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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-U-204. This report supports the requirements of Tri-Party Agreement Milestone M-44-08.

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Tank Characterization Report for Single-Shell Tank 241-U-204

G. F. Raphael
Westinghouse Hanford Company

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EXECUTIVE SUMMARY

This report compiles and summarizes characterization information relevant to tank 241-U-204. The findings satisfy the data requirements of the Organic[1] and Safety Screening[2] - except toxic vapor and flammable gas - data quality objectives. This report supports Federal Facility Agreement and Consent Order[3] FY 95 Milestone M44-08.

Tank 241-U-204 is a 208-kL (55-kgal)-capacity cylindrical, dished-bottom, carbon-steel, single-shell tank located in the 200 West Area of the Hanford Site. The tank has a 6.1-m (20-ft) diameter and a 5.69-m (224-in.) usable depth.

Tank 241-U-204 is classified as sound based on surface level measurements, and has been interim stabilized and interim isolated. Three of its risers (2, 3, and 6) are available for use.

The contents of the tank are currently estimated at ≈12 kL (3 kgal) of noncomplexed waste, corresponding to a waste depth of about 44.5 cm (17.5 in.). Sludge comprises ≈8 kL (2 kgal) of the waste, and ≈4 kL (1 kgal) are liquid supernatant.

---

[1]Babad, H., S. M. Blacker, and K. S. Redus, 1994, *Data Quality Objective to Support Resolution of the Organic Fuel Rich Tank Safety Issue*, WHC-SD-WM-DQO-006, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

[3]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.

Construction of the tank was completed in 1944, but the tank was not used until 1954 to support reduction-oxidation plant operation. No waste temperature data are available prior to 1975, but most recent records indicate no unusual readings. A minimum of ≈2 °C (35 °F) and a maximum of ≈32 °C (89 °F) were recorded respectively on January 1, 1988 and July 11, 1994. The average waste temperature is currently about 15 °C (59 °F).

The most recent data (Bell 1995) shows that the tank waste contains an average of ≈0.05% total organic carbon (TOC), negligible total α activity, and ≈26% moisture. Spatial and analytical variabilities were not estimated because of the small number of observations, but the data extrema comply with the thresholds established by the Safety Screening and Organic Safety data quality objectives (DQOs) (Babad and Redus, Babad at al. 1994)(refer to table 5-6). The tank could be classified as safe according to the criteria specified in the DQOs. However, the tank is currently on the Organic Safety Watch List.

The Safety Screening and Organic Safety data quality objectives (DQOs) (Babad and Redus, Babad et al. 1994) do not provide a mechanism for removing a tank from the Organic Safety Watch List based on characterization data alone. The Tank Waste Remediation System (TWRS) Safety Program will use the data to determine the future disposition of the tank.

Waste sampling activities consist of a supernatant sample in 1975, a sludge sample in 1978, and two push-mode core samples in 1995. Tables ES-1 and ES-2 and Figure ES-1 summarize data relevant to tank 241-U-204 and its waste contents.

Table ES-1. Tank 241-U-204 Design and Status Overview.

Parameter	Status
Type	Single-shell
Date of construction	1943-1944
Start service	1954
End service	1975
Diameter	6.1 m (20 ft)
Usable depth	5.69 m (224 in.)
Operating capacity	208 kL (55 kgal)
Construction material	Carbon steel
Shape	Cylindrical/dished bottom
Ventilation	Passive
Structure integrity	Sound
Mitigation activities	Interim stabilized 1977 Intrusion Prevention
Safety classification	Organic Watch List
Waste volume	≈12 kL (3 kgal)
Sludge volume	≈8 kL (2 kgal)
Supernatant volume	≈4 kL (1 kgal)
Waste depth	44.5 cm (17.5 in.)
Temperature	≈15 °C (59 °F)
Sampling event	1975 - Supernatant 1978 - Sludge 1995 - Core Riser 2 1995 - Core Riser 6

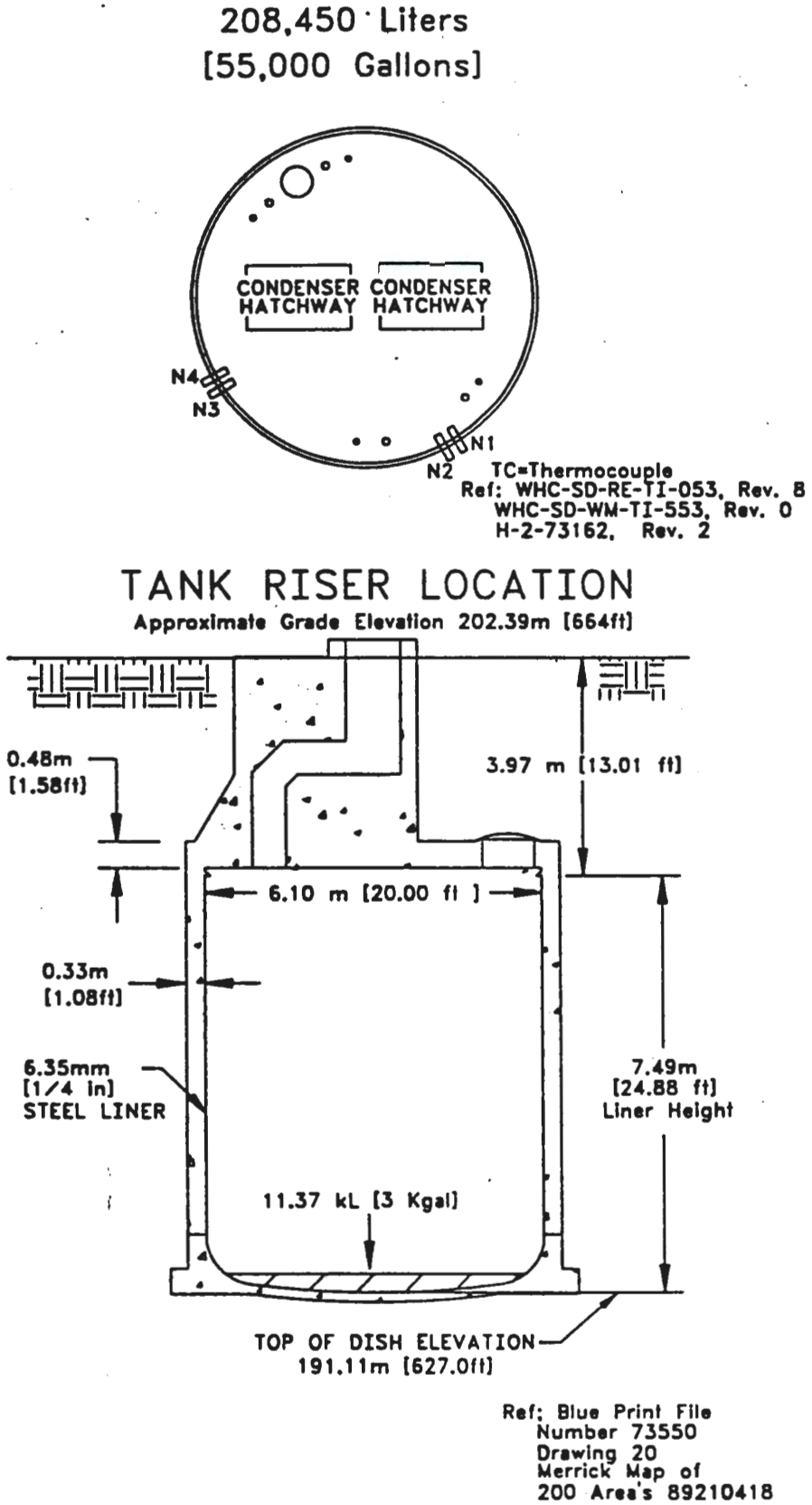
Table ES-2. Data Summary and Inventory Estimates for Key Analytes.

Analyte	Method/year	Average value	Calculated inventory (kg)
Physical properties			
Sludge color	Visual / 1995	Light brown to creamy	
Sludge consistency	Visual / 1995	Smooth to crumbly	
Water solubility	NR / 1978	70%	NA
Bulk density g/ml	NR / 1978	1.31	NA
Water content %	TGA / 1995	≈ 26	2600
Radiochemical properties μCi/g wet waste			
Total α Pu	KOH fusion / 1995	0.0967	Negligible
Chemical properties			
Cations in μg/g	1978		
Na^{+}	Water extraction	10000	100
Al^{+3}	Acid fusion	196000	1900
Ni^{+2}	Acid fusion	4000	40
La^{+3}	Water extraction	20000	200
Bi^{+3}	Acid fusion	1000	10
Anions in μg/g	1978		
OH^{-}	Water extraction	5000	50
F^{-}	Acid fusion	4000	40
NO_2^{-}	Water extraction	3000	30
CO_3^{-2}	Water extraction	6000	60
SiO_2^{-2}	Acid fusion	87000	860
NO_3^{-}	Water extraction	12000	120
PO_4^{-3}	Water extraction	5000	50
SO_4^{-2}	Water extraction	5000	50
Total cations and anions inventory			3500
Total organic carbon (μg/g wet waste)	Persulfate oxidation / 1995	470	≈5
Total inventory			6100

Notes:

NA = Not applicable
NR = Not reported
TGA = Thermo-gravimetric analysis

Figure ES-1. Tank 241-U-204 Configuration and Contents.



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LIST OF TERMS

BCS	Boeing Computer Services
CWR	REDOX cladding waste
CASS	Computer Automated Surveillance System
cm	Centimeter
ΔH	Change in enthalpy
DQO	Data quality objectives
DSC	Differential scanning calorimetry
ft	Feet
g	Gram
gal	Gallon
HTCE	Historical tank content estimate
ICP	Inductively coupled plasma spectroscopy
IDL	Instrument detection limit
hr	Hour
in.	Inch
J	Joules
kgal	Kilogallon
KHC	ICF Kaiser Hanford Company
kL	Kiloliter
L	Liter
m	Meter
μCi	Microcurie
μg	Microgram
mL	Milliliter
mmol	Millimole
mrad	Millirad
MW	Molecular weight
NA	Not applicable
NC	Not counted
NR	Not reported
ppm	Parts per million
QA/QC	Quality Assurance/Quality Control
REDOX	Reduction-oxidation
RPD	Relative percent difference
TCR	Tank characterization report
TGA	Thermo-gravimetric analysis
TIC	Total inorganic carbon
TLM	Tank layer model
TOC	Total organic carbon
TWINS	Tank Waste Information Network System
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company

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TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-U-204

1.0 INTRODUCTION

Tank 241-U-204 is a 208-kL (55-kgal) single-shell tank constructed in 1943-44. The tank was primarily used to store waste water and reduction-oxidation (REDOX) cladding wastes. Tank 241-U-204 is currently inactive and contains about 12 kL (3 kgal) of waste. The intent of this tank characterization report (TCR) is to present and interpret characterization information from three sampling events that were recorded for tank 241-U-204; a supernatant sample in 1975, a sludge sample in 1978, and two core samples in 1995. In addition to meeting Safety Screening - except toxic vapor and flammable gas - and Organic Safety data quality objective requirements (Babad and Redus 1994, Babad et al. 1994), this documents supports *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994) Milestone M44-08.

1.1 PURPOSE

This report, in addition to presenting physical, chemical, and radiochemical characterization data, assesses such information against the Safety Screening and Organic Safety data quality objectives (DQOs)(Babad and Redus 1994, Babad et al. 1994). This assessment is used by the cognizant program elements to classify the tank as "Safe," "Conditionally Safe," or "Unsafe," to determine whether the tank belongs on the Organic Watch List, and to identify any other potential safety issues associated with the tank. It also provides insight relevant to the nature and distribution of the waste constituents. This TCR will be reviewed and updated as new information becomes available.

1.2 SCOPE

Historical tank information, such as tank design specifications, waste process history, tank current mitigation status, and surveillance level and temperature data, is presented in Section 2.0. Volumetric and chemical estimations of the tank's contents, derived from the tank layer model (Agnew 1994b and 1995), are also presented in Section 2.0. Section 3.0 provides an overview of the waste sampling events. Section 4.0 presents summaries of the data from the 1995 sampling event. Detailed results are tabulated in the appendices. Section 5.0 interprets historical and most recent analytical information. Implications of the data as they relate to the DQOs are also assessed. The conclusion is presented in section 6.0.

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2.0 HISTORICAL TANK INFORMATION

2.1 TANK STATUS

According to Hanlon (1995), tank 241-U-204 contains ≈12 kL (3 kgal) of noncomplexed waste. The waste depth is 44.5 centimeters (cm) (17.5 in.). The tank waste consists of ≈4 kL (1 kgal) of supernate and ≈8 kL (2 kgal) of sludge. Waste volume is calculated based on surface level and tank geometry. Tank 241-U-204 was used to store waste water and REDOX cladding waste (Agnew et al. 1994a). The tank is interim stabilized and intrusion prevention has been completed (Weltey and Vermeulen 1989). Its integrity is classified as sound (waste level remains unchanged) and tank monitoring systems are in compliance with documented standards (Hanlon 1995). Tank 241-U-204 was added to the Organic Watch List as a precautionary measure in May 1994 after a statistical analysis of Hanford Site single-shell tank wastes derived a total organic carbon (TOC) estimate of greater than 3.0 weight percent (dry basis) for the waste in the tank (Turner 1994; Toth et al. 1994). The average in-tank temperature on June 12, 1995, was ≈15 °C (59.7°F). The tank is ventilated with a passive breather filter (WHC 1994).

2.2 TANK DESIGN DATA

Tank 241-U-204 is one of 16 waste storage tanks that comprise the U Tank Farm in the Hanford Site's 200 West Area; four of the tanks, including tank 241-U-204, have design capacities of 208 kL (55 kgal) and 12 have design capacities of 2,010 kL (530 kgal). Construction of this tank farm began in 1943 and was completed during 1944 (WHC 1994). Its location is depicted in Figures 2-1a and 2-1b (see the Tank Characterization Reference Guide [DeLorenzo et al. 1994] for more information about the U Tank Farm and single-shell tanks in general).

Tank 241-U-204 is a cylindrical single-shell tank consisting of a carbon-steel liner within a reinforced concrete shell and dome. The tank has a 6.1-m (20-ft) diameter and a 5.61-m (18.4-ft) usable depth; the tank bottom is dish-shaped (Brevick et al. 1994a). The basic design of tank 241-U-204 is presented in Figure 2-2. Instruments access the tank through risers to collect temperature, waste level, and other data. The positions of the tank's eight risers are shown in Figure 2-3. Three 31-cm (12-in.) risers (2, 3 and 6) are available for use (Bell 1995). Waste was added to the tank through piping that penetrated the tank sidewall; waste was pumped out through risers.

2.3 PROCESS KNOWLEDGE

Process knowledge combines both waste transfer history and the derived waste composition and volume estimates. Table 2-1 is an excerpt from Agnew et al. (1994) showing the waste type and total amount transferred to tank 241-U-204 during its active life.

Table 2-1. Waste Volumes of Tank 241-U-204 (Agnew et al. 1994).

