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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-203. 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-203

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August 1995

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Approved for Public Release

EXECUTIVE SUMMARY

This tank characterization report summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in the single-shell underground storage Tank 241-C-203. This report supports the requirements of the *Hanford Federal Facility Agreement and Consent Order*[1].

Tank 241-C-203 was constructed between 1943 and 1944 and is one of four 200 series tanks in the 241-C Tank Farm. The tank has a nominal capacity of 208 kiloliter (kL) or [55 kilogallon (kgal)]. Tank 241-C-203 first received metal waste from an unknown source in the fourth quarter of 1947. In 1953, the tank was sluiced for uranium recovery and was declared empty in 1954. Little or no metal waste remained in the tank. The tank received hot semiworks and strontium semiworks waste during 1955 through 1957. Most of the supernatant was transferred to other tanks in the C Tank Farm. The tank was removed from service in 1977. The tank was administratively interim stabilized in March 1982, and intrusion prevention was completed in December 1982. Refer to Table ES-1 for a description of tank 241-C-203 in general. Refer to Figures ES-1 and ES-2 for the location of C Tank Farm and tank 241-C-203 riser section, respectively.

[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.

Table ES-1. Tank 241-C-203.

Tank description	
Shell type/Series	Single-shell/200 Series
Constructed	1943 - 1944
In-service	1947 - 1977
Diameter	6.1 meter (20 feet)
Operating depth	7.2 meter (23.6 feet)
Operating capacity	208 kiloliter (55 kilogallon)
Bottom shape	15 centimeter (6 inch) dish
Heat load classification/Ventilation	Low heat/passive
Waste status (from Hanlon 1995,[1] unless otherwise noted)	
Waste classification	Non-complexed
Pumpable liquids	0 kiloliter (0 kilogallon)
Sludge volume (based on April 1, 1995 manual tape level)	11 kiloliter (3 kilogallon)
Waste volume (based on April 1, 1995 manual tape level)	11 kiloliter (3 kilogallon)
Manual tape level (April 1, 1995)	47 centimeter (18.5 inch)
Highest temperature (April 1991 - April 1995)	18.3 °C (65.0 °F)
Tank service history/status	
Integrity category	Assumed leaker
Estimated leak volume (1986)	1.5 kiloliter (400 gallon)
Estimated leak volume (based on April 1, 1995 manual tape)	8 kiloliter (2 kilogallon)
Declared assumed leaker	1984
Removed from service	1st Quarter 1976
Declared inactive	4th Quarter 1977
Interim stabilization completed	March 1982
Intrusion prevention completed	December 1982

Notes:

[1]Hanlon, B. M., 1995, *Waste Tank Summary Report for Month Ending March 31, 1995*, WHC-EP-0182-84, Westinghouse Hanford Company, Richland, Washington.

Figure ES-1. Hanford 200 East Area and C Tank Farm Location.

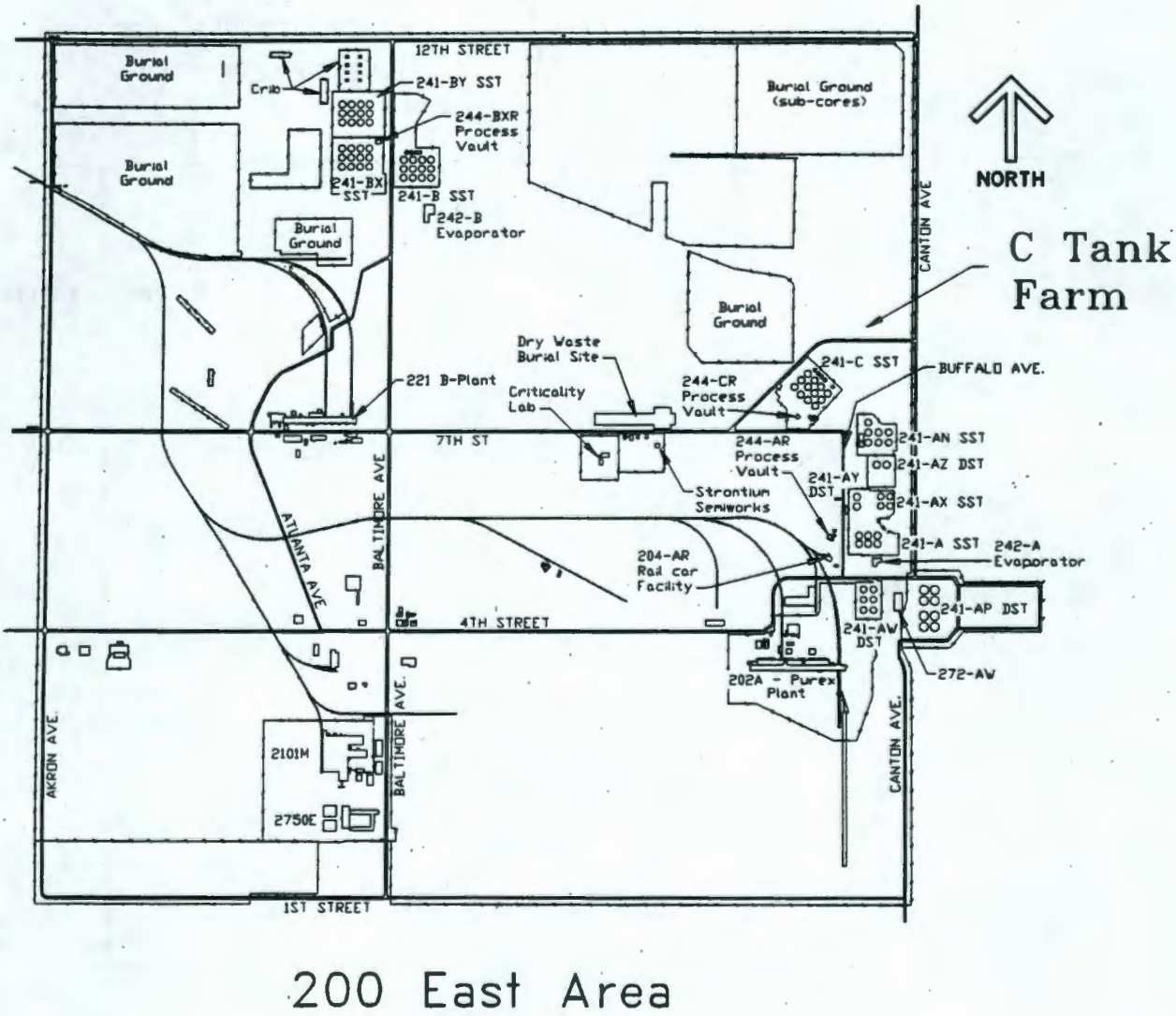
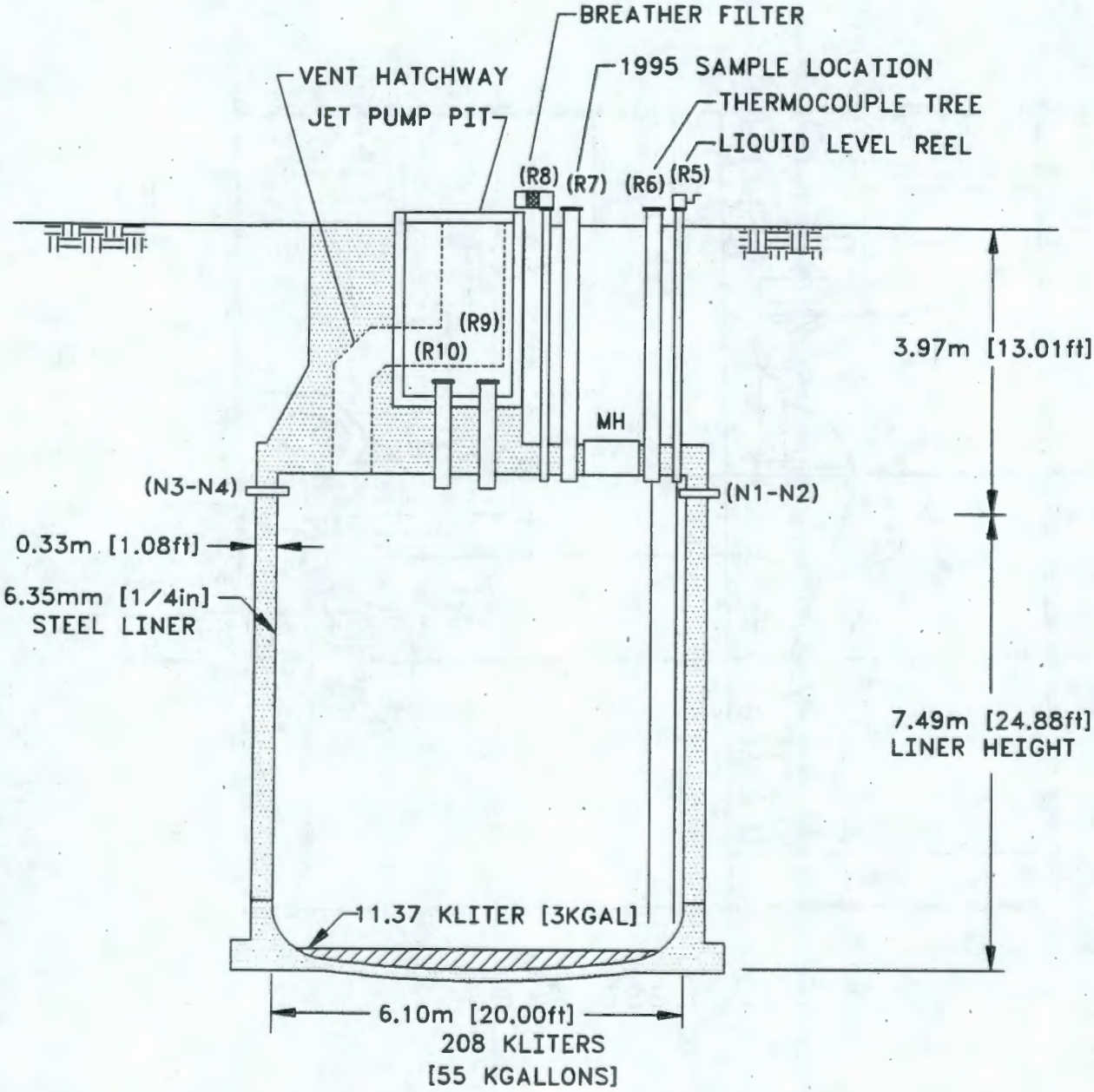


Figure ES-2. Tank 241-C-203 Tank Riser Sections.



