BTU/hr)	
Bulk Density	1.36 (g/cc)		
Water wt%	62.1		
TOC wt% C (wet)	0.850		
Chemical Constituents	mole/L	ppm	kg
Na^{+}	2.67E+00	4.52E+04	4.64E+02
Al^{3-}	0.00E+00	0.00E+00	0.00E+00
Fe^{3+} (total Fe)	002	7.25E+04	7.44E+02
Cr^{3+}	4.75E-03	1.82E+02	1.87E+00
Bi^{3+}	000	000	000
La^{3+}	0.000	0.000	0.00
Hg^{2-}	0.00	0.00	0.00
Zr (as $ZrO(OH)_2$)	000	000	000
Pb^{3+}	0.0	7000	71.8
Ni^{3+}	000	2446	2.51E+01
Sr^{2+}	0.000	0.000	0.00
Mn^{4-}	000	000	0.00E+00
Ca^{3+}	2.60E-02	7.67E+02	7.88E+00
K^{+}	3.49E-02	1.01E+03	1.03E+01
OH^{-}	8.62	1.08E+05	1.11E+03
NO_3^{-}	0.54	2.46E+04	2.53E+02
NO_2^{-}	0.01	3.65E+02	3.74E+00
CO_3^{2-}	0.451	2.00E+04	2.05E+02
PO_4^{3-}	0.200	1.40E+04	1.44E+02
SO_4^{2-}	0.107	7.61E+03	7.81E+01
Si (as SiO_2^{2-})	1.46E-03	030	3.10E-01
F^{-}	0.000	0.00E+00	0.00E+00
Cl^{-}	0.023	6.06E+02	6.22E+00

Table ES-2. Historically Estimated Concentrations for Analytes Present in Tank 241-C-201. (2 sheets)

$C_6H_5O_7^{3-}$	1.79E-02	2.50E+03	2.56E+01
$EDTA^{4-}$	3.58E-02	7.61E+03	7.81E+01
$HEDTA^{3-}$	0.00E+00	0.00E+00	0.00E+00
glycolate	0.000	0.00E+00	0.00E+00
acetate	2.28E-01	9940	1.02E+02
oxalate	0.00E+00	0.00	0.00
DBP	0.00E+00	0.00E+00	0.00E+00
butanol	0.00E+00	000	0.00E+00
NH_3	0.000	3.75E-02	3.85E-04
$Fe(CN)_6^{4-}$	0	0	0
Radiological Constituents			
Pu	0.0033 (μCi/L)		0.00057 (kg)
U	5.15E-01 (M)	9.0E+04 (μg/g)	9.27E+02 (kg)
Cs	0.001 (Ci/L)	000.47 (μCi/g)	4.80E+00 (Ci)
Sr	2.9E+00 (Ci/L)	2121.4 (μCi/g)	2.18E+04 (Ci)

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C. S. Chongsoo	G3-20	X			
W. L. Cowley	H4-65	X			
M. L. Dexter	R1-51	X			
R. A. Dodd	S5-07	X			
G. L. Dunford	S7-81	X			
S. J. Eberlein	R2-12	X			
D. B. Engelman	R1-49	X			
K. O. Fein	H4-65				X
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