Waste type	Volume received kL (kgal)
Waste Water	144 (38)
REDOX cladding waste	45.4 (12)

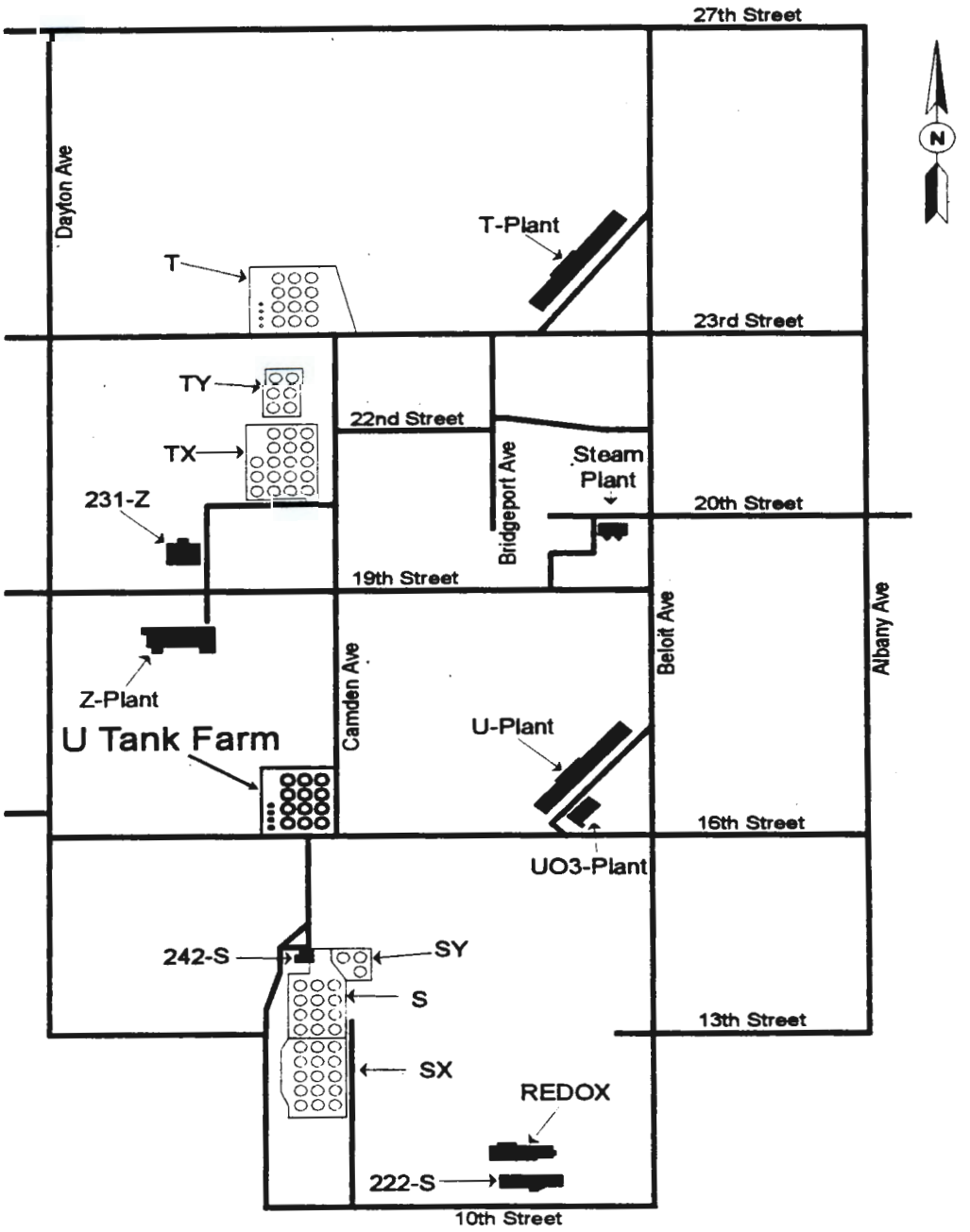
Although construction of the tank was completed in 1944, tank farm transfer summaries indicate that tank 241-U-204 did not receive waste until 1954. During 1954 the tank received 133 kL (35 kgal) of diversion box flush water. Agnew et al. (1994) classify this waste as waste water; however, Anderson (1990) classifies this dilute flush material as high-level waste from the REDOX process and second-cycle decontamination waste from the bismuth phosphate process.

Tank 241-U-204 received an additional 11 kL (3 kgal) of waste water in 1956. Also during 1956, its neighbouring tank 241-U-203 received a transfer of ≈45 kL (12 kgal) of supernate from tank 241-U-110. Historical transfer summaries show that at the time of the transfer, tank 241-U-110 was receiving REDOX cladding waste (CWR); this tank also contained REDOX high-level waste and bismuth phosphate first-cycle decontamination waste. The waste transferred to tank 241-U-204 may have been a mixture of these wastes consisting primarily of CWR. CWR (generated during the 1950's) resulted from the dissolution of aluminum fuel cladding; thus, it would contain an abundance of aluminum (Agnew 1994). The estimated composition of REDOX cladding waste supernate and sludge is presented in Table B-1. REDOX high-level waste also contained a large amount of aluminum and comparatively large concentrations of chromium; first-cycle decontamination waste from the bismuth phosphate process contained an abundance of aluminum, and comparatively large amounts of bismuth and phosphate.

No further activity occurred at tank 241-U-204 until the tank was nearly emptied in 1977. It was designated inactive and interim stabilized in 1978. The fill history of this tank is presented graphically in Figure 2-4.

A preliminary estimate of the major waste constituents of Tank 241-U-204 can be developed based on the tank's history. The tank layer model (Agnew 1995) is a computer model developed by Los Alamos National Laboratory to predict the chemical content of Hanford Site waste tanks. The model's predictions are presented in the historical tank content estimate (HTCE) documents (Brevick et al. 1994a and 1994b). Estimates of the solid

Figure 2-1a. Hanford Site 200 West Area Layout.



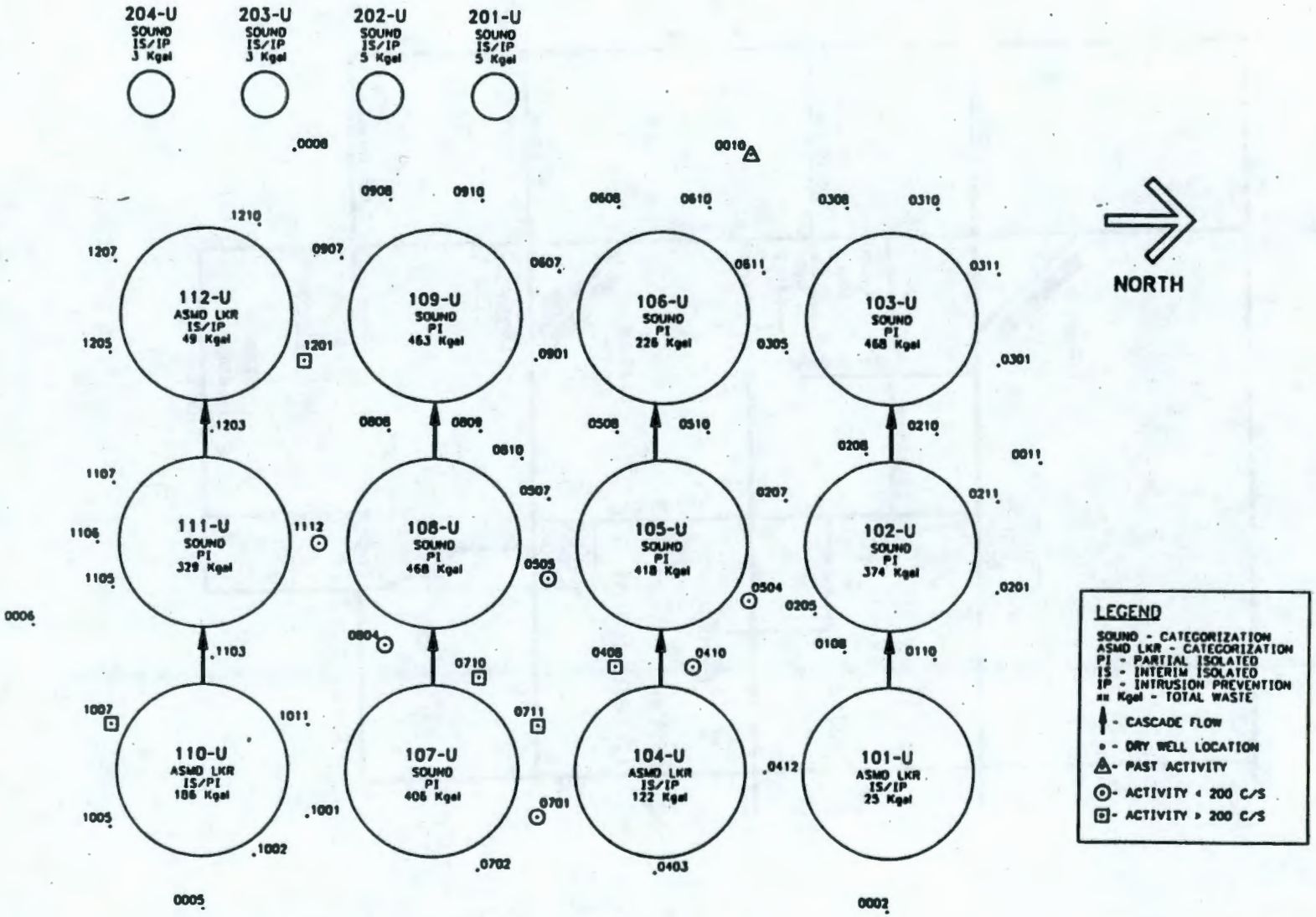


Figure 2-1b. U Tank Farm Layout.

Figure 2-2. Design Data for Tank 241-U-204.

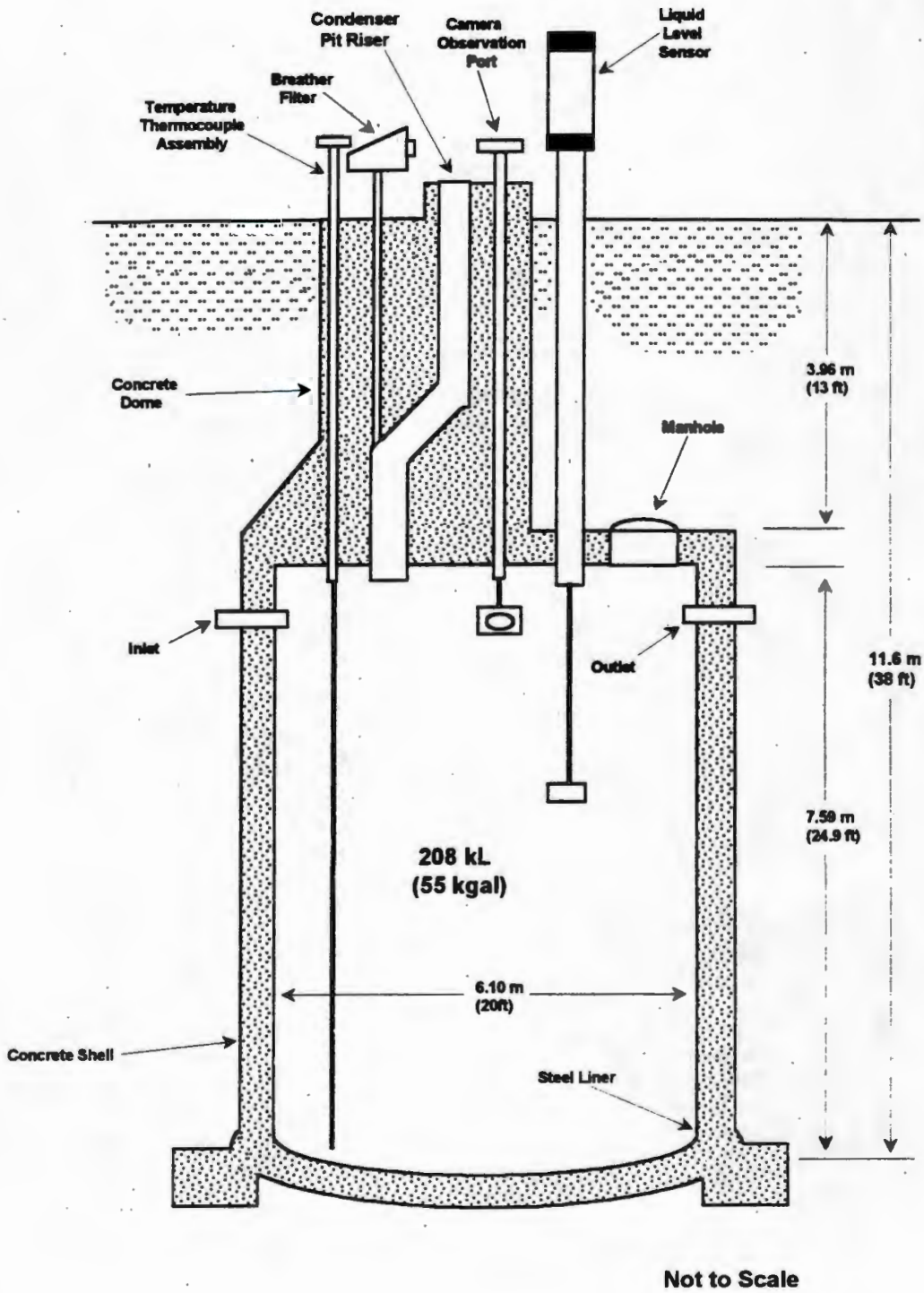
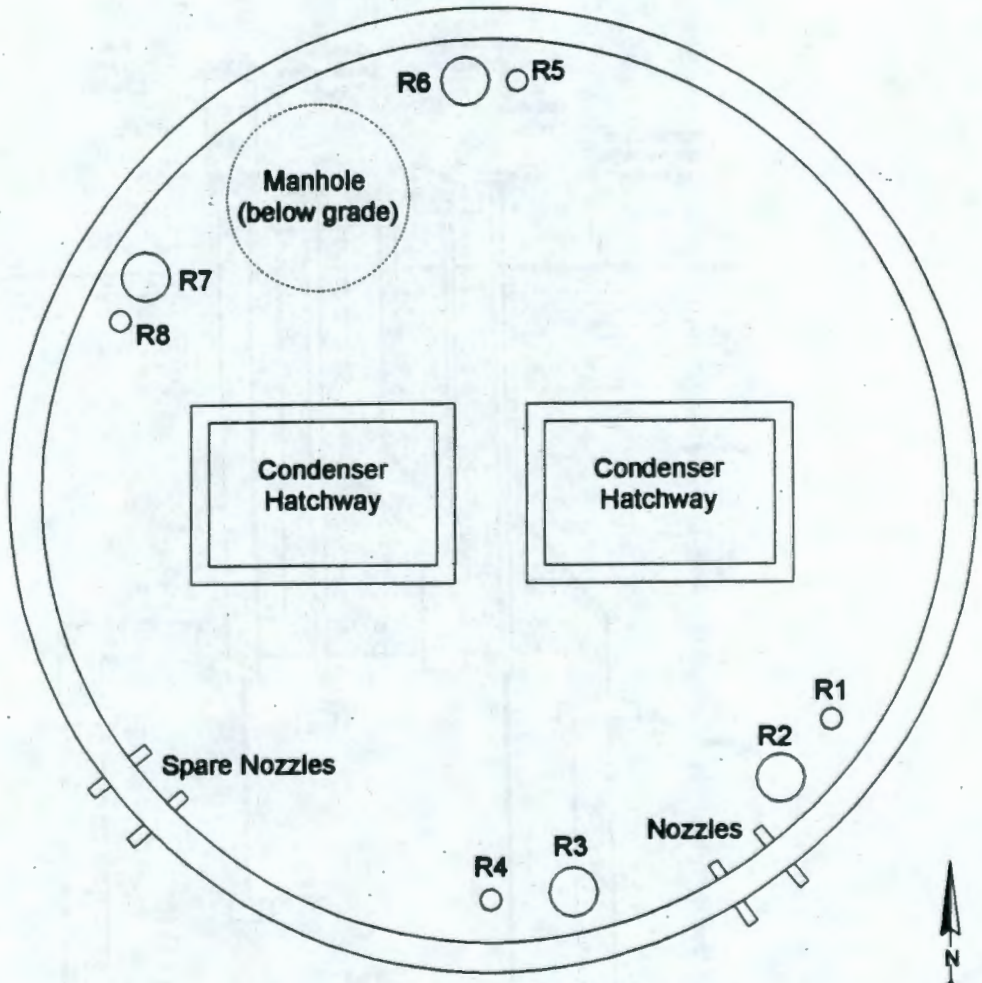
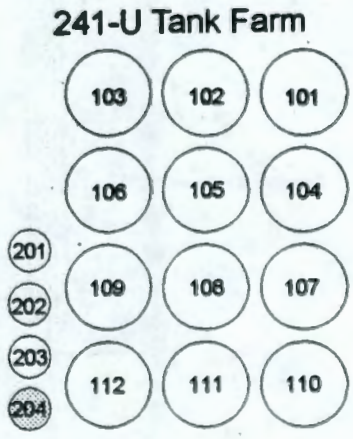


Figure 2-3. Tank 241-U-204 Riser and Equipment Configuration.