Notes:

The tank section above shows all the risers and inlets still in the tank. It is not an accurate representation of the actual location of those risers and inlets. Refer to Figure 2-1 for the plan view.

In 1984, the tank was declared an assumed leaker with an estimated loss of 1.5 kL (400 gal) by 1986. The tank has continued to leak slowly, at a rate of approximately 570 L (150 gallons) per year, with an estimated total leak volume of 8 kL (2 kgal). The tank contains approximately 11 kL (3 kgal) of waste. Based on the 1995 auger sample event and photographs taken in December 1986, the waste appears to be all sludge. The waste is classified as non-complexed. The tank is not on any Watch List.

Two auger samples were taken from the tank in April 1995. These samples were then analyzed at the 222-S Laboratory in the 200 West Area. The results from waste analyses were compared with the decision limits in *Tank Safety Screening Data Quality Objective*.[2] No notification threshold values were attained. Refer to Table ES-2 for a summary of the sample analyses results compared to the safety screening criteria. Water comprises 38 percent by weight of the sludge. As would be expected, the sludge was more moist in the lower sections of the samples than in the upper sections. The largest exotherm value was found to be 97.33 joules per gram (J/g) on a dry weight basis, and the largest total alpha value was 2.83 microcuries per gram (μCi/g). Both of these values are well below their safety screening limits. Neither vapor space monitoring nor sampling has been completed at this time to satisfy the gas composition portion of the safety screening. The bulk density was determined to be 1.62 grams per cubic centimeter (g/cc). Based on these analytical results, tank 241-C-203 is not, nor should it be, on any Watch List.

[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.

Table ES-2. Tank 241-C-203 Tank Safety Screening Summary.

Tank safety screening criterion[1]	Method	Units	Safety screening notification limit	Average value (all samples)	Worse Case
Density[2]	--	g/cc	--	1.62	--
Weight % H_2O	TGA	%wt	less than 17	38	30.98
Energy[3]	DSC	J/g dry	greater than 481	60.86	97.33
Total alpha[4]	--	μCi/g	greater than 41	1.46	2.83
Gas composition[5]	--	%LFL	greater than 25	No data yet	--

Notes:

DSC = differential scanning calorimetry
LFL = lower flammability limit
TGA = thermogravimetric analysis

cc = cubic centimeter
g = gram
J = joule
μCi = microcurie

[1]If *Tank Safety Screening Data Quality Objective* notification limits for the primary analyses (%wt water, energy, total alpha, and gas composition) do not exceed limits, no further analyses are required.

[2]Measurement of density is not required by the *Tank Safety Screening Data Quality Objective*; it was requested by Characterization Plant Engineering.

[3]Additional analysis for energy, cyanide, and total organic carbon are required if the differential scanning calorimetry energy value exceeds the *Tank Safety Screening Data Quality Objective* limit.

[4]Additional analysis for $^{239/240}Pu$ and for iron, manganese, and uranium are required if the sample value exceeds the *Tank Safety Screening Data Quality Objective* limit.

Although the actual decision criterion listed in the data quality objective is 1 g/L, total alpha activity is measured in μCi/g rather than g/L. To convert the notification limit for total alpha activity to μCi/g, it was assumed that all alpha decay originates from ^{239}Pu. Using an estimated waste density of 1.5 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:

$$(1\ g/L) \times (10^{-3}\ L/mL) \times (1/1.5\ mL/g) \times (0.0615\ Ci/g) \times (10^{6}\ \mu Ci/Ci) = 41\ \mu Ci/g.$$

Tank 241-C-203 was analyzed for density. The average value of 1.62 g/cc corresponds to 38 μCi/g.

[5]Monitoring or sampling tank vapor space gases to determine the percentage of the lower flammability limit is required by the *Tank Safety Screening Data Quality Objective*. Vapor samples have not been collected yet.

The major chemical constituents of tank 241-C-203 in the *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area*[3] are based on the assumption that the waste in the tank is metal waste. These estimates are considered inaccurate because the tank process history indicates the waste should be semiworks waste. Content estimate information is presented in the body of this report, but should be used with caution because of the inaccuracies. No sampling and analysis of tank 241-C-203 wastes was performed prior to the 1995 auger sampling event.

Although the 1995 sample analysis for tank 241-C-203 showed the waste stored in the tank are within the safety screening threshold limits, there is a concern, based on the process histories of tanks 241-C-201, 241-C-202, and 241-C-203. The three tanks have very similar process histories[4]. This would suggest that the tank contents should be similar at this time, however, *the waste in tank 241-C-203 does not appear similar to the other two tanks*. The waste in the other two tanks appear to be similar to each other and both tanks are outside the safety screening threshold values in percent water, energetics, and total organic carbon. Although tanks 241-C-201 and 241-C-202 do not meet all the criteria for being placed on the organic Watch List, the results of the 1995 sampling and analysis are sufficient to place them under the controls of the organic Watch List as a prudent management decision. Tank 241-C-203 does not belong on any Watch List based on the 1995 auger sample and analysis.

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

[4]Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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LIST OF TERMS

DSC	differential scanning calorimetry
RPD	relative percent difference
SACS	Surveillance Analysis Computer System
TMACS	Tank Monitoring and Control System
TGA	thermogravimetric analysis
WSTRS	Waste Status and Transaction Record Summary

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1.0 INTRODUCTION

This tank characterization report summarizes the 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).

Two auger samples were taken from single-shell tank 241-C-203 on April 5, 1995. These auger samples are henceforth referred to as the 1995 sampling event. No records of previous sampling events for this tank were found. Screening for tank safety issues was performed in accordance with *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The results of the 1995 sampling event are used to complete this tank characterization report in order to comply with requirements specified in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994).

This report overviews the 1995 sampling event and analysis efforts and contains observations regarding waste characteristics. It also addresses expected concentration and bulk inventory data for the waste contents based on the sampling data and background tank information.

1.1 PURPOSE

The purpose of this report is to describe and characterize the wastes stored in tank 241-C-203 based on information gathered from various sources. This report summarizes the available information and arranges it in a format that will help the reader understand the tank contents and condition.

The following specific objectives are potentially satisfied by sampling and characterizing the waste in tank 241-C-203.

- Contribute to the fulfillment of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-44-08 concerning characterizing Hanford Site high-level radioactive waste tanks (Ecology et al. 1994).

- Complete safety screening of tank 241-C-203 contents to meet characterization requirements of the *Defense Nuclear Facilities Safety Board Recommendation 93-5* (Conway 1993).

- Provide tank waste characterization information to the Tank Waste Remediation System program elements in accordance with the *Tank Waste Remediation System Tank Waste Analysis Plan* (Bell 1994).

In addition, during preparation of this report, the author noted several discrepancies between published information and currently available data. The authors of documents that are potentially affected by these discrepancies have been notified. Discrepancies include waste level, tank waste volume, estimated leak volume, and types of waste that were sources for the waste in the tank.

1.2 SCOPE

Tank 241-C-203 waste is described by investigating the process history surrounding the tank. Events and observations regarding the 1995 sampling event are discussed. The results of tank waste analyses are summarized. Analytical results are compared with the expected results based on tank history. Finally, recommendations based on the current waste inventory and tank status are given.

Characterization data from the two auger samples are the basis for the analytical section of this report, Section 4.0. The historical characterization of this tank, Section 2.3, is based on the historical tank contents estimate (Brevick et al. 1995) because no previous sample events are available for this tank. Differences based on the 1995 sampling event and discrepancies noted during preparation of this report are used to modify the information.

The characterization results are compared with the notification thresholds listed in *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), where possible. Data presented in this report are considered to be the best available information about the tank contents as of April 1995.

2.0 HISTORICAL TANK INFORMATION

This section describes tank 241-C-203 based on historical information. The first part of the section provides the current status of the tank. This is followed by a discussion of the basic design and construction of the tank. Next, the tank transfer history and process knowledge are presented. The estimate of the current contents is discussed. The final part of the section provides surveillance data available on the tank.

2.1 TANK STATUS

According to the *Waste Status Summary Report for Month Ending March 31, 1995* (Hanlon 1995), tank 241-C-203 contains 19 kiloliter (kL) [5 kilogallon (kgal)] of waste classified as non-complexed. However, based on the January and April 1995 quarterly manual tape surface level, the tank contains 11 kL (3 kgal) of waste. Section 2.4.1 provides a discussion of surface level and how decreased surface levels may affect calculations for waste volume and estimated-leak volume. The composition of the waste, using current waste level readings, is shown in Table 2-1.

Table 2-1. Summary Tank Contents Status as of April 1995.

Waste form	kL (kgal)
Total Waste	11 (3)
Supernatant/other liquid	0 (0)
Sludge	11 (3)
Saltcake	0 (0)

Notes:

kL = kiloliter
kgal = kilogallon

Tank 241-C-203 is identified as a *low-heat load* tank, is *passively ventilated*, and is categorized as an *assumed leaker* (1984). The tank is *interim stabilized* (March 1982) and *intrusion prevention is completed* (December 1982). The waste is made up primarily of hot semiworks waste and strontium semiworks waste, which are differentiated by the time frame in which they were produced. Hot semiworks waste was produced in C Plant between 1955 and 1961, and strontium semiworks waste was produced between 1961 and 1967. These waste types are similar, and therefore, in this report, both waste types are referred to as semiworks waste. There may have been a small amount of metal waste left in the tank after the tank was sluiced for uranium recovery and declared empty in 1954. The waste is classified as *non-complexed*.

2.2 TANK DESIGN AND BACKGROUND

The C Tank Farm is a first generation tank farm, built between 1943 and 1944, consisting of twelve 2,010 kL (530 kgal) tanks and four 208 kL (55 kgal) tanks. The larger tanks are numbered 241-C-1xx (100 series), while the smaller tanks are numbered 241-C-2xx (200 series). There was only one generation associated with the 200 series tanks. All tanks in C Tank Farm were designed for non-boiling waste with a maximum fluid temperature of 104 °C (220 °F). Figure 2-1 shows the riser plan view and the relative location of tank 241-C-203 within the C Tank Farm.