No.	Dia.	Description
1	4"	Manual Tape
2	12"	Not used
3	12"	Not used
4	4"	Thermocouple Tree
5	4"	Weather covered
6	12"	Observation Port
7	12"	Dip Tubes
8	4"	Breather Filter



Sources:
Vitro Engineering 1986

and liquid waste layers residing within a tank are derived based on an analysis of transfer records. The tank layer model also provides a volumetric and chronological description of the tank inventory based on defined wastes. The accuracy of the tank layer model is dependent on the completeness and accuracy of the transfer history and waste stream composition definitions (Those estimates carry a considerable amount of uncertainty because of the numerous assumptions made due to the limitations of the historical process and waste handling documentation). For the HTCE, the tank layer model assumed the sludge in tank 241-U-204 consisted entirely of CWR. The estimated composition of CWR waste is shown in Appendix B (table B-1). The HTCE for solids contained in tank 241-U-204 is presented in Table 2-2. The HTCE inventory for the supernatant waste in this tank was not available as this report was compiled.

Based on tank 241-U-204's process history, the waste in the tank should consist of sludge that settled from the CWR transferred to the tank in 1956, and supernate from the CWR and waste water. The waste components of largest concentration are expected to be aluminum, hydroxide, and nitrate. The tank may also contain some chromium from REDOX high-level waste that may have been mixed with the CWR. Some hydroxide, sodium, nitrate, phosphate, bismuth, iron, and fluoride may have been contributed to the waste by the dilute REDOX high-level waste and second-cycle decontamination waste flush water added to the tank in 1954. The tank's process history does not indicate it would likely contain significant amounts of organic complexants. The tank does not contain ferrocyanide, nor significant amounts of transuranics.

2.4 SURVEILLANCE DATA

The waste surface level within tank 241-U-204 is measured with a manual tape device through riser 1 (see Figure 2-2 for the location of this riser). Surface level measurements are recorded on a daily basis (Brevick et al. 1994a). The manual tape gauge consists of a reel-mounted calibrated steel tape to which an electrically conductive plummet is attached. Normally, the plummet is lowered until it contacts a conductive waste surface, completing the electrical circuit. A measurement precision of plus or minus ≈ 1.3 cm (0.5 in.) has been established for Hanford Site manual tapes measuring a liquid surface (Johnson 1995).

Tank 241-U-204 is assumed to have a partial liquid surface under the manual tape probe; the specification limit for such waste surfaces has been set at $\approx \pm 5$ cm (± 2 in.).

A surface level measurement of 44.5 cm (17.5 in.) was recorded April 3, 1995. Historical surface level data for the period 1980 to 1985 were available from the Surveillance Analysis Computer System database, and are plotted in Figure 2-5; the plot indicates the waste level has been relatively stable, with the measurements remaining near the baseline value of 45.1 cm (17.8 in.).

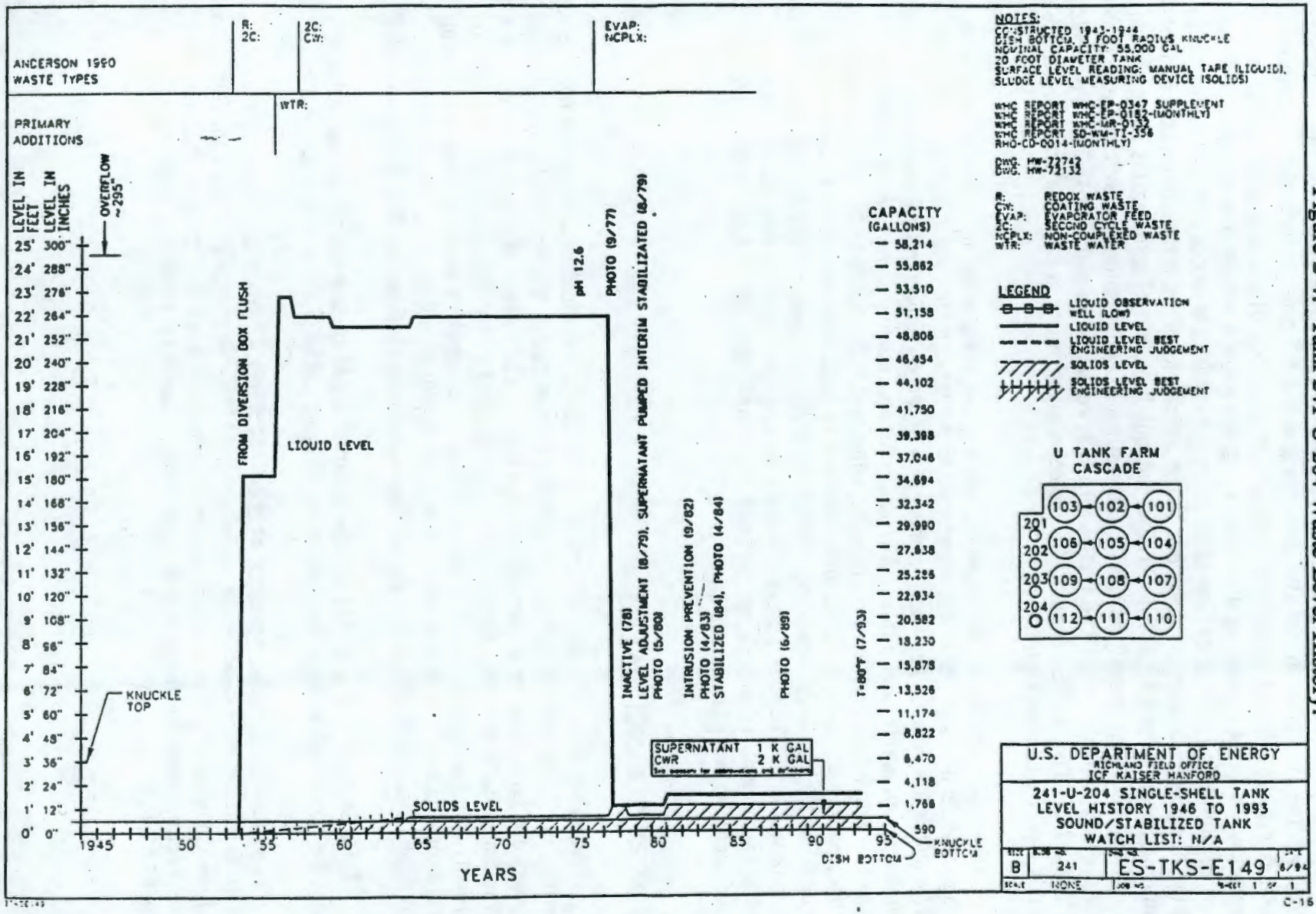


Figure 2-4. Tank 241-U-204 Waste Level History.

In-tank temperatures are monitored via a single thermocouple tree, equipped with 16 thermocouple probes, entering tank 241-U-204 at riser 4 (Tran 1993). Elevations for the probes are not available; however, the thermocouple with the lowest number is generally the lowest thermocouple in a particular tree). Measurement error can vary depending on thermocouple type (the specific type of thermocouples used in this tank are not available) and installation method; average error can vary from ±1 °C to 3 °C (±2 °F to 6 °F), while maximum error can vary from ±1.5 °C to 12 °C (±3 °F to 22 °F)(Scaief 1991).

Only very limited data are available prior to 1994 from the Surveillance Analysis Computer System; with a few exceptions, data are available from thermocouples 1 through 11 after May 1994. No temperature data prior to 1975 are reported in the HTCE documents. Maximum temperature readings and means for all thermocouple readings from this tank between March 1980 and June 1995 are plotted in Figure 2-6. Temperatures during this time period ranged from a minimum of 1.6 °C (35 °F) at thermocouples 3 to 16 on January 1, 1988 (not plotted) to 31.6 °C (89 °F) at thermocouple 1 on July 11, 1994. These temperatures are within the design limits of the tank (WHC 1994). Table C-1 contains the most recent excerpt of CASS-generated temperature data accessed through TWINS.

The interior of tank 241-U-204 was most recently photographed June 13, 1989 (Hanlon 1995). A montage of the photographs is presented in Figure 2-7. The photographs show a dark yellow supernatant surface surrounded by a light yellow sludge peppered with dark material[1] (Brevick et al. 1994a). Discarded measurement tapes, resting on the sludge, can be seen through the supernate. A thermowell can be seen in the foreground. The bright white area near the thermowell is the reflection of the camera strobe light. A manual tape and a temperature probe are located near the top of the montage. No transfer activity has occurred since the photographs were obtained; therefore, the photographs are expected to relatively represent the current contents of the tank.

[1] Most likely due to lighting effects

Figure 2-5. Tank 241-U-204 Surface Level Measurements 1980 to 1995.

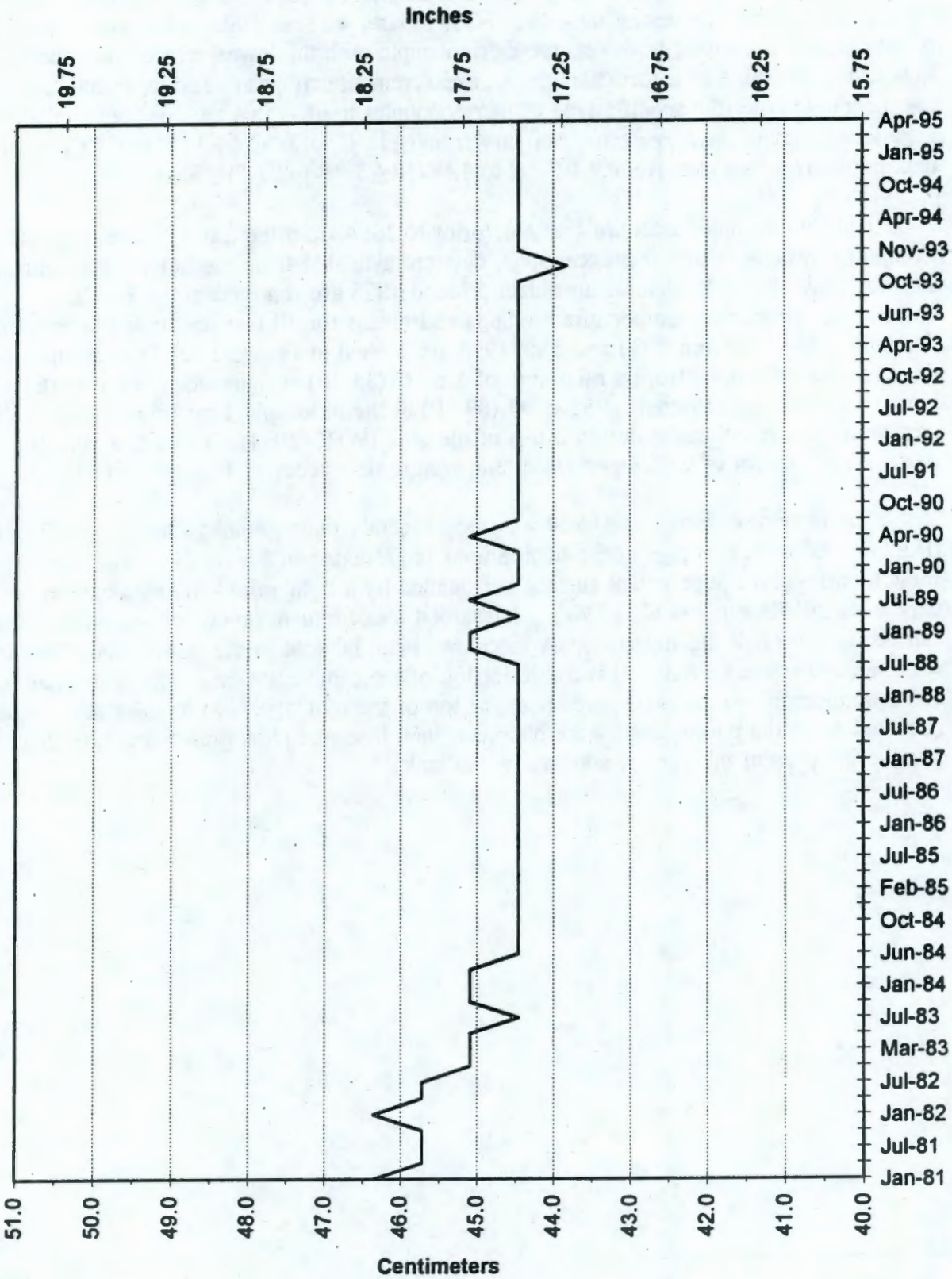
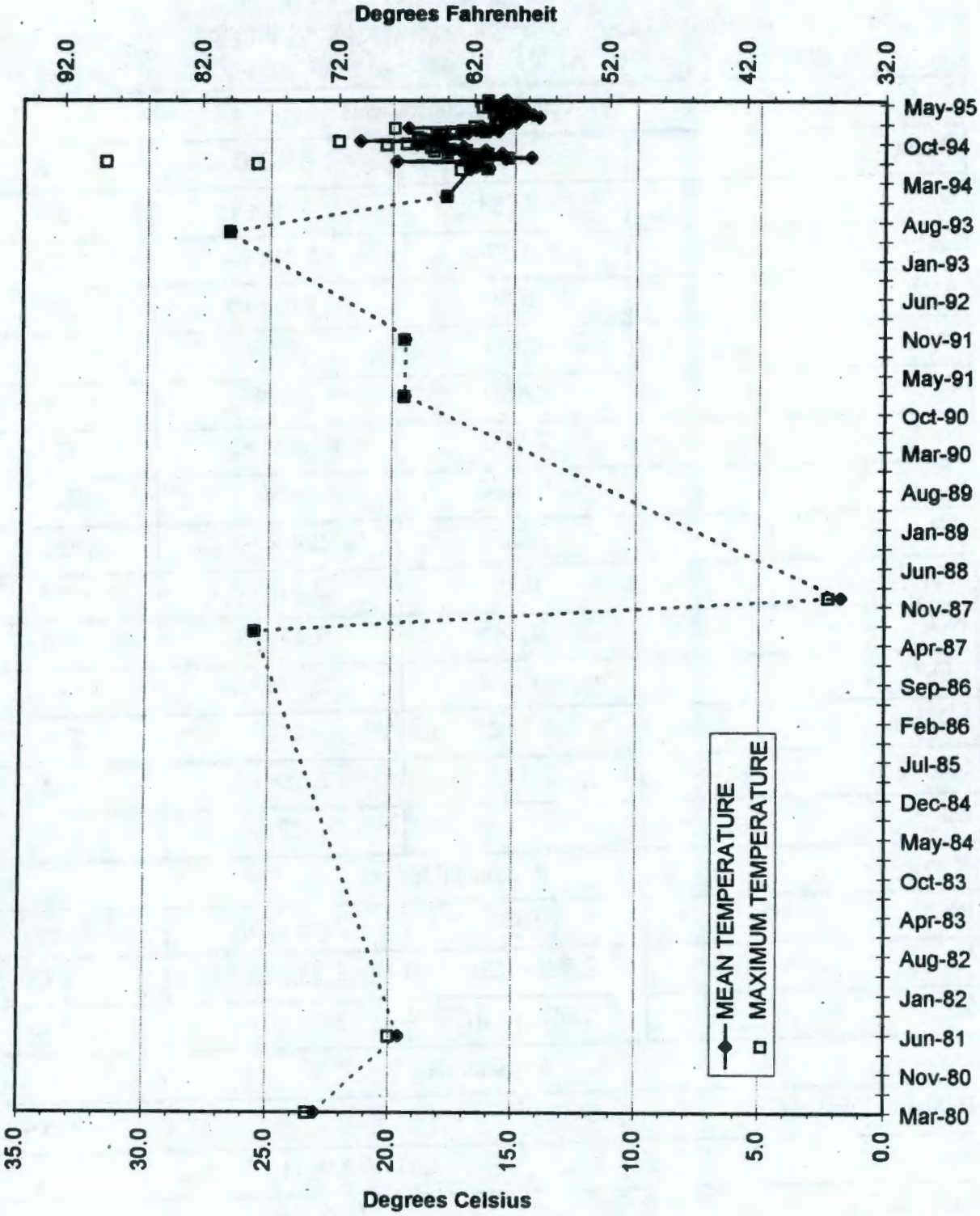