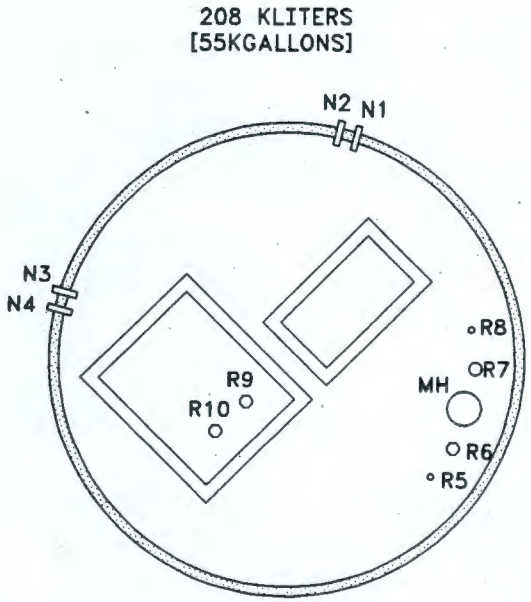
The 200 series single-shell tanks are constructed of 30 cm (1 ft) thick reinforced concrete with a 6.4 mm (1/4 in.) mild carbon steel liner on the bottom and sides and a 38 cm (1.25 ft) thick domed concrete top. These tanks have a 15 cm (6 in.) dished bottom with a 0.9 m (3 ft) radius knuckle and a 7.2 m (23.6 ft) operating depth.

The 200 series tanks are set on a reinforced concrete foundation. A three-ply cotton fabric waterproofing was applied over the foundation and steel tank. Four coats of primer paint were sprayed on all exposed interior tank surfaces. Tank ceiling domes were covered with three applications of magnesium zincfluorosilicate wash. Lead flashing was used to protect the joint where the steel liner met the concrete dome. Asbestos gaskets were used to seal the manholes in the tank dome. The tanks were waterproofed on the sides and top with tar and concrete. Each tank was covered with approximately 2.2 m (7.25 ft) of overburden.

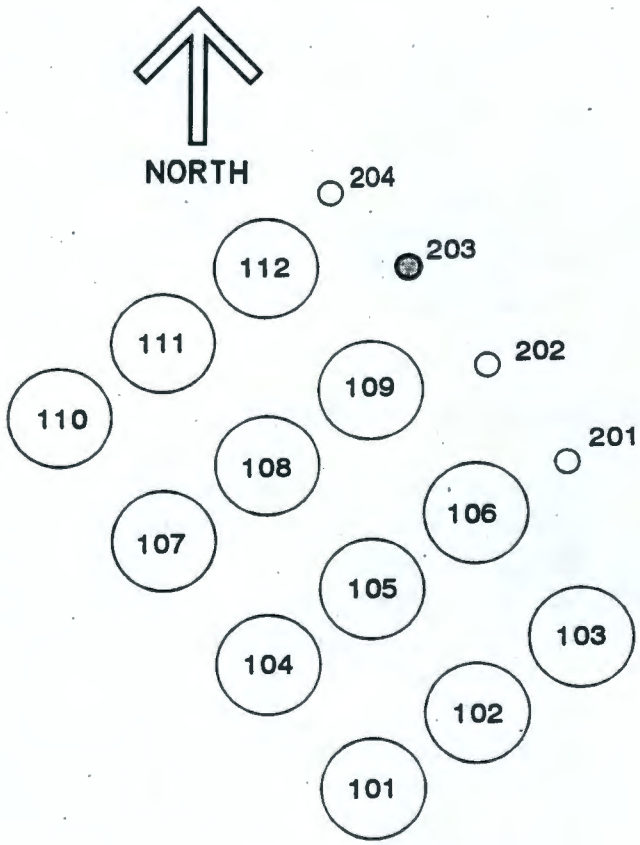
The C Tank Farm 200 series tanks were not cascaded to each other nor were they in a cascade series with the 100 series tanks, which were in cascades. The 200 series tanks were connected to two diversion boxes, through which waste could be sent to each tank. The tanks did not have overflow capability.

As with all first generation tank farms, equipment used to monitor the waste is sparse. A typical C Tank Farm 200 series tank was built with 10 risers, ranging in size from 10 to 30 cm (4 to 12 in.) in diameter, that provided surface level access to the underground tank. Four of the ten risers (risers 1 through 4) in tank 241-C-203 were covered by other equipment and two risers (riser 9 and 10) are in the sluicing pit. Three of the four remaining risers (risers 5, 6, and 8) are still in use. The surface level is monitored through riser 5 with a manual tape. Temperature is monitored on a thermocouple tree through riser 6. The breather filter is on riser 8. Riser 7 is a spare and has been used as an observation port for the purpose of photographing the tank and the waste contents. Used as the sampling port for the 1995 sampling event, riser 7 provided access to the side of the tank opposite from the inlets. This constitutes all installed equipment on or in tank 241-C-203.

Figure 2-1. Tank 241-C-203 Riser Locations and C Tank Farm Layout.



Tank 241-C-203
Riser and Inlet Plan View



C Tank Farm Layout

Table 2-2. Tank 241-C-203 Riser and Inlet Configuration.

Riser/inlet number	Diameter centimeter (inch)	Description and comments
R5	10 (4)	Manual tape
R6	30 (12)	Thermocouple tree
R7	30 (12)	Flange/observation port, 1995 auger sample location
R8	10 (4)	Breather filter
R9	30 (12)	Sludge jet access, weather cover (pit)
R10	30 (12)	Sluicing access, weather cover (pit)
N1 - N2	7.5 (3)	Spare
N3 - N4	7.5 (3)	Inlet

2.3 PROCESS KNOWLEDGE

Most of the major transfers of waste to and from tank 241-C-203 were documented, but are limited in describing the exact source and destination of each waste transfer (Anderson 1990). Some of the minor transfers into and out of tank 241-C-203 are not documented at all but show up as a change in the estimated volume in the tank. These estimated volumes were derived from waste level measurements. Section 2.3.1 presents the waste transfer history of tank 241-C-203, as a best estimate. A narrative describing the waste transfers is given in the section and the transfer history is also presented in Figure 2-2 and in Tables 2-3 and 2-4.

2.3.1 Waste Transfer History

Tank 241-C-203 received no waste until the fourth quarter of 1947, when the tank received metal waste from the bismuth phosphate process. Tank 241-C-203 received this waste from an unspecified source, but there is a strong probability that the waste was transferred to the tank directly from B Plant via master diversion box 241-CR-151. Tanks 241-C-101 through 241-C-106 and all four 200 series tanks received metal waste in 1946 and 1947. In November 1947, tank 241-C-203 was declared full (Anderson 1990).

Tank 241-C-203 was sluiced for uranium recovery. From the fourth quarter of 1953 to the first quarter of 1954, metal waste removal was in progress. During the fourth quarter 1953, 151 kL (40 kgal) of supernatant was transferred from tank 241-C-203 to tank 241-C-106, which was a metal waste supernatant blend tank. The remaining metal waste was removed during the first quarter 1954, and the tank was declared empty.

During the fourth quarter of 1955, tank 241-C-203 began receiving semiworks waste, eventually holding approximately 129 kL (34 kgal). During the first quarter of 1970, 72 kL (19 kgal) of supernatant was transferred to tank 241-C-109. Tank 241-C-203 evidently also received 11 kL (3 kgal) from an unknown source during that quarter. Tank 241-C-104 received 46 kL (12 kgal) of supernatant from tank 241-C-203 during the second quarter of 1970. Approximately 22 kL (6 kgal) remained, composed of 19 kL (5 kgal) sludge and the remainder liquid.

After the second quarter of 1970, the reported waste volumes in the tank varied somewhat. No additions or removals of waste were documented, but the waste volume varied by up to 18 kL (slightly less than 5 kgal) until interim stabilization in the first quarter 1982. A value of slightly less than 5 kgal (< 5 kgal) is used to account for the rounding effect in converting the recorded kgal to kL. Early records show only whole kgal amounts and could vary by up to 0.5 kgal. Tank 241-C-203 was removed from service in the first quarter of 1976 and was declared inactive in the fourth quarter of 1977. Tank 241-C-203 is categorized as an assumed leaker with a leak of 1.5 kL (400 gal) reported in January 1986.

Figure 2-2. Tank 241-C-203 Waste Transfer History.

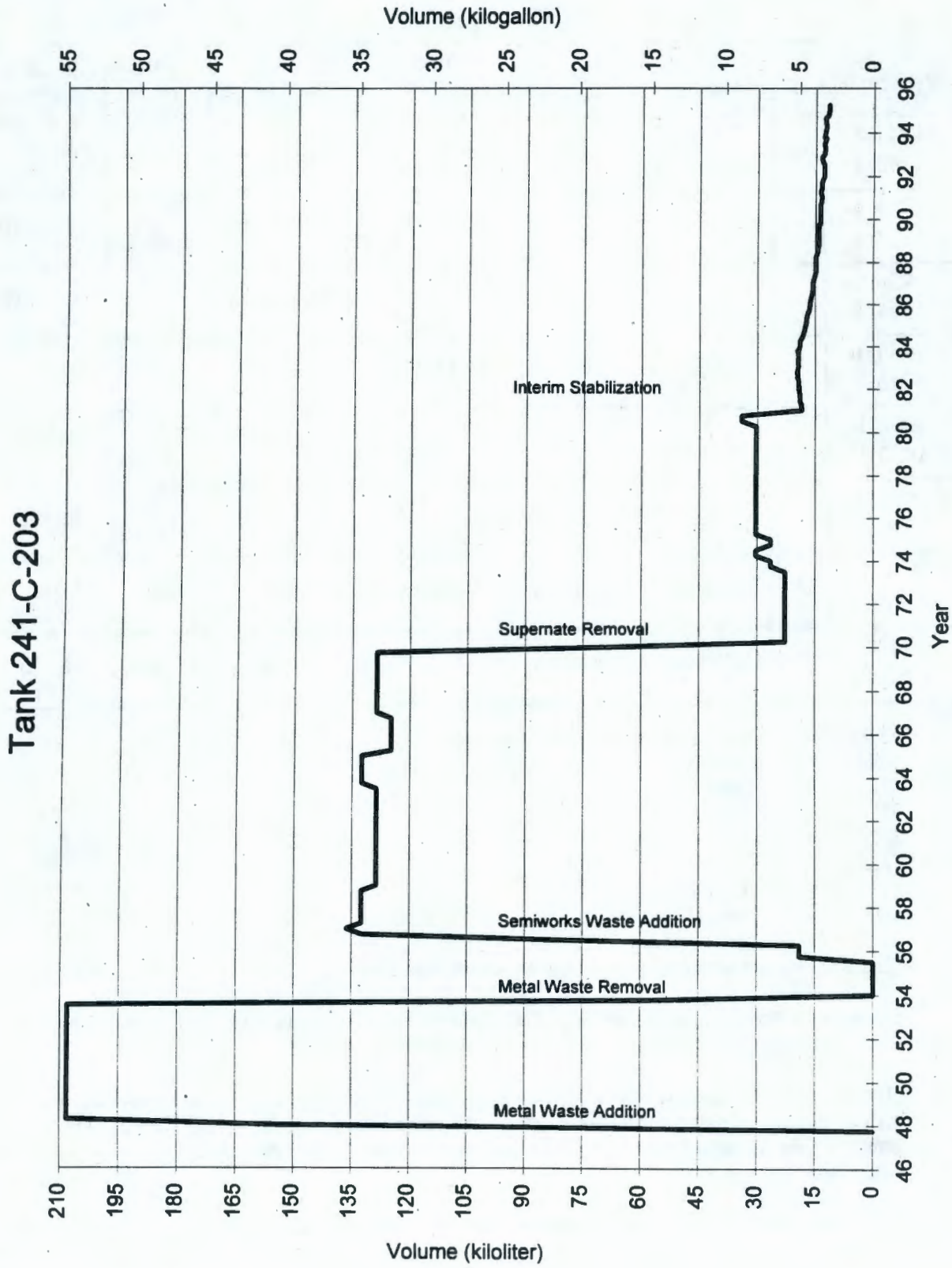


Table 2-3. Tank 241-C-203 Major Waste Transfers.