Table 2-2. Tank Layer Model Contents Estimates (Brevick et al. 1994)

Property/constituents	Estimated concentration moles/L	Estimated concentration μg/g	Estimated inventory kg
Chemical constituents			
Water	NR	653000	NR
U	0.183	2.8e+4	331
Na^{+}	3.57	5.26e+4	621
Al^{+3}	6.26	1.08e+5	1280
Fe^{+3}	0.471	1.68e+4	199
Cr^{+3}	6.61e-3	220	2.6
Ni^{+2}	2.9e-2	1.09e+3	12.9
Sr^{+2}	1.14e-2	639	7.55
OH^{-}	22.7	2.47e+5	2.92e+3
NO_3^{-}	0.79	3.14e+4	371
NO_2^{-}	1.16	3.41e+4	403
CO_3^{-2}	6.42e-2	2.47e+3	29.2
SO_4^{-2}	3.3e-2	203	2.4
SiO_3^{-2}	0.144	2.58e+3	30.5
Cl^{-}	9.84e-3	223	2.64
Radionuclides			
Pu	NR	1.68 μCi/g	30 kg
Cs	2.85e-3 Ci/L	1.83 μCi/g	21.6 Ci
Sr	2.67e-3 Ci/L	1.71 μCi/g	20.2 Ci
Physical data			
Total solid waste (kg)			1.18e+4
Heat Load	2.37e-4 KW (1 BTU/hr)		
Bulk density	1.56 g/mL		
Void fraction	0.814		

Figure 2-6. Tank 241-U-204 Temperature History - 1980 to 1995.



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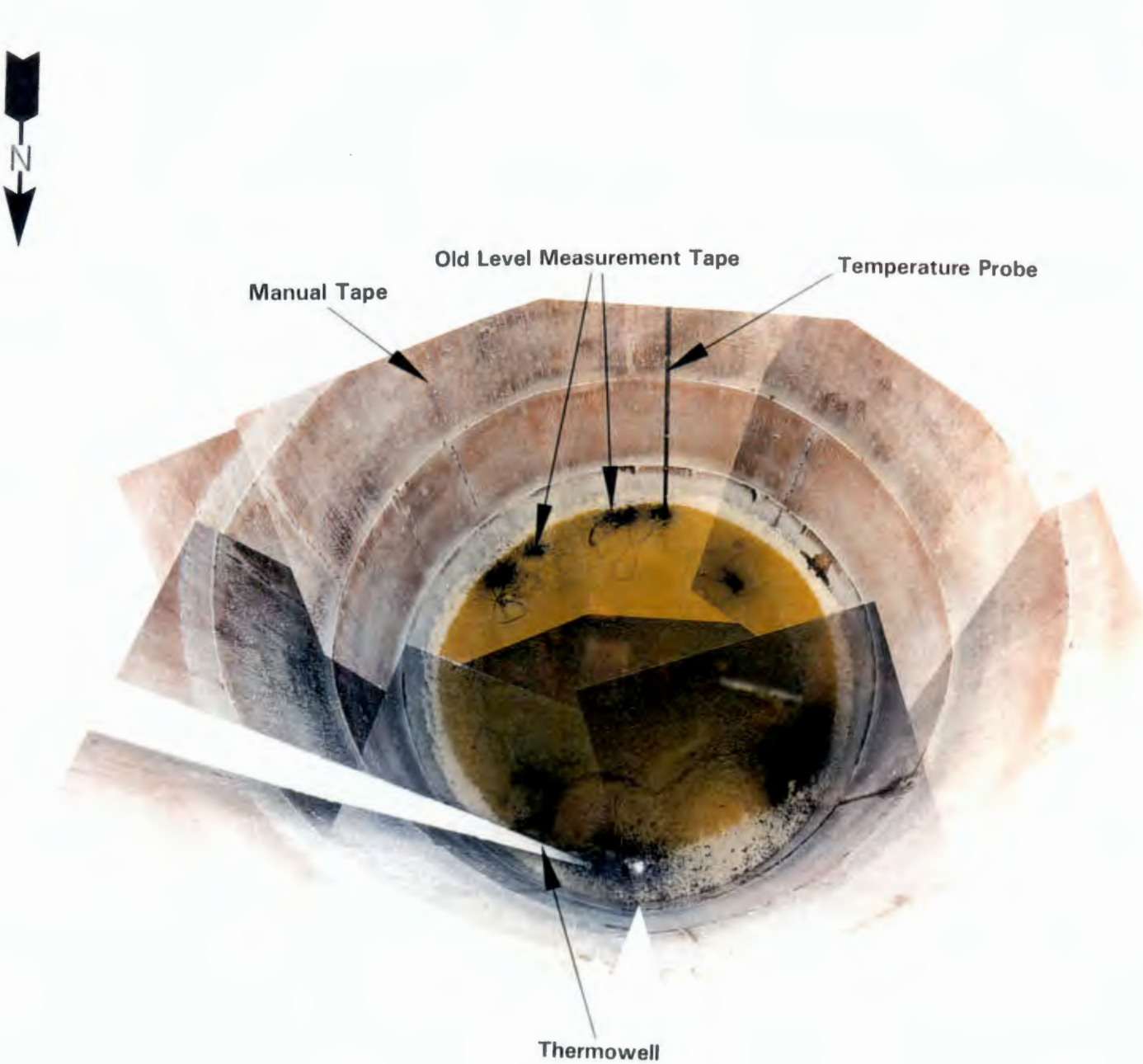

Figure 2-7. Photo Montage - Tank 241-U-204 Interior.

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3.0 TANK SAMPLING AND ANALYSIS OVERVIEW

Three sampling events are recorded for the tank 241-U-204. The first, in 1975, prior to any waste mitigation activities, consisted of a liquid phase supernatant sample. No other information such as riser location or sampling equipment were specified. The second sampling event happened in 1978. A sludge sample was retrieved and analyzed for select physical properties, radionuclides, and chemical constituents. Again, no other information are available.

The third and most recent sampling event, in April 1995, was the result of safety concerns associated with the tank. Those concerns were based on waste processing histories' statistical estimates (Toth et al. 1994) that indicate tank 241-U-204 might contain organic complexants such as acetate or oxalates which, in an oxidizer-rich environment such as one containing sodium nitrate, could pose a combustion hazard. The tank was consequently added to the Organic Watch List (Babad et al. 1994). Data quality objectives (DQOs) outlining characterization information requirements were developed for tanks on the Organic Watch List. In addition, safety screening DQOs were prepared to identify other possible safety issues associated with the Hanford Site tanks, and consequently classify the tanks in three categories; Safe, Conditionally Safe, and Unsafe[2]. The April 1995 sampling event adhered to the requirements and guidelines of those DQOs. Push-mode core sampling equipment and protocols were used. Information relative to the sampling system specifications and procedure numbers can be found in the Tank Characterization Reference Guide (DeLorenzo et al. 1994) and the sampling event work package (#WS-95-034). No unusual occurrences were recorded during sampling or transportation. Target analyses for the 1995 sampling event were waste reaction potential, water and organic carbon contents, and radiochemical activity. The detailed suite of analyses, developed based on the requirements of the appropriate DQOs, can be found in the tank's sampling and analysis plan (Bell 1995a).

Tank headspace vapor data is not currently available. A vapor sampling event is scheduled to start July 21, 1995 to satisfy the requirements of the generic in-tank health and safety vapor issue resolution DQO (Osborne 1994). Six SUMMA[3] canisters, twelve triple-sorbent traps, and six sorbent traps will be used as the sampling media, coupled with the appropriate chemical analysis, to address flammability and toxicity potentials in the tank's headspace.

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[2]A brief summary of the safety screening and organic DQOs can be found in the *Tank 241-U-204 Tank Characterization Plan* (Bell 1995a).

[3]Trademark of Molectrics, Inc., Cleveland, Ohio.

3.1 DESCRIPTION OF SAMPLING EVENT - 1995

Two push-mode core samples were collected[4] through risers 2 and 6 on April 5, 1995. One segment resulted per core, as expected based on the measured waste level in the tank. The samples were shipped to the Westinghouse Hanford Company 222-S Laboratory hot cell on April 6, and were extruded on April 7, 1995. No exceptions, modifications, or unusual weather conditions were reported.

The sampler hydraulic fluid was spiked with LiBr tracer. No lithium was found in the sample aliquots, indicating that the samples were not contaminated by the hydraulic head fluid. Drill string readings were 70 millirem per hour (mR/hr) for core 81 (Riser 2), 25 mR/hr for core 82 (Riser 6), and < 0.05 mR/hr for the field blank. Chain of custody records were completed for each core sample and contain relevant sampling data (copies can be found in the 1995 sampling event data package [Bell 1995c]).

3.2 DESCRIPTION OF SAMPLE PREPARATION AND ANALYSIS - 1995

The core samples were extruded and sub-sampled in the 222-S Laboratory hot cell as outlined in the hot cell work plan. No unusual occurrences, such as equipment failure or liquid seepage into the casks' liners, or exception from quality assurance/quality control procedures, were reported. Hot cell temperature was reported at 28 °C (83 °F) and relative humidity between 25 and 33 percent.

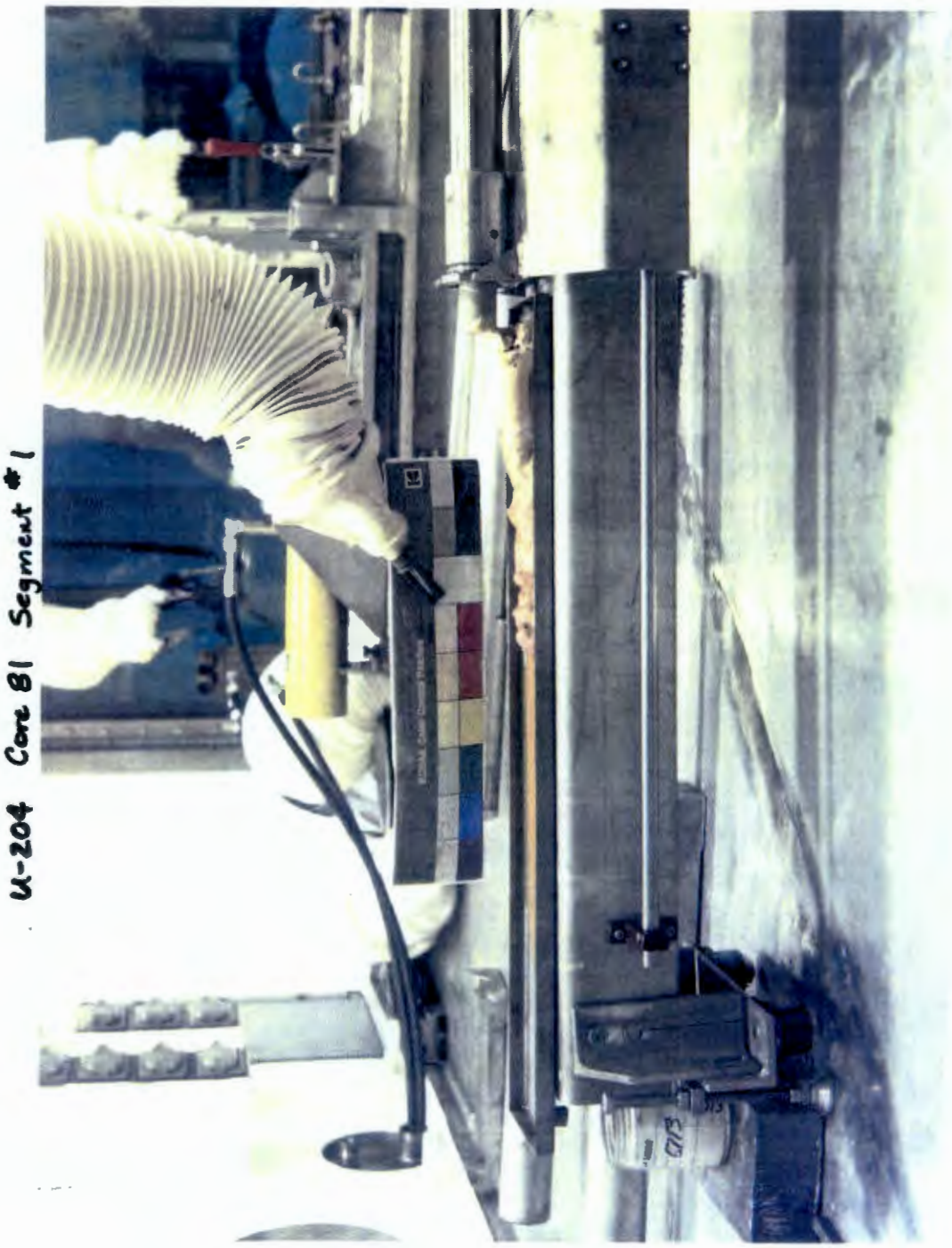
Hot cell sampling and sub-sampling instructions/flow charts can be found in the tank's sampling and analysis plan (Bell 1995a). Aliquots were taken from both homogenized solid and drainable liquid samples to satisfy preparation, analysis, and archiving requirements. Table 3-1 summarizes sample and analysis information. The two extruded core segments are shown in Figures 3-1 and 3-2. Corresponding photo negatives, original photos, and a video recording of the extrusion events, are archived and can be accessed by contacting the cognizant scientist in the hot cell facility. Hot cell chemist physical observations are found in Table 4-2.

No freestanding organic layers were observed in the drainable liquid samples. Sample recovery was reported at 100 percent for core 81 and 70 percent for core 82.

Lithium was analyzed by inductively coupled plasma spectroscopy (ICP) on KOH fused sample aliquots. Other peripheral analytes were also part of the ICP analytical matrix, and are presented in Appendix G.

[4]Rotary truck was used in push mode

Figure 3-1. Core 81 Segment Extrusion.



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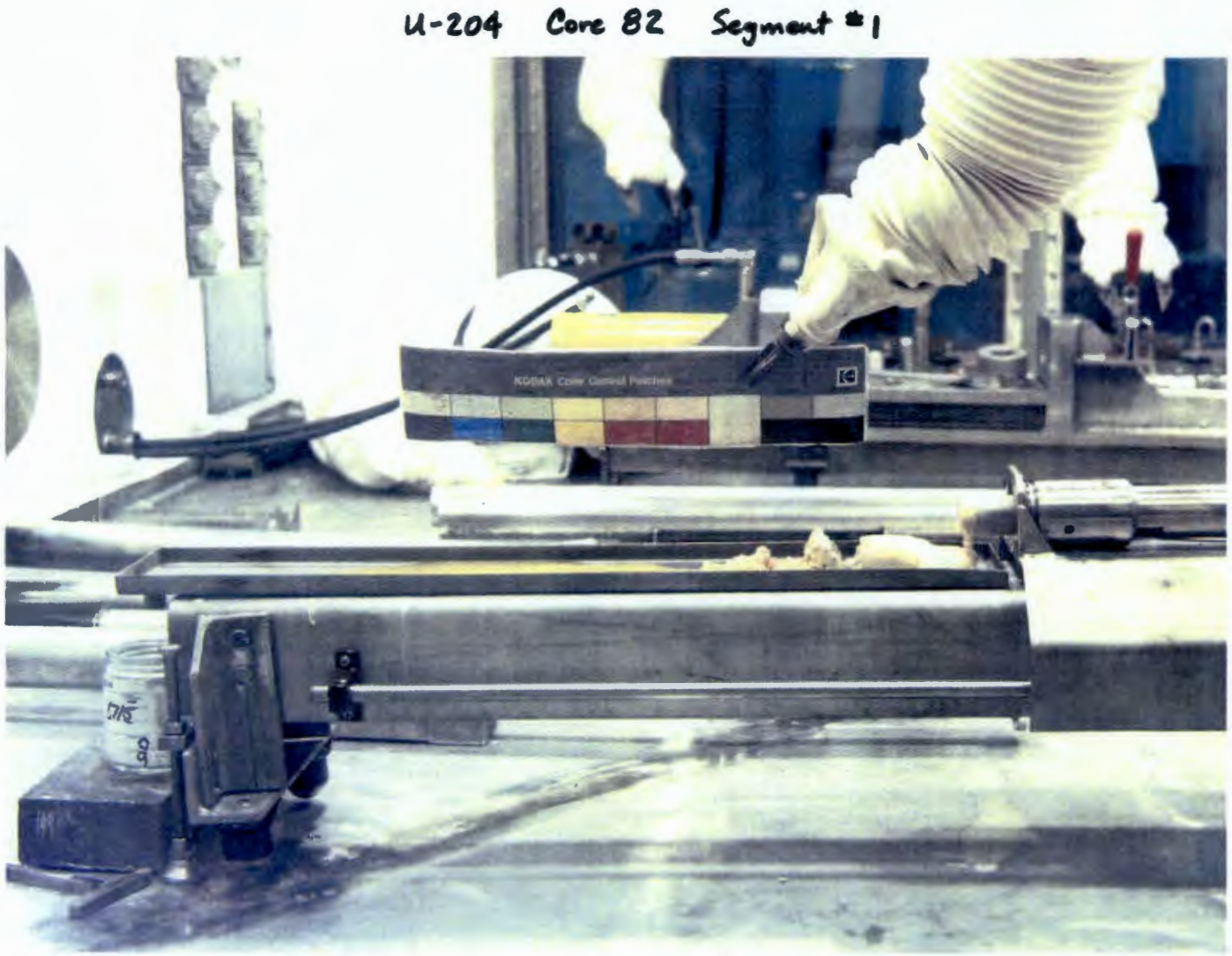

Figure 3-2. Core 82 Segment Extrusion.

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Table 3-1. Sample and Analysis Information (Bell 1995c).

Core	Subsample	Weight grams	Aliquot weight grams	Sample numbers (LabCore)	Correspondent analysis / destination
81 (riser 2)	Upper half of segment	193.78 20 cm (≈8 in. long)	7.45	S94T000712 S94T000717 S94T000721	TGA, DSC, TOC/TIC Li, Total α
			59	S95T000727	Archive
81	Drainable liquid (lower half of segment)	174.56	10.84	S94T000714 S94T000719 S94T000723	TGA, DSC, TOC/TIC, Li
			41.22	S95T000714	Archive
82	Upper half of segment	126.6 15 cm (6+ in. long)	11.95	S95T000713 S95T000718 S95T000722	TGA, DSC, TOC/TIC Li, Total α
			59.02	S95T000729	Archive
82 (Riser 6)	Drainable liquid	96.28	10.78	S95T000715 S95T000720 S95T000724	TGA, DSC, TOC/TIC, Li
			43.5	S94T000731	Archive
Field blank	Liquid	244.7	40.76	S95T000716 S95T000732	Organic layer (vis.) TGA, DSC, TOC/TIC
		23.05	NA	S95T000726	NA

Notes:

DSC = Differential scanning calorimetry
TGA = Thermo-gravimetric analysis
TOC/TIC = Total organic carbon/total inorganic carbon

Table D-1 contains corresponding analytical methods numbers. Outlines of those methods can be found in the Tank Characterization Reference Guide (DeLorenzo et al. 1994).

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4.0 ANALYTICAL RESULTS AND WASTE INVENTORY ESTIMATES

4.1 OVERVIEW

This section summarizes available characterization data as shown in table 4-1. Three sampling and analysis events are recorded, 1975, 1978, and 1995. 1995 results may be used for decision purposes while other results are presented to provide background information.

No method references are available for the 1975 and 1978 data. Since the tank was interim stabilized by pumping out excess liquid in 1977, the 1975 data may not represent the current composition of the supernatant.

The 1995 core samples were analyzed to satisfy Safety Screening and Organic Safety DQOs (Babad and Redus 1994, Babad et al. 1994). One segment was recovered per core. 1978 and 1995 analytical data are used to derive an approximate tank inventory.

4.2 DATA PRESENTATION

Table 4-2 summarizes observation data for the 1978 and 1995 samples. The 1995 observations were reported by the laboratory hot cell chemist. Sample recovery is discussed in Section 3.0. Additional field and laboratory observations with characterization relevance are discussed in Section 5.0.

Table 4-3 summarizes all the 1995 analytical data for tank 241-U-204. Waste reaction potential of the 1995 core samples was assessed using differential scanning calorimetry (DSC). No exotherms were found up to 500 °C (932 °F).

Thermo-gravimetric analysis (TGA) was used to evaluate moisture content. Copies of the TGA charts can be found in the 45-day report or the final 216-day report (data package) (Bell 1995b and 1995c). A total of four data points from both cores (two measurements from each core sample) were collected. The range was between 21.84 percent (riser 6) and 29.56 percent (riser 2). Drainable liquids from both core samples were also analyzed by TGA. Both samples contained approximately 86.7 percent water and no organic layers (Table 4-3 contains detailed data).

Total alpha activity for core 82 (riser 6) was equivalent to the blank reading in the two data points collected. Core 81 (riser 2) results were also close to the blank and instrument detection limit (IDL).

Table 4-1. Appendices Analytical Cross References.

Sample type	Riser location	Date reported	Analysis/Data	Table #
Supernatant liquid	Not reported	1975	Water %, pH, specific gravity, GEA (Cs,Sr), cations, anions	A-1
Solid sample	Not reported	1978	Water %, water solubility, bulk density, radionuclides and ions (water soluble and acid fusion)	A-2
Solid	Riser 2	1995	Water %, TOC, TIC, DSC exotherm, total alpha, lithium	4-3
Drainable liquid	Riser 2	1995	Water %, TOC, TIC, DSC exotherm, lithium	4-3
Solid	Riser 6	1995	Water %, TOC, TIC, DSC exotherm, total alpha, lithium	4-3
Drainable liquid	Riser 6	1995	Water %, TOC, TIC, DSC exotherm, lithium	4-3
Solid	Risers 2 and 6	1995	Peripheral[1] ICP metal data	G-1
Drainable liquid	Risers 2 and 6	1995	Peripheral[1] ICP metal data	G-2/ G-3
NA/tank layer model	NA	1994	Water %, void fraction, density, cations, anions, Pu, Cs, Sr	2-2
NA/CASS temperature data	Riser 4	1995	Temperature	C-1
NA/sample and method information	NA	1995	TGA, DSC, TIC, TOC, Total α, lithium	D-1

Notes:

CASS = Computer Automated Surveillance System
DSC = Differential scanning calorimetry
GEA = Gamma energy analysis
ICP = Inductively coupled plasma spectroscopy
NA = Not applicable
TGA = Thermo-gravimetric analysis
TOC/TIC = Total organic carbon/total inorganic carbon

[1]Generated during analysis for lithium. Those data were not requested and hence were not validated

Table 4-2. Observed Waste Properties - 1978 and 1995 Samples (Horton 1978 and Bell 1995).

Sample location	Date	Color	Consistency
Not reported	1978	Chalky white	Brittle solids
Riser 2	1995	Turbid orange-brown	Liquid
Riser 2	1995	Medium brown (first 5 cm [2 in.]) Cream (last 10 cm [4 in.])	Smooth sludge
Riser 6	1995	Turbid yellow	Liquid
Riser 6	1995	"Burnt" cream	Wet and crumbly solids (first 10 cm [4 in.]) Smooth sludge (final 7.6 cm [3 in.])

Total organic and inorganic carbon concentrations were reported following hot persulfate oxidation and coulometry analysis[5]. Both inorganic and organic carbon concentrations were higher in core 81 samples.

Potassium hydroxide fused samples were ICP analyzed for lithium. The reported concentrations were all below the instrument detection limit.

1978 anion and cation data are used for the inventory estimates reported in tables 5-5 and A-3. When both water extraction and acid digestion results are available for a certain analyte, the highest reported concentration is used. It is presumed that all results are reported on a per wet basis.

The following formula was used to covert μg/g-wet to kg:

kg analyte = (μg analyte/g wet waste)*(1.3 g wet waste/mL wet waste)*(1e3 mL/L)*(1e-9kg/μg)*(3.79L/gal)*2000 gal wet waste[6]

[5] Note that though TIC analysis was not requested, little additional effort was required to collect TIC data since inorganic carbon must be sparged from the sample during TOC determination.

[6] Value of waste sludge reported post the third quarter of 1977.

Table 4-3. 1995 Sludge Samples Analytical Results - Wet Basis (Bell 1995c).

Core	Riser	Segment portion	Method	Primary Result	Duplicate Result	Average	Units
Physical properties - water content							
81	2	Upper	TGA	29.12	29.56	29.34	%
81	2	Drainable liquid	TGA	86.46	86.89	86.67	%
82	6	Upper	TGA	24.18	21.84	23.01	%
82	6	Drainable liquid	TGA	87.18	86.18	86.68	%
Chemical properties - total organic carbon (TOC)							
81	2	Upper	Persulfate/ Coulometry	807	823	815	μg/g
81	2	Drainable liquid	Persulfate/ Coulometry	90.8	73.2	82	μg/mL
82	6	Upper	Persulfate/ Coulometry	120	128	124	μg/g
82	6	Drainable liquid	Persulfate/ Coulometry	<80	<80	<80	μg/mL
Total inorganic carbon (TIC)							
81	2	Upper	Acid/coulometry	1310	1300	1305	μg/g
81	2	Drainable liquid	Acid/coulometry	2240	2220	2230	μg/mL
82	6	Upper	Acid/coulometry	719	774	746	μg/g
82	6	Drainable liquid	Acid/coulometry	2100	2180	2140	μg/mL
Radiochemical properties							
81	2	upper	Total α	0.0967	<6.23e-1	0.0967	μCi/g
82	6	upper	Total α	<4.36e-2	<4.4e-2	NA	μCi/g

5.0 INTERPRETATION OF CHARACTERIZATION RESULTS

This section assesses the overall quality of the data reported for the tank 241-U-204. In addition, waste species and possible layering are postulated based on these data and scientific and engineering knowledge. Finally, these results are shown to satisfy, or not, the applicable program requirements, otherwise termed data quality objectives (DQOs).

5.1 ASSESSMENT OF SAMPLING AND ANALYTICAL RESULTS

Sample extrusion and subsampling in 1995 proceeded as planned using the appropriate quality assurance/quality control measures. As mentioned in Section 4.0, no organic layers were observed in drainable liquids from core 81 and 82 samples.

No quality control or other supporting pedigree is available for the 1975 and 1978 data. The 1978 data cannot be used to determine the contents of the tank. However, this data, as well as the non-validated 1995 ICP data, could be used as a baseline or reference for future characterization events.

The 1995 core sampling results consisted of a suite of five analytical methods; TGA for water content, DSC to assess energetic behavior, persulfate oxidation/coulometry to determine TOC/TIC content, KOH fusion plus ICP analysis for lithium (and other metals), and KOH fusion/Total α to evaluate alpha activity. Table 5-1 is a summary of the data quality as reported in the 45- and 216-day reports (Bell 1995b and 1995c). Criteria relevant to quality assurance/quality control assessments can be found in the relevant laboratory documents as well as in the tank characterization plan and sampling and analysis plan (Bell 1995a).

Drainable liquid and sludge samples showed a normal water evaporation endotherm at approximately 100 °C (212 °F) during DSC analysis. A quantitatively less significant endotherm, confirmed by duplicate analysis, was detected at about 160 °C (320 °F) for the drainable liquid samples. Sludge samples showed a significant endotherm spanning between approximately 200 °C (392 °F) and 320 °C (608 °F), with a peak at 295 °C (563 °F). This observation was reinforced by the TGA scans, which also show the associated sample weight loss. Copies of the sludge samples' DSC and TGA scans are shown in Appendix E. One possible explanation of this behavior is the occurrence of a phase transformation with release of vapor, most likely water resulting from bound water of hydration plus other gases resulting from fusion and/or degradation of nitrates and nitrites. Further discussion on this subject is found in Section 5.3.

Table 5-1. Data Quality Summary - 1995.

Sample #	Sample type	Standard % recovery	Passes lab QC?	Detection limit	Blank	Indication	Results relative % difference (RPD)	Passes QC?	Spike % recovery	Passes QC?
Water % by TGA										
S95T000717	Core 81 solids	99.59	yes	NA	NA	NA	1.5	yes	NA	NA
S95T000723	Core 81 drainable liquid	100.4	yes	NA	NA	NA	0.5	yes	NA	NA
S95T00718	Core 82 solids	99.59	yes	NA	NA	NA	10.2	≈10%[5]	NA	NA
S95T000724	Core 82 drainable liquid	100.4	yes	NA	NA	NA	1.15	yes	NA	NA
S95T000732	Field blank	99.63	yes	NA	NA	NA	1.59	yes	NA	NA

Table 5-1. Data Quality Summary - 1995.

Sample #	Sample type	Standard % recovery	Passes lab QC?	Detection limit	Blank	Indication	Results relative % difference (RPD)	Passes QC?	Spike % recovery	Passes QC?
DSC exotherms[1]										
S95T000717	Core 81 solids	104.7	yes	NA	NA	NA	NA (no exotherms found)	NA	NA	NA
S95T000723	Core 81 drainable liquid	98.77	yes	NA	NA	NA	NA	NA	NA	NA
S95T000718	Core 82 solids	104.7	yes	NA	NA	NA	NA	NA	NA	NA
S95T000724	Core 82 drainable liquid	98.77	yes	NA	NA	NA	NA	NA	NA	NA
S95T000732	Field blank	100.9	yes	NA	NA	NA	NA	NA	NA	NA
TOC by persulfate / coulometry										
S95T000717	Core 81 solids	91	yes	80 μg/g	21.1 μg/g	No contamination	1.96	yes	112	>110 %[2]
S95T000723	Core 81 drainable liquids	94.33	yes	40 μg/g	35.5 μg/g	No contamination	21.5	>10%[2]	NA	NA

Table 5-1. Data Quality Summary - 1995.