Year: qtr	Waste received by tank 241-C-203				Waste transferred out of tank 241-C-203			
	#	Source	Waste type	Volume kL (kgal)	#	Destination	Waste type	Volume kL (kgal)
1947:4-1948:1	1	B Plant (assumed)	MW	208 (55)				
1953:4-1953:4					1	241-C-106	MW SU	151 (40)
[1] 1954:1-1954:1					1	Unknown	MW SL	57 (15)
1955:4-1956:4	1	SS/HS	SW	129 (34)				
1970:1-1970:1	1	Unknown	Unknown	12 (3)	1	241-C-109	SW SU	72 (19)
[2] 1970:2-1970:2					1	241-C-104	SW SU	46 (12)
[3] 1970:3-1982:1	?	Unknown	Unknown	15 (4)	?	Unknown	SU	18 (< 5)
[4] 1982:2 1995:2	?	Unknown	Unknown	?	-	Leak	Liquid	8 (2)

Notes:

SS/HS = strontium semiworks/hot semiworks
MW = metal waste
SL = sludge
SU = supernatant
SW = semiworks waste

kL = kiloliter
kgal = kilogallon

[1]The tank was declared empty after sluicing for uranium recovery.

[2]An addition during the same quarter as the transfer to tank 241-C-109 is required for the math to be correct, although no transfers into tank 241-C-203 were documented.

[3]The waste volume estimated by the surface level, varied by up to 18 kL (< 5 kgal) over this time period. A value of slightly less than 5 kgal (< 5 kgal) is used to account for the rounding effect in converting the recorded kgal to kL. Early records show only whole kgal amounts and could vary by up to 0.5 kgal.

[4]Photographs indicate a increase in liquid between December 1980 and August 1983. The source is unknown.

Table 2-4. Synopsis of Major Waste Transfers.

Transfer type	Transfers into tank volume kL (kgal)	Transfers out of tank volume kL (kgal)	Remaining volume kL (kgal)
Addition of metal waste	208 (55)		208 (55)
Transfer out supernatant to 241-C-106		151 (40)	57 (15)
Transfer out of metal waste (sluice)		57 (15)	0 (0)
Totals for metal waste	208 (55)	208 (55)	0 (0)
Addition of semiworks waste	129 (34)		129 (34)
Addition of unknown and Transfer out of supernate to 241-C-109	11 (3)	72 (19)	68 (18)
Transfer out of supernate to 241-C-104		46 (12)	22 (6)
Misc. transfers in/out of unknown	15 (4)	18 (< 5)	19 (5)
Leak volume		8 (2)	11 (3)
Totals (after 1954)	155 (41)	144 (38)	11 (3)

Notes:

kL = kiloliter
kgal = kilogallon

2.3.2 Historical Estimation of Tank Contents

The following is an estimate of the contents for tank 241-C-203 based on historical transfer data. The historical data used for this estimate is the Waste Status and Transaction Record Summary (WSTRS) (Agnew and Brown 1994), the Hanford Defined Waste list (Agnew 1994A), and the Tank Layer Model (Agnew 1994B) from the *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area* (Brevick et al. 1995). WSTRS is a compilation of available waste transfer and volume status data. The Hanford Defined Waste list provides the assumed typical compositions for 50 separate waste types. In some cases, the available data is incomplete, reducing the usability of transfer data and modeling results derived from it. The Tank Layer Model takes the WSTRS data, models the waste deposition processes and, using additional data from the Hanford Defined Waste list (which may introduce more error), generates an estimate of the tank contents. Therefore, these model predictions can only be considered an estimate that requires further evaluation using analytical data.

The historical content estimates for tank 241-C-203 are based on the assumption that the tank contained and still contains metal waste. However, the tank was sluiced for metal waste and declared empty in 1953. It is believed that little or no metal waste remained in the tank. Beginning in 1955, the process history shows the tank received semiworks waste and undocumented waste additions and removals (Anderson 1990). Based on this information, it can be assumed that the content estimates for metal waste in the WSTRS, the Hanford Defined Waste list, and the Tank Layer Model are not valid.

The waste in tank 241-C-203 is expected to be semiworks waste, which was a byproduct of the strontium recovery process. The safety screening results do no corroborate this fully. From 1986 photographs (see Section 2.4.3), the waste appears to be comprised entirely of sludge. Table 2-5 shows the published waste composition estimate (Brevick et al. 1995). Modifications, based on the 1995 sample event and analysis, are shown in a separate column. Only constituents with values other than zero are shown.

Tank 241-C-203 has a process history similar to those of tanks 241-C-201 and 241-C-202 (Anderson 1990). It can be assumed that the three tanks would contain similar wastes at this time. However, the results of the analyses of the auger samples for tank 241-C-203 were much different than those of tanks 241-C-201 and 241-C-202. Both tanks 241-C-201 and 241-C-202 analytical results fell below the safety screening threshold value for weight percent water content. Both tanks also were above the safety screening threshold value for energetics and subsequent analyses revealed they contain total organic carbon above the safety screening threshold value. For both tanks 241-C-201 and 241-C-202, the total alpha values were below the safety screening threshold value.

The apparent differences in the waste in the three C Tank Farm 200 Series tanks cannot be resolved by comparing their respective process histories and the derivative waste models nor by comparing of their safety screening results. The amount of sample from the tank 241-C-203 1995 sample event (approximately 1121 grams total) is small compared to the amount of waste in the tank (approximately 17,000 kilograms total). The 1995 sample represents only 0.0066 percent of the tank waste volume, however, it is significantly greater than the amount of waste recovered from tanks 241-C-201 and 241-C-202, 15.81 grams and 8.54 grams, respectively.

Table 2-5. Tank 241-C-203 Historical Tank Inventory Estimate.

Solid composite inventory estimate				
Physical properties				
	Historical Tank Content Estimate[1] (based on metal waste in tank)			Content Estimate (based on 1995 auger sample analyses or 1995 volume estimate)
Total Solid Waste	2.85×10^4 kg (5 kgal)			1.71×10^4 kg (3 kgal)
Heat Load	1.22×10^{-2} kW (42 BTU/hr)			7.3×10^{-3} kW (25 BTU/hr)
Bulk Density	1.51 g/cc			1.62 g/cc
Void Fraction	0.486			No analysis
Water (wt%)	57.4			38
TOC (wt% C, wet)	0			No analysis
Chemical Constituents	mole/L	ppm	kg	kg
Na	4.84	7.38×10^4	2.10×10^3	1.26×10^3
Fe	0.319	1.18×10^4	337	202
Cr	4.14×10^{-3}	143	4.07	2.44
Ni	2.01×10^{-2}	785	22.4	13.4
Ca	4.75×10^{-2}	1.26×10^3	36	21.6
OH^1	7.13	8.05×10^4	2.29×10^3	1.37×10^3
NO_3^-	0.133	5.45×10^4	155	93
CO_3^{-2}	0.784	3.12×10^4	890	534
PO_4^{-3}	0.473	2.98×10^4	850	510
SO_4^{-2}	0.903	5.76×10^4	1.64×10^3	9.84×10^2
Si (as SiO_3^{-2}	2.07×10^{-3}	38.6	1.10	0.66
Cl^-	2.59×10^{-3}	61.0	1.74	1.04
Radiological Constituents				
Pu		4.59×10^{-3} μCi/g	2.8×10^{-3} kg	1.3×10^{-3} kg
U	1.02 M	1.61×10^5 μg/g	4.6×10^3 kg	2.76×10^3 kg
Cs	9.0×10^{-4} Ci/L	0.598 μCi/g	1.7×10^1 Ci	1.02×10^1 Ci
Sr	9.51×10^{-2} Ci/L	63.2 μCi/g	1.8×10^3 Ci	1.08×10^3 Ci

Notes:

[1]Brevick et al. 1995. This information should be used with caution because of the inaccuracies associated with the assumption that the waste type remaining in the tank is metal waste.

2.4 SURVEILLANCE DATA

Surveillance of tank 241-C-203 is comprised of surface level measurements (liquid and solid) and temperature monitoring inside the tank (waste and vapor space). Liquid level measurement provides an indicator of any major leak from a tank. Solid surface level measurements provide an indication of physical changes and consistency of the solid layers of a tank waste. Tank 241-C-203 does not have a liquid observation well.