Sample #	Sample type	Standard % recovery	Passes lab QC?	Detection limit	Blank	Indication	Results relative % difference (RPD)	Passes QC?	Spike % recovery	Passes QC?
TOC by persulfate / coulometry (continued)										
S95T000718	Core 82 solids	91	yes	80 μg/g	21.1 μg/g	No contamination	6.45	yes	NA	NA
S95T000724	Core 82 drainable liquids	92.67	yes	80 μg/g	38.2 μg/g	No contamination	NA	NA	NA	NA
Total Inorganic Carbon (TIC)										
S95T000717	Core 81 solids	96.17	yes	5 μg/g	4.2 μg/g	No contamination	0.77	yes	60.5	no[4]
S95T000723	Core 81 drainable liquid	95.17	yes	5 μg/g	2.9 μg/g	No contamination	0.90	yes	NA	NA
S95T000718	Core 82 solids	96.17	yes	5 μg/g	4.2 μg/g	No contamination	7.37	yes	NA	NA
S95T000724	Core 82 drainable liquid	100.7	yes	5 μg/g	4.7 μg/g	No contamination	3.74	yes	NA	NA

Table 5-1. Data Quality Summary - 1995.

Sample #	Sample type	Standard % recovery	Passes lab QC?	Detection limit	Blank	Indication	Results relative % difference (RPD)	Passes QC?	Spike % recovery	Passes QC?
Alpha of digested solids										
S95T000721	Core 81 solids	85.81	no[3]	9.6 e-2 μCi/g	<4.34e-2 μCi/g	No contamination	NA	NA	92.8	yes
S95T000722	Core 82 solids	85.81	no[3]	9.6 e-2 μCi/g	<4.34e-2 μCi/g	No contamination	NA	NA	92.8	yes

Notes:

DSC = Differential scanning calorimetry
QC = Quality control
TGA = Thermo-gravimetric analysis
TIC = Total inorganic carbon
TOC = Total organic carbon

[1]Drainable liquids were not filtered prior to analysis as specified in the sampling and analysis plan (Bell 1995a). However, no exotherms were detected which rendered unnecessary re-analysis of filtered samples.
[2]Even though this result did not meet QC requirements, "no re-runs were requested since all results were more than an order of magnitude lower than the notification limit of 30,000 μg carbon/g or 30,000 μg carbon/mL" (Bell 1995).
[3]"No reruns were requested due to the very low activity of the samples." "All results are at least a factor of 424 below the notification limit of 41 μCi/g" (Bell 1995a, 1995b and 1995c).
[4]No re-analysis was requested since TIC was not part of the requested suite of analysis.
[5]Deemed acceptable by laboratory chemist.

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Table 5-2 summarizes DSC and TGA scan data. Water mass loss in column 3 was calculated based on water heat of vaporization 2261 J/g. Percent mass loss in column 4 was calculated based on the amount of sample used for analysis (reported on scans). For the endotherms detected above 200 °C (392 °F), the evaporating substance is assumed to be water for calculation purposes, but could also be some nitrogen oxide compound as discussed in Section 5.3.

The discrepancy between the DSC calculated values and TGA results for the primary (peak at ≈100 °C [212 °F]) endotherms is attributed to several factors such as sample size and waste sample heterogeneity. Larger discrepancies are found for the secondary endotherms (above 200 °C [392 °F]), indicating that substances other than water are also vaporizing. No residual ash or exhaust data are available for the DSC analysis to generate an accurate comparison.

Table 5-2. Summary of DSC and TGA Results - 1995.

Endotherm peak °C	ΔH mJ	Water mass loss mg	Water mass loss %	TGA results %
Core 81 primary results				
100	10217	4.519	34.66	29.12
295[1]	7995	3.536	27.13	17.18
Core 81 duplicate results				
100	9595	4.244	29.44	29.56
295	9300	4.113	28.53	17.62
Core 82 primary results				
100	10443	4.619	30.150	21.84
295	11389	5.037	32.88	21.18
Core 82 duplicate results				
100	7376	3.262	22.60	NR
295	11166	4.939	34.21	NR

Note:

[1]287 °C reported in TGA scans.

Table 5-3 presents an electrolyte charge balance based on the 1978 analytical data. Water extraction results are termed water soluble, while acid fusion results are termed insoluble. The reported density of 1.31 g/mL is used to generate the normality values. Because data are not comprehensive, a considerable uncertainty is introduced in the actual total anion and cation concentrations as well as the total electrolyte balance. The acid fused samples were not analyzed for sodium, but based on background knowledge of Hanford Site tank waste, one can postulate that sodium is usually associated with highly soluble nitrites or nitrates, and the ratio of insoluble to soluble sodium is usually on the order of 1.5.

If aluminum and silicates are postulated to exist as neutrally charged species such as hydroxides and silica, the charge balance for the insoluble matrix reduces to 0.0009 cations while the ratio of cations to anions increases to approximately 1.00.

Chemical species postulates can provide a more accurate account of the amount of waste in the tank. Hanford Site tank waste experience, coupled with an understanding of chemistry and chemical thermodynamics, is a useful tool. The focus in this case is on species found in considerable concentrations from both water extraction and fusion digestion (refer to Table 5-5). Table 5-4 reports the corresponding stoichiometric balance (see Appendix F for a detailed version of the table).

As shown, the postulated species mass balance accounts for about 100 percent of the sludge material in the tank. The calculated waste weight based on those species corresponds well with the calculated sludge weight based on in-tank level measurements. This agreement indicates that the postulated combination and concentrations of those species are good estimates of the tank's waste contents.

5.2 COMPARISON OF THE 1978 AND 1995 ANALYTICAL DATA

Water content, Pu activity, and sludge color and consistencies are information reported in both data sets. Water content and Pu activity agreed, while the physical descriptions of the sludge slightly differed. That difference is attributed to several factors, such as human perception, waste aging, or any other events that occurred in the tank prior to intrusion prevention implementation.

Tank layer model calculated concentrations were also higher than analytical values for most reported analytes (refer to Table A-3).

Table 5-3. Comparison of Water Soluble and Water Insoluble Electrolytes Concentration (1978 data).

Electrolyte	Water soluble matrix	Water insoluble matrix
Cations	Normality	
Na^{+}	0.570	NR
Al^{+++}	0.073	28.53
K^{+}	0.002	NR
Mn^{+}	1.67e-6	NR
Fe^{+2}	0.0002	0.014
Ni^{+2}	0.0002	0.178
La^{+3}	0.565	0.141
Hg^{+1}	0.0007	0.007
Bi^{+++}	0.002	0.019
Total cations	1.213	28.88
Anions	Normality	
OH^{-}	0.385	0.005[a]
F^{-}	0.005	0.276
Cl^{-}	0.004	NR
$NO2^{-}$	0.085	NR
$CO3^{-2}$	0.262	NR
$SiO2^{-2}$	2.18e-5	3.799
$NO3^{-}$	0.254	NR
$PO4^{-3}$	0.138	0.055
$SO4^{-2}$	0.136	0.016
$CrO4^{-}$	0.003	NR
Total anions	1.135	4.152
Ratio cations/anions	0.936	0.144
Balance (cations)	0.078	24.73

Notes:

NR = Not reported

[a]Suspicious result

Table 5-4. Stoichiometric Balance Based on Postulated Waste Species.

Electrolyte	Assumed specie	Specie concentration	Specie to electrolyte ratio	Mass balance	Equivalent mass
Cations		mmol/g	weight ratio	μg/g (wet basis)	kg
Na^{+}	$NaNO_3$	0.435	3.696	37000	360
Al^{+3}	$Al(OH)_3$	7.259	2.888	570000	5600
K^{+}	KCl	Negligible	NA	NA	NA
Mn^{+}	MnO_2	Negligible	NA	NA	NA
Fe^{*}	$Fe(OH)_2$	Negligible	NA	NA	NA
Ni^{+2}	NA	NA	NA	NA	NA
La^{+3}	LaF	0.144	1.137	NC	NA
Hg^{*}	NR	Negligible	NA	NA	NA
Bi^{+3}	$BiPO_4$	0.0048	1.455	(1500) NC	NA
Anions					
OH^{-}	$Al(OH)_3$	2.94	4.353	NC	NA
F^{-}	LaF	0.211	8.316	33000	330
Cl^{-}	KCl	Negligible	NA	NA	NA
$NO2^{-}$	$NaNO_2$	Negligible	NA	NA	NA
$CO3^{-2}$	Na_2CO_3	~0.1	1.767	(11000) NC	NA
$SiO2^{-2}$	SiO_2	1.45	1	87000	860
$NO3^{-}$	$NaNO_3$	0.194	1.371	(16000) NC	NA
$PO4^{-3}$	Na_3PO_4	0.021	3.2	16000	160
$SO4^{-2}$	Na_2SO_4	Negligible	NA	NA	NA
$CrO4^{-}$	NA	NA	NA	NA	NA
Balance				740000	73000
Water				260000	2600
TOC				470	≈5
Total				≈1000000	≈9900
Expected waste mass based on calculated waste volume ≈ 8kL (2,000 gal)					≈9900

5.3 TANK WASTE PROFILE

Table 5-5 summarizes all the analytical data for tank 241-U-204. In addition an inventory is calculated based on the discussion and formula presented in section 4.2. Note that the total inorganic carbon (TIC) results were not used to calculate the total inventory (those results were close to those reported in 1978, but did not pass laboratory quality control), while the average organic carbon result was used without any speciation postulates.

Table 5-6 presents data relative to postulated equilibrium chemical species (derived from tables 5-3 and 5-4). A ratio of water soluble to water insoluble concentration is also calculated based on the 1978 sludge data. Other compounds that are most likely present in minor concentrations include chromates, phosphates ($BiPO_4$), carbonates (such as Na_2CO_3), and sulfates (such as Na_2SO_4).

The weight loss associated with the DSC/TGA results above 200 °C (392 °F) (peak at 295 °C [563 °C]) may be attributed to nitric oxide evolution, hydrofluoric acid, and bound hydrate water.

5.4 PROGRAM REQUIREMENTS

Program requirements are outlined in the DQOs. Three DQOs apply to tank 241-U-204: 1) Generic Health and Safety Vapor Issue Resolution (Osborne 1994); 2) Tank Safety Screening (Babad and Redus 1994); and 3) Organic Fuel Rich Tank Safety Issue (Babad et al. 1994).

To satisfy the first DQO, vapor sampling is necessary. No headspace vapor data are currently available for the tank. A vapor sampling event is scheduled to start July 21, 1995. Based on process knowledge and available information about the waste, no flammability concerns are expected to be found. Vapor sampling data will be incorporated or referenced in this report once it becomes available.

The most recent sampling event (1995) was undertaken based on the Safety Screening and Organic Safety DQO requirements. The Safety Screening DQO's objective is to classify the tank in one of three safety categories: safe, conditionally safe, or unsafe, based on fuel content (energetics), flammable gas concentration, and alpha activity (Pu, total α). The Organic DQO (Babad et al. 1994) primarily requires fuel content analysis.

The sampling and analysis plan outlined the analytical path to satisfy both DQOs. "Primary" water, energetics, and activity analyses showed that it was unnecessary to proceed with the secondary analysis (refer to TCP and sampling and analysis plan [Bell 1995a]). No exotherms or high amounts of organics were found in the waste samples. Table 5-6 lists the DQO criteria (action limits) and the corresponding analytical findings.

Table 5-5. Tank Waste Profile - Physical Properties and Major Waste Constituents.

Analyte	Method/ year	Number of data points	Average Analytical Result	Calculated inventory kg
Physical properties				
Sludge color	Visual / 1995	2	Light brown to creamy	
Sludge consistency	Visual / 1995	2	Smooth to crumbly	
Water solubility	NR / 1978	1	70%	NA
Bulk density g/mL	NR / 1978	1	1.31	NA
Water content %	TGA / 1995	4	≈ 26	2600
Radiochemical properties in μCi/g-wet				
Total α Pu	KOH fusion / 1995	4	0.0967	≈ 0
Chemical properties				
Cations in μg/g	1978		μg/g	
Na^{+}	Water extraction	1	10000	100
Al^{+3}	Acid fusion	1	196000	1900
Ni^{+2}	Acid fusion	1	4000[a]	40
Bi^{+3}	Acid fusion	1	1000	10
Anions in μg/g	1978			
OH^{-}	Water extraction	1	5000	50
F^{-}	Acid fusion	1	4000	40
NO_2^{-}	Water extraction	1	3000	30
CO_3^{-2}	Water extraction	1	6000	60
SiO_2^{-2}	Acid fusion	1	87000	860
NO_3^{-}	Water extraction	1	12000	120
PO_4^{-3}	Water extraction	1	5000	50
SO_4^{-2}	Water extraction	1	5000	50
Total cations and anions inventory				≈ 3500

Table 5-5. Tank Waste Profile - Physical Properties and Major Waste Constituents.

Analyte	Method/ year	Number of data points	Average Analytical Result	Calculated inventory kg
Total organic carbon (μg/g-wet)	Persulfate oxidation	4	470	≈ 5
Total inventory				6100

Notes:

NR = Not reported
TGA = Thermo-gravimetric analysis

Inventory estimates do not account for the 1995 ICP data.

[a]It is unclear if this is due to cross-contamination from the nickel-impregnated crucibles.

Table 5-6. Postulated Waste Sludge Equilibrium Species and Approximate Concentrations.

Specie	Concentration % by weight	Water solubility ratio	Other possible equilibrium species
$Al(OH)_3$	≈ 56	0.0026	Aluminosilicates, aluminum oxides hydrates, aluminum nitrate
H_2O	≈ 26	NA	NA
SiO_2	≈ 9	5.7e-6	Aluminosilicates, other silicates
$NaNO_3$	≈ 4	NR	Aluminum nitrate, sodium nitrite, phosphate and hydroxide
LaF	≈ 3	4	Lanthanum hydroxide or hydrated oxides, other metal fluorides
Na_3PO_4	≈ 2	2.5	Other sodium salts, other phosphates
Total	≈ 100		

Table 5-6. Assessment of Characterization Results versus DQO Criteria.

Required analysis	Associated parameter	Result (May 1995)	DQO criteria (Action limit)
Generic Health and Safety Vapor Issue Resolution DQO			
Flammability	A vapor sampling event is scheduled for July 21, 1995. The results will be incorporated or referenced in the next revision of this TCR. Based on TOC results and water content (May 1995) no flammability or toxicity issues are expected to be found in the tank's headspace.		
Toxicity			
Tank Safety Screening and Organic Fuel Rich DQOs			
Criticality	Total α	0.0967 μCi/g	>41 μCi/g
Exotherms	DSC	None found	≥ 481 J/g
Heat generation	Temperature	≈15 °C (59 °F)	≥ 149 °C (300 °F)
Reaction propagation	Water content by TGA	≈ 23 to 29%	< 17%
Organic content	TOC (by hot persulfate oxidation)	124 to 815 μg/g	> 30,000 μg/g

The analyses were performed from homogenized half segment aliquots (both solid and liquid in the case of cores 81 and 82). Those segments (two in this case, one per core) were collected from widely spaced locations within the tank (≈ 180° angle between risers 2 and 6) as specified in the Safety Screening and Organic DQOs (Babad and Redus 1994, Babad et al. 1994).

One duplicate was performed per analysis. Spatial and analytical variabilities were not estimated because of the small number of data points, and consequently the 95 percent confidence ranges for the results were not calculated. The relative percent difference (RPD)[7] between samples and duplicates for the required analyses passed the 222-S Laboratory's quality control requirements (refer to Table 5-1).

Table 5-6, column 4 shows the DQO specified limits at which some action must be taken. Action is required if water is below the threshold value, or if the other parameters are above the values noted in the table. The range of the reported results for total α, temperature, and TOC were all below the DQO thresholds (refer to tables 4-3, C-1, and 5-6). No exotherms were also found in all samples and duplicates. Water content ranges were also above the DQO action limit threshold (see table 5-6).

[7] RPD=[(Sample Result-Duplicate Result)/(Sample Result+Duplicate Result)/2]*100

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6.0 CONCLUSION AND RECOMMENDATIONS

The most recent DQO-driven characterization data addressed all identified safety concerns - except headspace vapor and flammable gas - relative to the waste in tank 241-U-204. No other data requirements have been identified for this tank for retrieval, pretreatment, or disposal purposes. With a waste volume exceeding 850 L (30 ft^3), the tank is not considered empty according the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994) Milestone M-45-00. The waste in tank 241-U-204 will continue to be appropriately managed through interim mitigation measures and continuous monitoring of tank temperature and waste level.

Based on the 1995 analytical outcome, the tank could be classified as "Safe" per the Safety Screening and Organic Safety data quality objectives (DQOs) (Babad and Redus, Babad et al. 1994). The tank is currently on the Organic Watch List. The TWRS Safety Program will use the characterization data and other information to determine if a change in this status is warranted.

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APPENDIX A

1975, 1978, AND 1995 CHARACTERIZATION DATA AND INVENTORY ESTIMATES

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APPENDIX A

1975, 1978, AND 1995 CHARACTERIZATION DATA AND INVENTORY ESTIMATES

Table A-1 presents the results reported for the 1975 supernatant sample. No information regarding sampling locations or methods was enclosed with the analysis report letter. Note that interim stabilization; i.e., pumping of excess tank supernatant liquid, of the waste took place in the third quarter of 1977. The tank contents for that period (prior to the third quarter of 1977) were reported as 193,290 L (51,000 gal) of which 3,790 L (1,000 gal) were sludge at the bottom of the tank.

The cesium result is suspicious because the data sheet reports a negative number (-5,000 μCi/gal). Literature-reported specific activity values were used to convert radionuclide data.

No methods were reported for the electrolytes analysis. Those results, as for the radionuclides, are reported per volume of supernatant liquid.

Table A-1. 1975 Supernatant Sample (#T8247) Analytical Results (Wheeler 1975).

Properties	Method	Reported results	Units	Converted results
Physical properties				
Consistency	Visual observation	Liquid	NA	NA
Color	Visual observation	Clear yellow	NA	NA
pH	NR	12.6	NA	NA
Specific gravity	NR	1.064	NA	NA
Water content	NR	88.65	%	NA
Precipitation 35 to 5 °C (95 to 41 °F)		None	NA	NA
Reaction potential	DTA < 200 °C (392 °F)	None	NA	NA

Table A-1. 1975 Supernatant Sample (#T8247) Analytical Results (Wheeler 1975).

Properties		Method	Reported results	Units	Converted results
Radiochemical properties					μCi/L
Radiation level	Metal waste	NR	30	mrad/hr	NA
$Pu^{239/240}$		NR	<0.000004	g/gal	0.00
Cs^{137}	137	GEA	59000[a]	μCi/gal	15567[a]
$Sr^{89/90}$	90	NR	0.0883	μCi/gal	0.02
Chemical properties					
Cations					μg/mL
Na^{+}	23	NR	1.48	moles/L	34040
Al^{+3}	27	NR	0.0702	moles/L	1895
Anions					
OH^{-}	17	NR	0.63	moles/L	10710
F^{-}	19	NR	0.00854	moles/L	162.26
Cl^{-}	35	NR	0.0241	moles/L	843.50
$NO2^{-}$	46	NR	0.162	moles/L	7452
$NO3^{-}$	62	NR	0.995	moles/L	61690
$CO3^{-2}$	60	NR	0.0395	moles/L	2370
$PO4^{-3}$	95	NR	0.0252	moles/L	2394

Notes:

DTA = Differencial thermal analysis
GEA = Gamma energy analysis

[a]Suspicious result

Table A-2 presents the results reported for the 1978 sludge sample. No preparation or analysis methods were specified. Radionuclide values were converted using literature-specific activity data. Acid digestion concentration values for several analytes were not reported. Close examination of the data indicates that the sample was water extracted (extract water analyzed), then exposed to acid fusion.

Table A-2. 1978 Sludge Sample (#641) Analytical Results (Horton 1978).

Properties		Method	Reported results	Units	Converted results
Physical properties					
Color		Visual	Chalky white		NA
Consistency		Visual	Brittle solids		NA
Water solubility		NR	70	%	NA
Bulk density		NR	1.31	g/mL	NA
Water content		NR	26	%	NA
Radiochemical properties					
Radionuclides	MW				μCi/g
Am	241	Water extraction	6.52e-11	g/g	0.00
		Acid fusion	1.86e-10	g/g	0.00
Pu*	240	Water extraction	1.33e-09	g/g	0.00
		Acid fusion	6.23e-10	g/g	0.00
U*	238	Water extraction	2.83e-07	g/g	0.00
		Acid fusion	7.46e-07	g/g	0.00
Cs^{137}	137	Water extraction	3.69	μCi/g	NA
		Acid fusion	0.27	μCi/g	NA
$Sr^{89/90}$	90	Water extraction	0.00058	μCi/g	NA
		Acid fusion	0.0086	μCi/g	NA
Chemical properties					
Cations					μg/g
Na^{+}	23	Water extraction	1	%	10000
Al^{+3}	27	Water extraction	0.05	%	500
		Acid fusion	19.6	%	196000
K^{+}	39	Water extraction	0.006	%	60
Mn^{+}	55	Water extraction	0.000007		0.07

Table A-2. 1978 Sludge Sample (#641) Analytical Results (Horton 1978).

Properties		Method	Reported results	Units	Converted results
Fe*	56	Water extraction	0.0004	%	4
		Acid fusion	0.03	%	300
Ni^{+2}	59	Water extraction	0.0005	%	5
		Acid fusion	0.4	%	4000
La^{+3}	139	Water extraction	2	%	20000
		Acid fusion	0.5	%	5000
Hg*	201	Water extraction	0.01	%	100
Bi^{+3}	209	Water extraction	0.01	%	100
		Acid fusion	0.1	%	1000
Anions					μg/g
OH^-	17	Water extraction	0.5	%	5000
F^-	19	Water extraction	0.007	%	70
		Acid fusion	0.4	%	4000
Cl^-	35	Water extraction	0.01	%	100
NO_2^-	46	Water extraction	0.3	%	3000
CO_3^{-2}	60	Water extraction	0.6	%	6000
SiO_2^{-2}	60	Water extraction	0.00005	%	0.50
		Acid fusion	8.7	%	87000
NO_3^-	62	Water extraction	1.2	%	12000
PO_4^{-3}	95	Water extraction	0.5	%	5000
		Acid fusion	0.2	%	2000
SO_4^{-2}	96	Water extraction	0.5	%	5000
		Acid fusion	0.06	%	600
CrO_4^-	116	Water extraction	0.03	%	300

*Refers to all oxidation states.

Table A-3 reports inventory values derived from the 1978 and 1995 analytical data (Tables A-2 and 4-3). When both water extraction and acid digestion results are available for a certain analyte, the highest reported concentration is used to calculate the inventory on a wet basis, or per weight of wet waste. Because of the limited amount of data currently available, no statistics are added. Corresponding TLM data is added for comparison purposes.

Table A-3. Data Summary and Inventory Estimates.

Analyte	TLM data	Method/ year	Number of data points	Average Analytical Result	Calculated inventory kg
Physical properties					
Sludge color	NR	Visual / 1995	2	Light brown to creamy	
Sludge consistency	NR	Visual / 1995	2	Smooth to crumbly	
Water solubility	NR	NR / 1978	1	70%	NA
Bulk density g/mL	1.56	NR / 1978	1	1.31	NA
Void fraction	0.814	NA	NA	NR	NA
Water content %	65.3	TGA / 1995	4	≈ 26	2600
Radiochemical properties in μCi/g-wet					
Total α Pu	1.68	KOH fusion / 1995	4	0.0967	NA
Chemical properties					
Cations in μg/g		1978		μg/g	
Na^{+}	5.26e+4	Water extraction	1	10000	100
Al^{+3}	1.08e+5	Acid fusion	1	196000	1900
K^{+}	NR	Water extraction	1	60	≈0
Mn^{+}	NR	Water extraction	1	0.07	≈0
$Fe^{\bullet}$	1.68e+4	Acid fusion	1	300	3
Ni^{+2}	1.09e+3	Acid fusion	1	4000[a]	40
Ba^{++}	NR	NA	NA	NA	NA
La^{+3}	NR	Water extraction	1	20000	200
$Hg^{\bullet}$	NR	Water extraction	1	100	1

Table A-3. Data Summary and Inventory Estimates.

Analyte	TLM data	Method/ year	Number of data points	Average Analytical Result	Calculated inventory kg
Chemical Properties (continued)					
Cations in μg/g (continued)				μg/g	
Bi^{+3}	NR	Acid fusion	1	1000	10
* Refers to all oxidation states					
Anions in μg/g		1978		μg/g	
OH^-	2.47e+5	Water extraction	1	5000	50
F^-	NR	Acid fusion	1	4000	40
Cl^-	NR	Water extraction	1	100	1
NO_2^-	3.41e+4	Water extraction	1	3000	30
CO_3^{-2}	2.47e+3	Water extraction	1	6000	60
SiO_2^{-2}	NR	Acid fusion	1	87000	860
NO_3^-	3.14e+4	Water extraction	1	12000	120
PO_4^{-3}	NR	Water extraction	1	5000	50
SO_4^{-2}	NR	Water extraction	1	5000	50
CrO_4^-	NR	Water extraction	1	300	3
Total cations and anions inventory					3500

Table A-3. Data Summary and Inventory Estimates.

Analyte	TLM data	Method/ year	Number of data points	Average Analytical Result	Calculated inventory kg
Total organic carbon (μg/g-wet)	NR	Persulfate oxidation	4	470	≈ 5
Total inventory					6100

Notes:

NR = Not reported
TGA = Thermo-gravimetric analysis
TLM = Tank layer model

Inventory estimates do not account for the 1995 ICP data.

[a]It is unclear if this is due to cross-contamination from the nickel-impregnated crucibles.

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APPENDIX B

TANK LAYER MODEL CONTENTS ESTIMATES

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Table B-1. Estimated Composition of REDOX Cladding Waste Sludge and Supernate (Agnew 1994).

Constituent	Sludge (μg/g)	Supernate (μg/g)
Na	3.91e+04	7.15e+04
Al	9.52e+04	3.51e+04
OH^-	2.02e+05	1.85e+02
NO_3^-	2.01e+04	4.03e+04
NO_2^-	2.60e+04	5.23e+04
U	2.55e+04	—
Pu	1.84 (μCi/g)	—
Cs	1.40 (μCi/g)	—
Sr	1.44e+01(μCi/g)	

APPENDIX B REFERENCE

Agnew, S. F., et al., 1995 *Tank Layer Model (TLM) for Northeast, Southwest, and Northwest Quadrants*, Rev.1, LAUR-94-4269, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., 1994, *Hanford Defined Wastes: Chemical and Radionuclides Compositions*, LAUR-94-2657, Los Alamos National Laboratory, Los Alamos, New Mexico.

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APPENDIX C

MAY-JUNE 1995 TEMPERATURE DATA

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Table C-1. Most Recent Temperature Reading From Riser 4 in °F (from 1995 TWINS [CASS Access] Data).

Sensor ID	Value	Measurement Date
1	48	1995-05-16
1	61	1995-05-19
1	61	1995-05-23
1	61	1995-05-30
1	59.9	1995-06-12
2	48	1995-05-16
2	61	1995-05-19
2	61	1995-05-23
2	61	1995-05-30
2	60.1	1995-06-12
3	48	1995-05-16
3	60	1995-05-19
3	61	1995-06-12
4	48	1995-05-16
4	61	1995-05-19
4	60.8	1995-06-12
5	48	1995-05-16
5	60	1995-05-19
5	60.4	1995-06-12
6	48	1995-05-16
6	60	1995-05-19
6	59.9	1995-06-12
7	48	1995-05-16
7	60	1995-05-19
7	60.3	1995-06-12
8	48	1995-05-16

Table C-1. Most Recent Temperature Reading From Riser 4 in °F (from 1995 TWINS [CASS Access] Data).

Sensor ID	Value	Measurement Date
8	60	1995-05-19
8	61	1995-05-23
8	61	1995-05-30
8	60.3	1995-06-12
9	48	1995-05-16
9	59	1995-05-19
9	60.4	1995-06-12
10	48	1995-05-16
10	60	1995-05-19
10	60.7	1995-06-12
11	48	1995-05-16
11	59	1995-05-19
11	52.6	1995-06-12

APPENDIX D

ANALYTICAL METHODS REFERENCE

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Table D-1. Analytical Methods Reference - 1995 Characterization Event.

Method name	Target analytes	Method number (222-S)
KOH fusion digestion	NA	LA-549-141, Rev. C-2
Inductively coupled plasma	Li	LA-505-151, Rev. D-2
Differential scanning calorimetry (DSC)	Enthalpy	LA-514-113, Rev. B-1
Thermo-gravimetric analysis (TGA)	Water content	LA-560-112 Rev. A-2
Total alpha	α activity	LA-508-101, Rev. D-2
Total organic carbon/ Total inorganic carbon (TOC/TIC)	TOC, TIC	LA-342-100, Rev.A0

Notes:

DSC = Differential scanning calorimetry
TGA = Thermo-gravimetric analysis
TIC = Total inorganic carbon
TOC = Total organic carbon

APPENDIX D REFERENCES

222-S Laboratory Procedures, Westinghouse Hanford Company, Richland, Washington:

LA-342-100, 1994, Rev. A-0, *Determination of Carbon by Hot Persulfate Oxidation and Detection.*

LA-505-151, Rev. D-2, 1995, *Inductively Coupled Plasma (ICP) Emission Spectrometric Method for the Applied Research Laboratories (ARL) Model 3580.*

LA-508-101, Rev. D-2, 1994, *Alpha and Beta in Liquid Samples.*

LA-514-113, Rev. B-1, 1994, *Differential Scanning Calorimetry (DSC).*

LA-549-141, Rev. C-2, 1994, *Fusion with Alkali Metal Hydroxide.*

LA-560-112, Rev. A-2, 1994, *Determination of Weight Loss as Percent Water by Thermo-gravimetric Analysis (TGA) - Mettler TG 50.*