2.4.1 Surface Level Readings

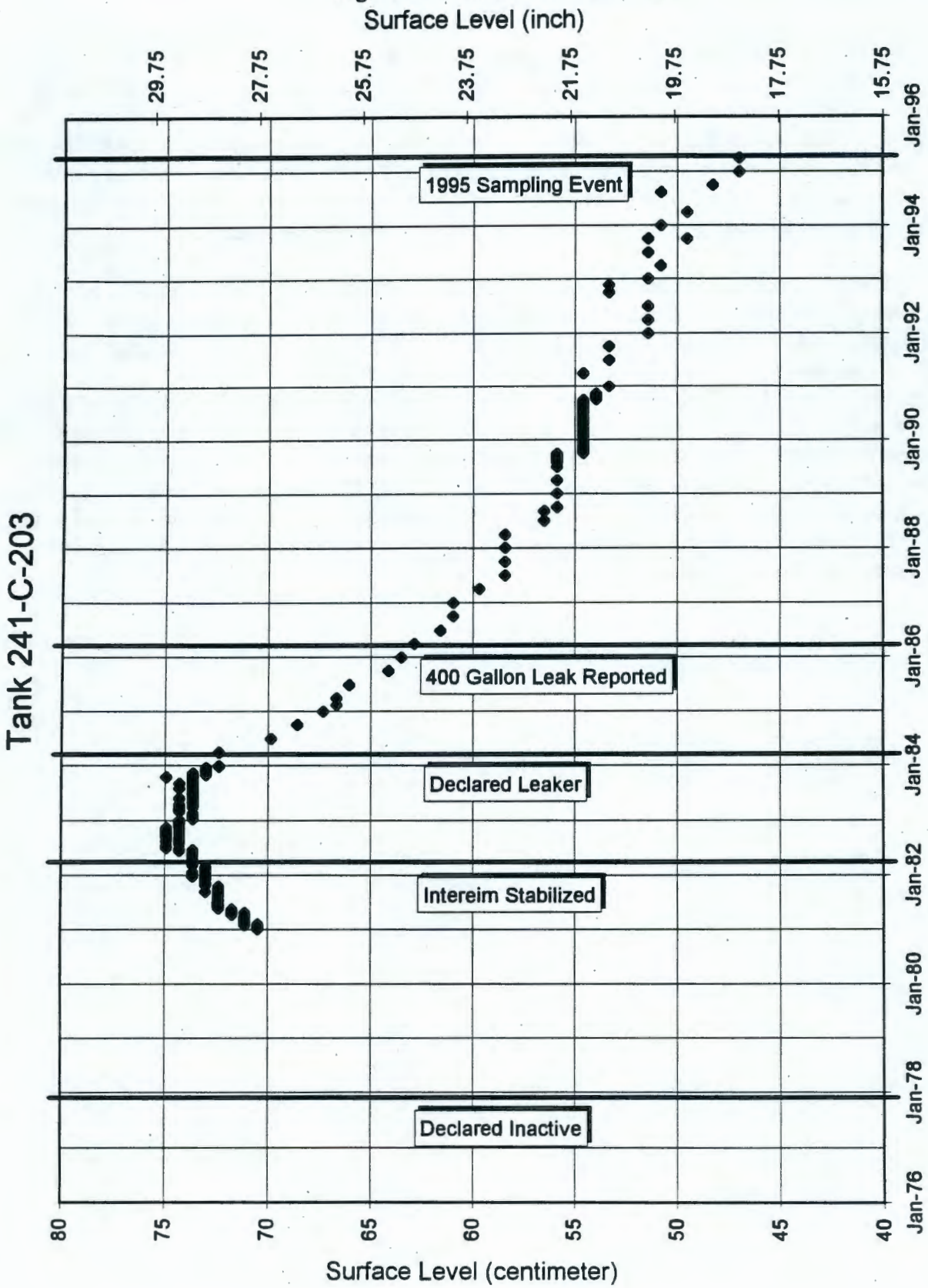
The surface level of tank 241-C-203 is measured quarterly with a manual tape through riser 5. The manual tape is a metal conductivity probe attached to a reel or tape that can be raised and lowered until the probe touches the surface of the waste. When the probe contacts the conductive waste surface, the circuit with the tank wall is completed and the tape is then read and recorded on round sheets. The data are later entered into the Surveillance Analysis Computer System (SACS) database. The manual tape is marked in quarter inch intervals.

Liquid waste volume is determined by a photographic evaluation and solid waste volume is determined by a manual tape and photographic evaluation. The maximum allowable increase from the 705 mm (27.75 in.) baseline is 51 mm (2 in.) (Welty 1988). There is no criterion for a decrease.

Using data from the SACS database, the surface level has shown a downward trend since 1984 when it was declared an assumed leaker. The tank now has a depth of 47 cm (18.5 in.) according to the January and April 1995 quarterly manual tape readings. This corresponds to a total volume of 11 kL (3 kgal) of sludge and a leak volume of 8 kL (2 kgal). A graphical representation of this information can be found in Figure 2-3.

The surface-level data recorded from manual-tape measurements differs from data in documents such as, *Waste Tank Summary Report for Month Ending March 31, 1995* (Hanlon 1995). That document notes that the latest update to the solids volume was in April 1982 (the tank was interim stabilized in March 1982) and the latest update to the leak volume estimate was in January 1986. The data in those published reports have not been updated recently, and the tank certainly could have continued to leak after 1986. The manual tape data recorded since 1982 support a long term slow leak, averaging 570 L (150 gal) each year for the past 13 years. This is consistent with the leak volume in the first years following the classification of the tank as an assumed leaker. It is peculiar that from October 1989 to November 1990, readings were taken almost every day, and during that period, the manual tape read consistently within 6.4 mm (0.25 in.). There is no explanation given for this behavior. After that time, the readings were taken less frequently and continued their generally downward trend.

Figure 2-3. Tank Level History.



2.4.2 Internal Tank Temperatures

Tank 241-C-203 has a single thermocouple tree in riser 6 with 11 thermocouples to monitor temperatures in the tank. Thermocouple 1 is at 40 cm (16 in.) from the bottom of the tank. Thermocouples 1 through 9 are evenly spaced 60 cm (2 ft) apart. Thermocouples 9 through 11 are spaced 1.2 m (4 ft) apart. Sporadic thermocouple readings are available from 1976 to 1983, then are not available again until 1992. In April 1994, Thermocouples 1, 2, and 8 were connected to the Tank Monitoring and Control System (TMACS), and daily readings from those three thermocouples are recorded in the SACS database.

Review of the surface level in tank 241-C-203 indicates that Thermocouple 1 is located slightly below the waste surface, and the remaining thermocouples are located in the vapor space. All eleven thermocouples have similar readings. A plot of the temperature trend for Thermocouple 1 is provided in Figure 2-4; Thermocouple 2 is shown for comparison. The TMACS readings appear to be cyclical over a period of approximately one year. These are somewhat offset from the exterior temperature extremes (highest readings in the September and October and lowest reading in March and April). This same phenomena has been noted on other tanks connected to TMACS. This phenomena is believed not to be a TMACS instrumentation error, rather a set of valid readings. It is believed that this behavior would have been seen before the TMACS was installed if data had previously been recorded at the frequency of once a day.

9613456.1047

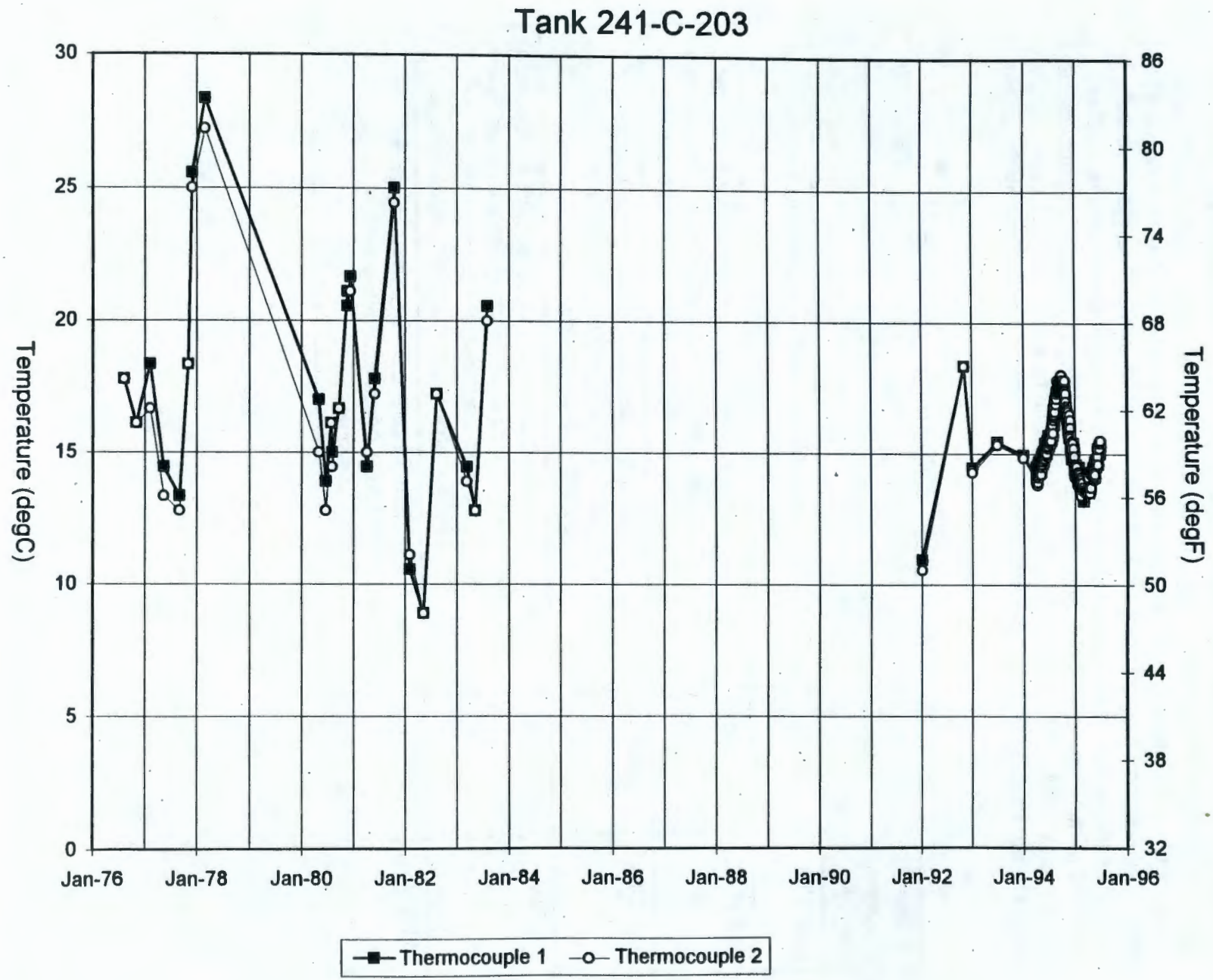


Figure 2-4. Thermocouple 1 Temperature Trend.

2.4.3 Tank 241-C-203 Photographs

A composite picture of the interior of tank 241-C-203 was made from photographs taken in December 1986. The photographs show a black and yellow mixed waste surface. A variety of risers, the manual tape, a thermocouple tree, and a spare inlet nozzle can be seen, in addition to a long pipe-like object labeled as debris (possibly an old thermocouple tree). The photograph appears in the *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area* (Brevick et al. 1995). A number of photographs exist for tank 241-C-203. Photographs taken of the tank between April 1980 and December 1986, are shown in Table 2-6. The description and comments are provided by the author.

Table 2-6. Comparison of Photographs of Tank 241-C-203.

Date of Photographs	Photograph Number	Manual Tape centimeter (inch)	Description and Comments
4/3/80	90651	122 (48)	Clear surface liquid (dark brown) with no exposed sludge visible.
12/16/80	093995	70 (27.5)	Approximately 50% of the surface is exposed sludge (dark brown and yellow). The remainder is clear, shallow liquid (brown to orange).
8/12/83	108930	76 (30)	Clear surface liquid (dark brown) with no exposed sludge visible. No explanation for surface liquid increase.
6/7/84	8403920	69 (27.25)	Approximately 50% of the surface is exposed sludge with some cracking (brown to rust, some yellow in drier area). The remainder of the surface area is clear, shallow liquid (orange).
12/9/86	8608030	61 (24)	Entire surface area is exposed sludge with deep cracking (black and yellow surface area). No liquid visible.

The photograph chosen for this report is a single image taken in December 1986. This photograph was chosen because it clearly shows the sludge nature of the waste, the lack of supernatant liquid and a somewhat dry, cracked waste surface. The 1995 auger samples were taken at riser 7, which is about the same diameter from the tank center as the thermocouple tree and manual tape, visible on the right side of the photograph. Riser 7 is the same riser from which the photograph was taken. The approximate sample locations are within the reflection of the camera flash. There have been no additions to or removals from the tank, with the exception of the leak, since the photograph was taken. The photograph should be a fairly good representation the current tank appearance. Additional drying of the waste surface is expected because of the leak.

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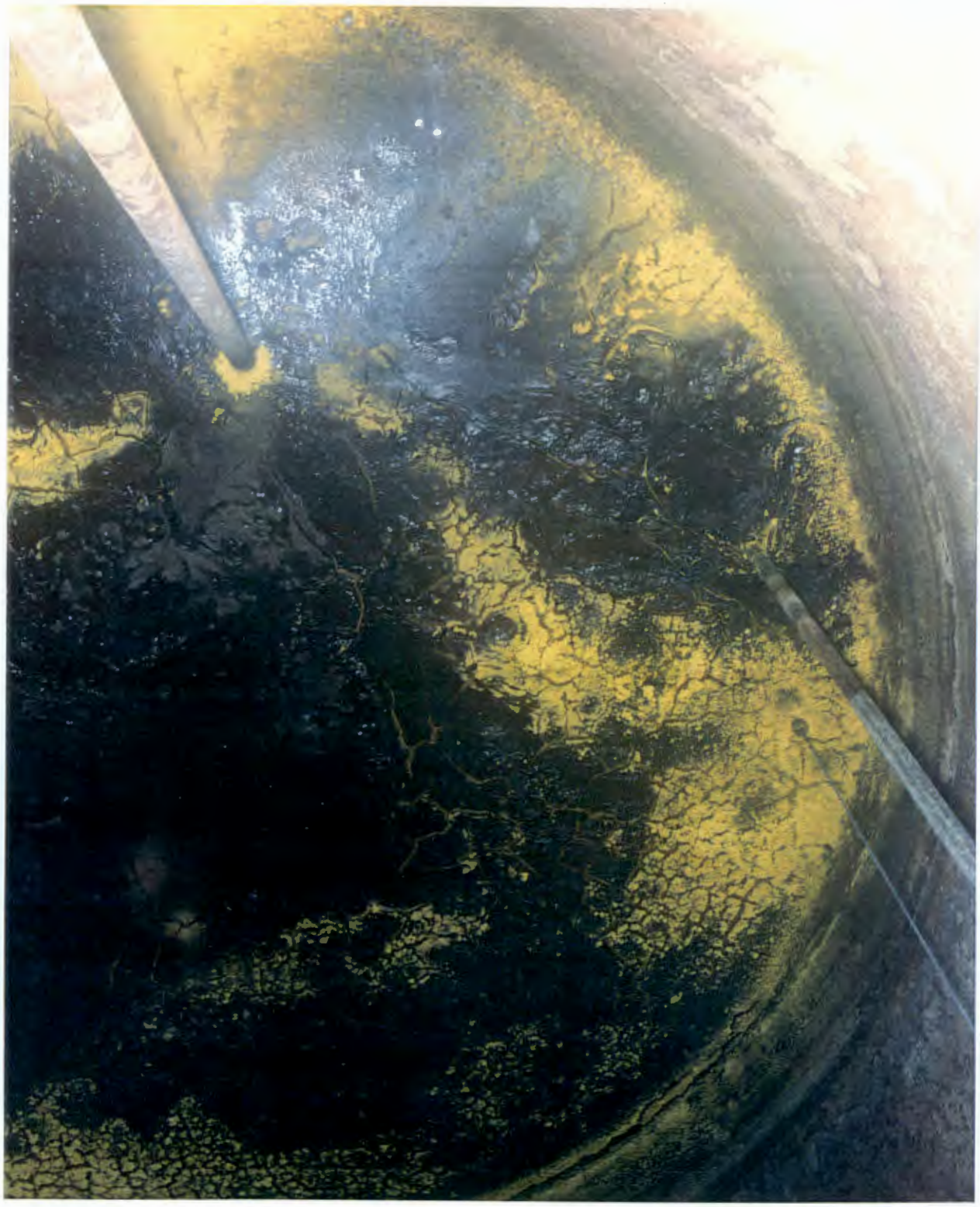
Figure 2-5. December 1986 Photograph of Tank 241-C-203 (8608030-18).



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3.0 TANK SAMPLING OVERVIEW

This section describes the 1995 auger sampling event associated with tank 241-C-203. Two auger samples were collected from the tank on April 5, 1995 for safety screening following the requirements of the Westinghouse Hanford Company *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) and *Tank 241-C-203 Tank Characterization Plan* (Schreiber 1995). Sample handling and reported results may be found in the *45-Day Safety Screen Results and Final Report for Tank 241-C-203, Auger Samples 95-AUG-020 and 95-AUG-021* (Conner 1995).

3.1 DESCRIPTION OF 1995 SAMPLING EVENT

Two samples were collected from tank 241-C-203 riser 7, using 51 cm (20 in.) augers. Sample 95-AUG-020 was collected from the eastern coordinate and sample 95-AUG-021 was collected from the western coordinate of the riser. The western coordinate is about 8 inches closer to the tank center than the eastern coordinate, and therefore, has a slightly deeper sludge depth due to the dish bottom of the tank. Auger sampling was used because the waste material appeared to be mostly sludge and was expected to be about 48 cm (19 in.) in depth.

A total of 493.21 grams of solid material were obtained from sample 95-AUG-020. Sample 95-AUG-021 yielded 627.69 grams of solid material. The total sample from both augers is 1120.9 g. No drainable liquids were recovered from either auger sample. The dose rates through the drill strings are 25 millirem/hour (mR/hr) and 17 mR/hr for auger samples 95-AUG-020 and 95-AUG-021, respectively. Table 3-1 summarizes the sampling data and describes the material collected by the augers. No problems related to the sample collections were noted.

3.1.1 Sample Handling (1995)

The two auger samples were received at the 222-S Laboratory on April 6, 1995 and extruded in the hot cell on April 7, 1995. No discrete layers were noted in the samples, but more yellow material was noticed on the upper half than on the lower half of the auger for sample 95-AUG-021.

Both auger samples were divided into half segments for analyses and archive specimens of each half segment were retained in the hot cell. Non-homogenized specimens (some incidental mixing) removed from the augers were analyzed for thermal properties, percent water, and total alpha activity. Subsampling information, sample identification, and the completed analyses are provided in Table 3-2.

Table 3-1. Tank 241-C-203 Sampling Summary.

Sample ID	Riser	Amount collected (g)	Drill string dose rate (mR/hr)	Description
95-AUG-020	7 (EC)	493.21	25	Solids damp, light cream to dark brown in color. Cream colored material overlaid with brown to dark brown sludge. Upon subsampling and incidental mixing, sample material appeared brown.
95-AUG-021	7 (WC)	627.69	17	Solids damp, medium brown to dark brown in color. Yellow material was mixed in with the top half (Flutes 1 through 9) dark brown solids. Top half solids slightly darker brown than lower half solids. Upon subsampling and incidental mixing, sample material appeared brown.

Notes:

EC = eastern coordinate
WC = western coordinate

g = gram
mR/hr = millirem/hr

3.1.2 Sample Analysis (1995)

In accordance with the requirements of the tank characterization plan (Schreiber 1995), energetics by differential scanning calorimetry (DSC), percent water by thermogravimetric analysis (TGA), and total alpha activity analysis were completed on the samples. The density was also determined for two samples (S95T000798 and S95T000802) at the request of Characterization Plant Engineering. The results of these analyses are presented in Section 4.0 of this document and the *45-Day Safety Screen Results and Final Report for Tank 241-C-203, Auger Samples 95-AUG-020 and 95-AUG-021* (Conner 1995). All results were within the safety screening notification limits.

Table 3-2. Tank 241-C-203 Sample Data Summary.

Sample ID	Auger ID	Segment	Preparation	Analyses
S95T000798	95-AUG-021	UH	NA	Density
S95T000799	95-AUG-021	UH	Direct	DSC/TGA
S95T000800	95-AUG-021	UH	Fusion/digest	Total alpha
S95T000801	95-AUG-021	UH	NA	Archive
S95T000802	95-AUG-021	LH	NA	Density
S95T000803	95-AUG-021	LH	Direct	DSC/TGA
S95T000804	95-AUG-021	LH	Fusion/digest	Total alpha
S95T000805	95-AUG-021	LH	NA	Archive
S95T000806	95-AUG-020	LH	Not used	Not used
S95T000807	95-AUG-020	LH	Direct	DSC/TGA
S95T000808	95-AUG-020	LH	Fusion/digest	Total alpha
S95T000809	95-AUG-020	LH	NA	Archive
S95T000810	95-AUG-020	UH	Not used	Not used
S95T000811	95-AUG-020	UH	Direct	DSC/TGA
S95T000812	95-AUG-020	UH	Fusion/digest	Total alpha
S95T000813	95-AUG-020	UH	NA	Archive
S95T001259	95-AUG-020	LH	Fusion/digest	Total alpha rerun
S95T001261	95-AUG-020	UH	Fusion/digest	Total Alpha rerun

Notes:

LH lower half segment
UH upper half segment
TGA thermogravimetric analysis

Upper and lower specimens from both auger samples were analyzed. The DSC and TGA were performed on 5 to 20 milligram (mg) specimens of the waste material under a nitrogen atmosphere. The total alpha activity specimens had to be dissolved before analysis. This was accomplished by fusing a solid aliquot (0.2 to 0.5 g) of the waste material in potassium hydroxide and dissolving, or digesting, the resultant fluxed material in hydrochloric acid. Total alpha activity is then determined on a liquid aliquot of the dissolved waste material.

Laboratory control standards, spikes, and duplicate analysis quality control checks were applied to the TGA, DSC, and total alpha activity analyses. Blank analysis was also applied to the total alpha activity analyses. No quality control checks were completed for the density analyses. Assessment of the quality control data is presented in Section 5.1.2.

All reported analyses were completed using approved laboratory procedures. No deviations from or modifications to the procedures were noted. The laboratory report stated that spike recoveries have typically been below the specified lower limit when solids are observed on the total alpha activity sample mount, as occurred during these analyses.

The preparation used for each analysis, and the preparation and analytical procedures used for these analyses are shown in Table 3-3.

Table 3-3. 222-S Preparation and Analytical Procedures.

Analysis	Instrument	Preparation procedure	Analytical procedure
Energetics by DSC	Mettler	NA	LA-514-113, Rev. B-1
Energetics by DSC	Perkin-Elmer	NA	LA-514-114, Rev. B-0
%Water by TGA	Mettler	NA	LA-560-112, Rev. A-2
%Water by TGA	Perkin-Elmer	NA	LA-514-114, Rev. B-0
Total Alpha	NA	LA-549-141, Rev. C-2	LA-508-101, Rev. D-2
Density	NA	NA	LO-160-103, Rev. A-7

Notes:

DSC = differential scanning calorimetry
TGA = thermogravimetric analysis
NA = not applicable

4.0 ANALYTICAL RESULTS AND WASTE INVENTORY ESTIMATES

4.1 OVERVIEW

Tank 241-C-203 was sampled in April 1995 in order to evaluate the waste against safety screening criteria defined in the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). This data quality objective requires analyses for percent water, energetics, and total alpha activity for criticality evaluation. In addition, sampling or monitoring for flammable gas concentration in the vapor space is required. No previous sampling and analysis event was documented for tank 241-C-203. The estimate of the chemical and radiochemical composition and inventory for the waste in the tank is derived from the Tank Layer Model (Agnew 1994B) is believed to be incorrect. The safety screening analysis results reported by Conner (1995) are summarized in the next two sections. Because both auger samples were taken from the same risers, about 20 to 25 cm (8 to 10 in.) apart, a complete statistical analysis was not performed. No estimate of variability is given.

4.2 DATA PRESENTATION - TOTAL ALPHA

Total alpha activity measurements were completed on material from the upper and lower halves of both auger samples. Duplicate aliquots of each portion were fused, digested, and analyzed, then reported as one value. The results of these analyses are summarized in Table 4-1.

Although these values are well below the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994) notification threshold value of greater than 41 μCi/g, the relative percent difference in the 94-AUG-020 sample readings are 101 percent and 91.8 percent. When the analyses for total alpha were run in the laboratory, poor sample reproducibility and spike recovery led to a rerun. The rerun results were no better, so the original data was retained (Conner 1995).

During the preparation of this report, the laboratory ran additional analysis on archived samples, both from 95-AUG-020. Those results are included at the bottom of Table 4-1 as sample numbers S95T001259 and S95T001261, the lower half and upper half segments, respectively. The relative percent differences for these samples were 10.7% and 2.54%, respectively. These values are not included in the overall mean for the initial sample analysis.

Table 4-1. Tank 241-C-203 Analytical Data: Total Alpha.

Sample number	Sample identification	Run	Results Bq/g (μCi/g)	Mean Bq/g (μCi/g)	Overall mean Bq/g (μCi/g)
S95T000812	95-AUG-020 (UH)	1	3.28×10^4 (0.887)	6.65×10^4 (1.8)	5.44×10^4 (1.47)
		2	1.00×10^5 (2.71)		
S95T000808	95-AUG-020 (LH)	1	1.05×10^5 (2.83)	7.18×10^4 (1.94)	
		2	3.89×10^4 (1.05)		
S95T000800	95-AUG-021 (UH)	1	5.33×10^4 (1.44)	5.62×10^4 (1.52)	
		2	5.88×10^4 (1.59)		
S95T000804	95-AUG-021 (LH)	1	2.45×10^4 (0.662)	2.24×10^4 (0.606)	
		2	2.04×10^4 (0.55)		
S95T001259 Archive Rerun	95-AUG-020 (LH)	1	2.62×10^4 (0.708)	2.77×10^4 (0.748)	5.74×10^4 (1.55)
		2	2.92×10^4 (0.788)		
S95T001261 Archive Rerun	95-AUG-020 (UH)	1	8.62×10^4 (2.33)	8.73×10^4 (2.36)	
		2	8.84×10^4 (2.39)		

Notes:

LH = lower half segment
UH = upper half segment

Bq = becquerel
g = gram
μCi = microcurie

4.3 PHYSICAL MEASUREMENTS RESULTS

Weight percent water by TGA and energetic content are the only physical measurements required by the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). The results of the TGA and DSC analyses are summarized in Section 4.3.1. The bulk density measurement is also presented at the end of this section.

4.3.1 Thermodynamic Analysis Results

TGA and DSC analyses were completed on material from the upper and lower halves of both auger samples. After extrusion on April 6, 1995, specimens were collected from the upper and lower halves of each auger sample. These specimens were analyzed from May 8 through May 10, 1995 using TGA and DSC. TGA and DSC analyses were run in duplicate (Runs 1 and 2). In the case of a triplicate run, the data are presented, in the table, but are not included in the mean value calculation. Data are presented in the next two sections.

4.3.1.1 Thermogravimetric Analysis Results

The results of the TGA analysis are provided in Table 4-2. The TGA recorded weight losses are relative to the original weight of the sample. TGA analysis shows three weight loss transitions. The first transition occurs between 30 °C and 140 °C and is associated with the free or interstitial water contained within the waste material. This weight loss represents the percent water in the sample. The second transition occurs between 180 °C and 280 °C. Based on the DSC analysis, at least two events in this temperature range are causing weight loss in the sample. This second weight loss may be caused by the dehydration of aluminum hydroxide or the melting of sodium nitrate, which occurs near 300 °C. Both of these weight losses are associated with endothermic reactions. The third transitional weight loss, which has been integrated with the second transition in Table 4-2, is associated with the exothermic reaction that occurs between 320 °C and 475 °C. This third weight loss probably represents the oxidation of organics in the sample by sodium nitrate and the subsequent loss of carbon dioxide. Additional chemical and thermal analyses would be required to confirm these possible reactions.

Table 4-2. Tank 241-C-203 Analytical Data: Thermogravimetric.

Sample number	Sample identification	Run	Transition 1 %wt loss		Transition 2 %wt loss	
			Range (30 °C - 120 °C)	Mean %wt loss	Range (180 °C - 475 °C)	Mean %wt loss
S95T000811	95-AUG-020 (UH)	1	30.98	31.38	5.72	5.32
		2	31.78		4.92	
S95T000807	95-AUG-020 (LH)	1	41.04	37.15	5.95	6.45
		2	33.26		6.95	
		3	39.79		5.95	
S95T000799	95-AUG-021 (UH)	1	33.67	35.16	10.31	9.33
		2	36.66		8.35	
S95T000803	95-AUG-021 (LH)	1	52.12	50.58	6.91	6.63
		2	49.03		6.34	

Notes:

LH = lower half segment
UH = upper half segment

4.3.1.2 Differential Scanning Calorimetry Results

The exothermic results of the DSC analyses are provided in Table 4-3 based on both wet and dry weights of the samples. As in the TGA analysis, the DSC scans show three distinct transition ranges. Exothermic reactions are identified by a negative sign for enthalpy or by peaks pointing down on the scans. The endothermic values for the first two transitions are based on the wet weight of the sample. For dry weight, the results are corrected using the weight percent water values determined by TGA analysis.

The temperature range, temperature at maximum enthalpy change, and the magnitude of the enthalpy change in joules per gram are provided for each transition. The first transition represents the endothermic reaction for the evaporation of the free or interstitial water in the sample. The second endothermic transition probably represents 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 third transition represents an exothermic reaction. This is probably the result of organics in the sample reacting with the molten nitrate salts.

The energy required for the endothermic reactions is several times greater than the exothermic energy released. This indicates that a relatively large amount of energy would have to be applied to the waste before the exothermic reaction could be initiated. The onset for an exothermic reaction is about 320 °C. Typical TGA and DSC scans of the tank 241-C-203 waste samples can be found in the *45-Day Safety Screen Results and Final Report for Tank 241-C-203, Auger Samples 95-AUG-020 and 95-AUG-021* (Conner 1995).

Table 4-3. Tank 241-C-203 Analytical Data: Differential Scanning Calorimetry.

Run	Range °C	Peak °C	ΔH J/g (wet)	Range °C	Peak °C	ΔH J/g (wet)	Range °C	Peak °C	ΔH J/g (wet)	ΔH J/g (dry)
Sample: S95T000811 Sample ID: 95-AUG-020 (UH)										
1	33-215	105.9	758.9	285-345	324	79.15	350-440	369.4	-34.91	-50.87
2	74-220	117.1	522.2	270-350	288.8	32.66	352-460	409.3	-33.19	-48.37
Mean of Exotherms									-34.05	-49.62
Sample: S95T000807 Sample ID: 95-Aug-020 (LH)										
1	36-190	105.7	807.9	269-290	283.3	11.83	348-380	362.2	-20.36	-32.85
2	116-190	123.1	792.3	269-290	281.3	14.85	348-380	363.2	-19.1	-30.82
Mean of Exotherms									-19.75	-31.84
Sample: S95T000799 Sample ID: 95-AUG-021 (UH)										
1	40-200	106.2	845.5	245-320	283.2	43.7	320-420	355.5	-42.8	-66.02
2	40-210	120.5	780.6	225-325	282.9	39.8	325-425	359.6	-41.7	-64.32
Mean of Exotherms									-42.25	-65.17
Sample: S95T000803 Sample ID: 95-AUG-021 (LH)										
1	40-202	112.8	761.8	222-300	283.1	17.9	308-418	349.6	-48.1	-97.33
2	42-218	107.5	975.1	220-302	283.1	22.9	307-415	345.5	-47.6	-96.32
Mean of Exotherms									-47.85	-96.8

Notes:

UH = upper half segment
LH = lower half segment

g = gram
ΔH = change in enthalpy
J = joule

Negative sign denotes exothermic reaction ΔH indicates a change in enthalpy.

4.3.2 Density

Although not required by the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), the density of the waste material for two samples was measured at the request of Characterization Plant Engineering. These results are presented in Table 4-4.

Table 4-4. Tank 241-C-203 Analytical Data: Density.

Sample number	Sample identification	Result (g/cc)	Mean (g/cc)
S95T000798	95-AUG-021 (UH)	1.72	1.62
S95T000802	95-AUG-021 (LH)	1.51	

Notes:

UH = upper half segment
LH = lower half segment

g = gram
cc = cubic centimeter

Both density measurements were taken from the same auger sample, one from the upper half and the other from the lower half. The samples are centrifuged in a tared, graduated centrifuge cone. No duplicates were run. From these results, the waste appears to be more dense in the upper half segment than the lower half segment. No explanation is given why this is the case.

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

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

5.1.1 Field Observations

No problems were documented while obtaining the two auger samples. The radiation levels for the drill strings were 25 mR/hr and 17 mR/hr for samples 95-AUG-020 and 95-AUG-021, respectively (Conner 1995).

During the handling of the 1995 samples, an observation was made that could impact the interpretation of the data. Although the safety screening data quality objective specifies that at least two risers be sampled, only one riser from tank 241-C-203 was available for sampling. Because of the small amount of solids in the tank, there was a suspicion that the material would be dry (percent moisture results of less than the notification limit of 17 weight percent). In order to help lessen the chance of receiving a false positive result, it was decided that two auger samples would still need to be obtained. Consequently, both auger samples were obtained from the same riser. The safety screening data quality objective requires only a limited analysis suite. Thus, no analysis was done of the effects, if any, of taking the samples approximately 20 to 25 cm (8 to 10 in.) apart in the same riser.

5.1.2 Quality Control Assessment of Analytical Data

An attempt is usually made to quantify the different sources of error possible during the 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 acceptable limits, the accuracy of the concentration estimate is questioned. Possible sources of error include poor instrument calibration, matrix interferences, sample contamination, and analytical error. Systematic error estimates are determined from analysis of reference standards, spike recoveries, and blank contamination. Analytical error is determined by the differences between primary and duplicate samples.

The appropriate blanks, duplicates, spikes, and standards for quality control measures were performed on the 1995 auger sampling safety screening data quality objective analyses. The criteria established by the data quality objective and the tank characterization plan was ± 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. All of the standards conducted on the analyses were in the acceptable range. Spikes were conducted only on the total alpha activity data, as they are not applicable to DSC and TGA methods. Both spikes for the original analyses and the spike conducted for the rerun of the total alpha activity, were outside the 90 to 110 percent recovery criterion. These values of 68.4 and 54.4 percent recovery for the original analyses and the rerun spike was 79.3 percent recovery. The poor recovery was attributed to the probable presence of solids on the sample mount.

With the exception of the bulk density analysis, duplicate analyses were performed on each of the auger samples in order to provide an indication of the reproducibility for these analyses and also an indication of the sample homogeneity. Precision requirements are estimated by the relative percent difference (RPD) between the primary and duplicate samples. The DSC results, varied between 1.4 and 6.4 percent RPD, showing very good agreement.

For the TGA analyses, only one RPD result, at 20.9 percent, did not agree well. The other RPD values are within the 10 percent RPD criterion specified in the safety screening data quality objective, meaning the data reliability is not impacted seriously by the laboratory's analytical precision or sample heterogeneity.

As discussed earlier, the RPD results for total alpha activity showed very poor correlation. The results varied from 9.9 percent to 101 percent RPD. These data resulted in a rerun for two samples, which were an improvement, although one was still greater than 10 percent. The rerun RPD results were 10.7 percent and 2.54 percent.

5.1.3 Data Consistency Checks

The ability to assess overall consistency or trends in the data between samples is limited for tank 241-C-203 sampling and analysis events because limited samples were taken and limited analyses were performed.

5.1.3.1 Mass and Charge Balance.

This analysis cannot be performed with the data generated.

5.2 COMPARISON OF DIFFERENT SAMPLING EVENTS

A comparison cannot be made between the 1995 sampling event and earlier sampling events because this is the first documented sampling event for tank 241-C-203.

5.3 TANK WASTE PROFILE

Tank 241-C-203 contains approximately 11 kL (3 kgal) of sludge from strontium recovery processes in the mid-1950s to mid-1960s. Water comprises 38 percent by weight of the sludge on average. The sludge was more moist in the lower sections of the samples than in the upper sections. The highest recorded value was 52.12 weight percent in the lower half of the auger sample, which was taken closer to the tank center. The lowest recorded value was 30.98 weight percent in the upper half of the auger sample, which was taken closer to the tank wall. The largest exotherm value was 48.1 J/g (wet) or 97.33 J/g (dry). Total alpha averaged 5.44×10^4 Bq/g (1.47 μCi/g). The highest value was 1.05×10^5 Bq/g (2.83 μCi/g). The average bulk density was 1.62 g/cc.

The samples were taken from the same riser, approximately 20 to 25 cm (8 to 10 in.) apart. From the photographs, the waste appears to be heterogenous, but fairly uniform in appearance throughout the tank. However, with the limited number of analyses performed, it is not possible to gain a good understanding of the waste profile of tank 241-C-203.

5.3.1 Review of Analyte Profiles

This was not done because no analysis of chemicals was performed.

5.4 COMPARISON OF ANALYTICAL AND TRANSFER HISTORY

Tank 241-C-203 has a process history similar to those of tanks 241-C-201 and 241-C-202. It can be assumed that the three tank would contain similar wastes at this time. However, the results of the analysis for tank 241-C-203 were much different than those of tanks 241-C-201 and 241-C-202. Both tanks 241-C-201 and 241-C-202 analytical results fell below the safety screening threshold value for weight percent water content. Both tanks also were above the safety screening threshold value for energetics and subsequent analyses revealed they contain total organic carbon above the safety screening threshold value. For both tanks 241-C-201 and 241-C-202, the total alpha values were below the safety screening threshold value.

If one assumes that the safety screening results for tanks 241-C-201 and 241-C-202 are correct, and that they reflect the actual process history for those tanks, one can conclude that the current waste in tank 241-C-203 is not consistent with the process history.

5.5 EVALUATION OF PROGRAM REQUIREMENTS

5.5.1 Safety Evaluation

The analytical results for the 1995 sampling event of tank 241-C-203 were compared to notification thresholds listed in *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). Water comprises approximately 38 percent by weight of the sludge. The sludge was more moist in the lower sections of the samples than in the upper sections. The largest exotherm value was found to be 97.33 J/g (dry weight basis) (less than 21 percent of the safety screening limit) and largest total alpha value was 2.83μCi/g (less than 7 percent of the safety screening limit). Neither vapor space monitoring nor sampling has been completed at this time to satisfy the gas composition portion of the safety screening. Based on the data, tank 241-C-203 does not belong on any Watch List.

5.5.2 Operational Evaluation

Tank 241-C-203 was sampled to comply with the requirements of the safety screening data quality objective. These requirements do not include a complete list of the analyses required for a compatibility assessment. Further, interim stabilization and intrusion prevention were completed in 1982, so this tank is not being considered for any further stabilization or operational efforts.

5.5.3 Environmental Evaluation

Tank 241-C-203 waste was not characterized to designate the waste or for evaluation of any environmental compliance issues. No environmental assessment can be made of the waste. However, in general, tank waste matrices are highly caustic, radioactive, and have soluble nitrates associated with them. In turn, each of these characteristics has environmental issues associated with it.

5.5.4 Process Development Evaluation

The waste in tank 241-C-203 has not been characterized for process development purposes, which requires a complete list of metal cations and anions in addition to a full physical and rheological evaluation. This information was not requested. Retrieval procedures, pumping requirements, and final waste-form determinations must await more complete analyses at a later date as part of a data quality objective for the disposal program.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Tank 241-C-203 is within the safety screening notification limits established by the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), with the exception of the gas composition criterion, because monitoring or sampling for this parameter has not been completed. There is little reason to believe this tank might pose a safety hazard. The tank contains only 11 kL (3 kgal) of waste.

During the preparation of this report, the author noted several discrepancies in the published information about tank 241-C-203 and its contents. Authors of potentially affected documents have been notified of the following discrepancies.

- The surface level in this tank is now approximately 25 cm (10 in.) below the published value of 72 cm (28 in.). The last two quarterly surface-level readings (January and April 1995) were 47 cm (18.5 in.). This is in agreement with a general downward trend in the surface level for the past thirteen years, since interim stabilization. The surface level affects the calculation of the waste volume in the tank and the leak estimate. The previously reported value of the tank volume is 19 kL (5 kgal), while the value based on surface level measurements is 11 kL (3 kgal). The reported leak estimate is 1.5 kL (400 gal), while the value based on surface level readings is 8 kL (2 kgal). The leak estimate has not been updated for tank 241-C-203 since 1986 (Hanlon 1995).

- The source of waste in tank 241-C-203, listed in various documents, is metal waste. Most or all of the metal waste was removed from the tank during tank sluicing for uranium extraction. After 1955, wastes added to the tank were identified as semiworks waste and unknown waste. All the documented supernatant was transferred to other tanks in C Tank Farm or other unknown locations before interim stabilization in 1982 or has leaked out since that time. The sludge should be classified as non-complexed and the source should be semiworks waste.

The following are recommendations regarding further sampling and analysis of wastes in tank 241-C-203.

- Tank 241-C-203 is required to have the vapor space gases monitored or sampled to fulfill the *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994). There are no indications that this effort should be expedited.

- The results from the 1995 auger sampling event and analysis indicate that the tank waste is well within the safety screening threshold values. No additional sampling or analysis is required for tank 241-C-203, except as may be needed for future retrieval and disposal efforts.

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