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APPENDIX E

1995 DSC SCANS FOR SLUDGE SAMPLES

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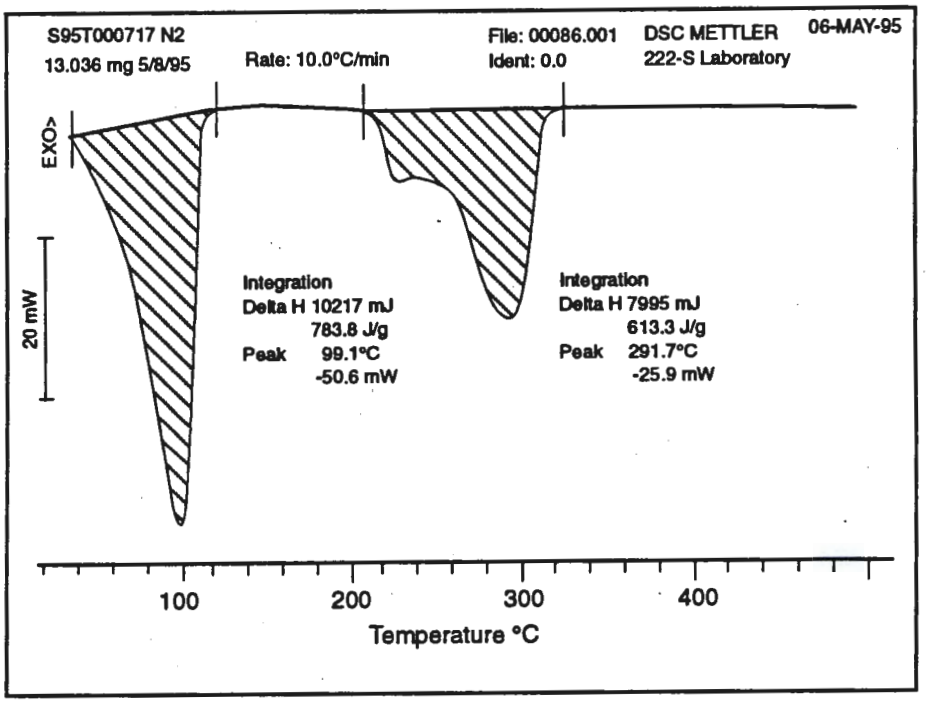
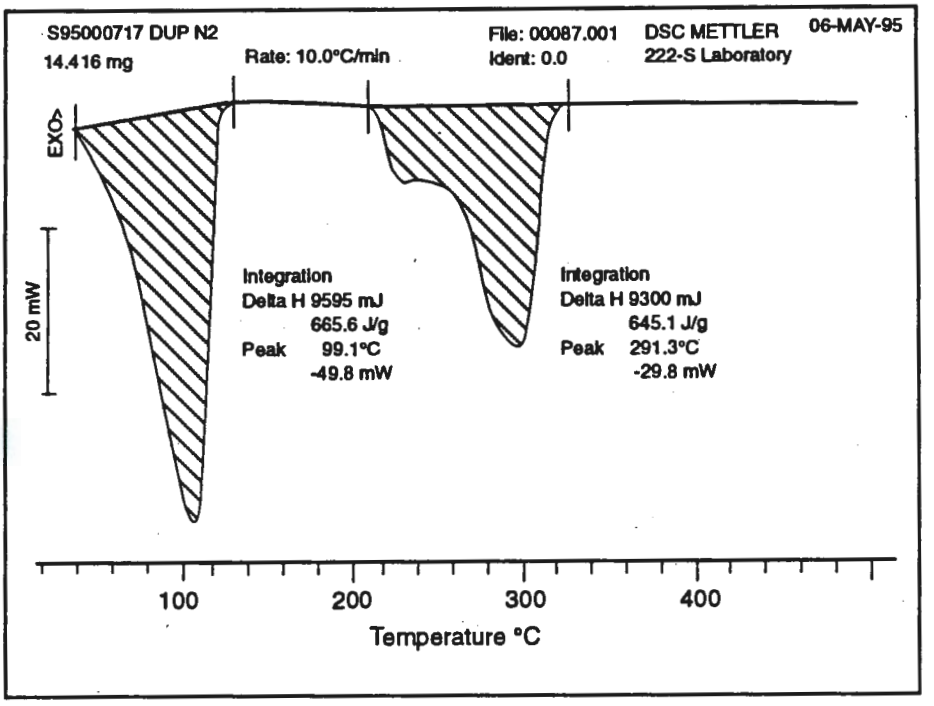
Figure E-1. Core 81 Solids - DSC Scans.

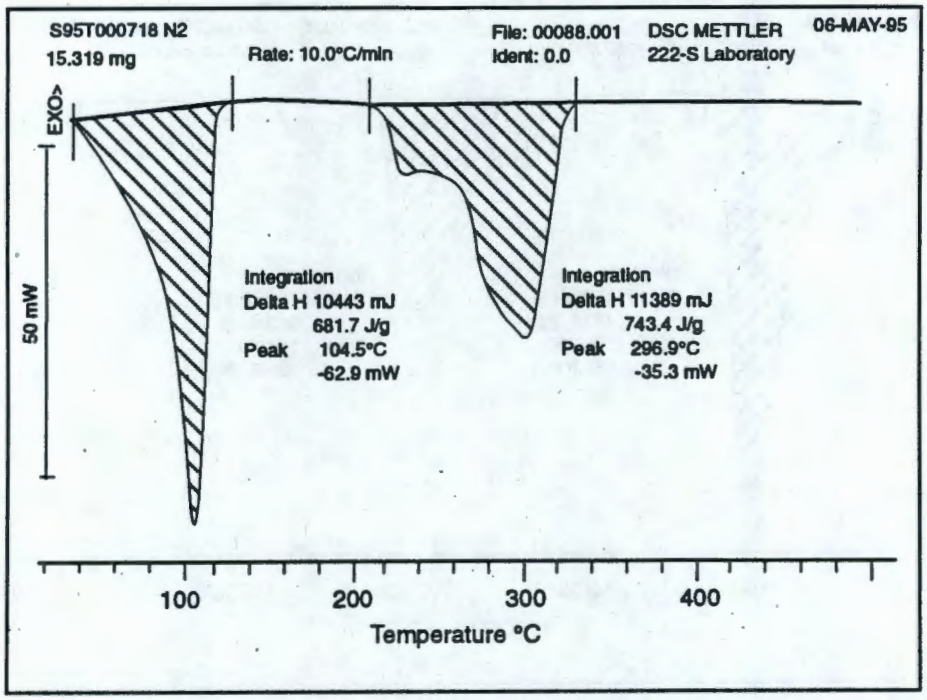


29507020.1

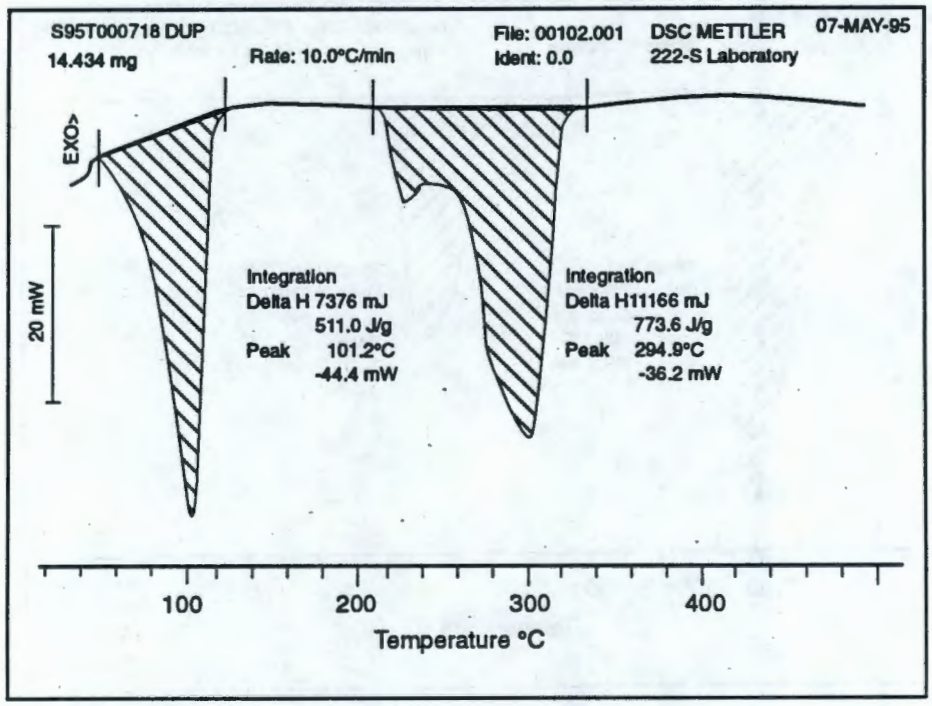


29507020.2

Figure E-2. Core 82 Solids - DSC Scans.



29507020.3



29507020.4

APPENDIX F

STOICHIOMETRIC BALANCE BASED ON POSTULATED WASTE SPECIES

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Table F-1. Detailed Stoichiometric Balance Based on Postulated Waste Species.

Electrolyte	Water Soluble Matrix	Water Insoluble Matrix	Assumed Specie	Specie Concentration	Specie to Electrolyte Ratio	Specie Concentration	Specie Mass Balance	Equivalent Mass
Cations	μmol/g	μmol/g		μmol/g	weight ratio	μg/g	μg/g	kg
Na^{+}	434.8	0	$NaNO_3$	435	3.70	37000	37000	360
Al^{+++}	18.52	7259	$Al(OH)_3$	7259	2.888	570000	570000	5600
K^{+}	1.54	0	KCl	Negligible	NA	NA	NA	NA
Mn^{+}	0.001	0	MnO_2	Negligible	NA	NA	NA	NA
Fe^{+2}	0.071	5.36	$Fe(OH)_2$	Negligible	NA	NA	NA	NA
Ni^{+2}	0.085	67.80	NA	NA	NA	NA	NA	NA
La^{+3}	143.9	35.97	LaF	144	1.137	23000	NC	NA
Hg^{+1}	0.498	0	NR	NA	NA	NA	NA	NA
Bi^{+++}	0.478	4.78	$BiPO_4$	4.8	1.455	1500	NC	NA
Anions								
OH^{-}	294	4.118	$Al(OH)_3$	294	4.353	22000	NC	NA
F^{-}	3.68	210.5	LaF	211	8.316	33000	33000	330
Cl^{-}	2.857	0	KCl	Negligible	NA	NA	NA	NA
$NO2^{-}$	65.22	0	$NaNO_2$	Negligible	NA	NA	NA	NA
$CO3^{-2}$	100	0	Na_2CO_3	100	1.767	11000	NC	NA
$SiO2^{-2}$	0.008	1450	SiO_2	1450	1	87000	87000	860
$NO3^{-}$	193.5	0	$NaNO_3$	194	1.37	16000	NC	NA
$PO4^{-3}$	52.63	21.05	Na_3PO_4	21	3.2	16000	16000	160
$SO4^{-2}$	52.08	6.25	Na_2SO_4	Negligible	NA	NA	NA	NA
$CrO4^{-}$	2.586	0	NA	Negligible	NA	NA	NA	NA
Balance	≈ 167	≈ 5681					740000	7300
Ratio	1.28	0.229						
Water							260000	2600
TOC							470	≈ 5
Total							≈1000000	≈9900

Notes:

NA = Not applicable
NC = Not counted

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APPENDIX G

1995 PERIPHERAL ICP DATA

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APPENDIX G

1995 PERIPHERAL ICP DATA

The data was provided by the 222-S Laboratory for informational purposes only. For the solid samples, core 82 shows higher amounts of aluminum while core 81 shows higher concentrations of all other major analytes such as Bi, Ca, Fe, Mg, Ni, P (most likely phosphate), Pb, Si (most likely SiO_2 or $Si(OH)_6^{-2}$), and Zn. This phenomena could be attributed to several factors, such as heterogeneity, water content, and thermodynamic equilibrium state. About 0.1 percent uranium was detected in core 81, but none was detected in core 82. Because of the low activity of both core samples, it is most likely a pocket of U^{238}. Concentration results for elements such as Na, Al, Ni, and Bi are about the same order of magnitude as the 1978 sludge data. Potassium results are highly biased because of method contamination (KOH fusion). Nevertheless, drainable liquid data indicates the presence of potassium.

Drainable liquid analytical results confirm the presence of certain analytes detected in the solid samples. In addition, they provide clues relative to the thermodynamic equilibrium state and solubility. Solubility could help decipher possible waste species. In this case, soluble Al, Cr, Fe, K, Na, Si, and Pb species are attributed to soluble salts and activated oxides.

Table G-1. ICP Data from Solid Samples - 1995.

Core 81 Upper Segment Half Solids KOH Fusion Results - ppm (μg/g)						
		Sample		Duplicate	RPD	Spike % Recovery
Ag	<	15.68	<	15.68	N/A	85
Al		186838.00		185674.69	0.62	108
As	<	156.78	<	156.78	N/A	91
B	<	78.39	<	78.39	N/A	92
Ba	<	78.39	<	78.39	N/A	99
Be	<	7.84	<	7.84	N/A	100
Bi		2292.93		1763.89	26.08	109
Ca		1887.32		1696.24	10.66	105
Cd	<	15.68	<	15.68	N/A	102
Ce	<	156.78	<	156.78	N/A	95
Co	<	31.36	<	31.36	N/A	104
Cr		226.18		225.93	0.11	107
Cu	<	15.68	<	15.68	N/A	106
Fe		4332.36		2676.33	47.26	99
K		4044002.29[a]		4202967.66[a]	-3.86	2570
La	<	78.39	<	78.39	N/A	100
Li	<	15.68	<	15.68	N/A	93
Mg		1583.12		1424.70	10.53	102
Mn		132.38		107.43	20.80	106
Mo	<	78.39	<	78.39	N/A	98
Na		21595.62		21932.12	-1.55	68
Nd	<	156.78	<	156.78	N/A	95
Ni		4646.80[b]		4881.33[b]	-4.92	99
P		1115.22		1072.34	3.92	103
Pb		12430.93		10793.78	14.10	94
S	<	156.78	<	156.78	N/A	100
Sb	<	94.07	<	94.07	N/A	93
Se	<	156.78	<	156.78	N/A	74
Si		4082.16		3808.76	6.93	103

Table G-1. ICP Data from Solid Samples - 1995.

Core 81 Upper Segment Half Solids KOH Fusion Results - ppm (μg/g)						
		Sample		Duplicate	RPD	Spike % Recovery
Sm	<	156.78	<	156.78	N/A	93
Sr		54.69		49.21	10.56	104
Ti		60.44		103.03	-52.11	101
Tl	<	313.56	<	313.56	N/A	85
U		1969.41		2103.72	-6.60	106
V	<	78.39	<	78.39	N/A	99
Zn		1428.34		1257.99	12.68	102
Zr	<	15.68	<	15.68	N/A	102
Core 82 Upper Segment Half Solids KOH Fusion Results - ppm (μg/g)						
Ag		423.79		496.40	15.78	56
Al		252651.17		258522.03	2.30	211
As	<	157.46	<	157.46	N/A	94
B	<	78.73	<	78.73	N/A	92
Ba	<	78.73	<	78.73	N/A	99
Be	<	7.87	<	7.87	N/A	101
Bi		389.07		374.63	3.78	107
Ca		188.13	<	157.46	17.75	105
Cd	<	15.75	<	15.75	N/A	104
Ce	<	157.46	<	157.46	N/A	95
Co	<	31.49	<	31.49	N/A	105
Cr		124.37		126.05	1.34	108
Cu	<	15.75	<	15.75	N/A	106
Fe		1944.92		1936.30	0.44	109
K		4180223.33[a]		4041798.17[a]	3.37	2729
La	<	78.73	<	78.73	N/A	101
Li	<	15.75	<	15.75	N/A	93
Mg		180.56	<	157.46	13.67	106
Mn		46.67		42.16	10.16	107
Mo	<	78.73	<	78.73	N/A	99

Table G-1. ICP Data from Solid Samples - 1995.

Core 81 Upper Segment Half Solids KOH Fusion Results - ppm (μg/g)						
		Sample		Duplicate	RPD	Spike % Recovery
Na		14430.18		14691.09	1.79	80
Nd	<	157.46	<	157.46	N/A	94
Ni		3286.36[b]		2934.13[b]	11.32	105
P	<	314.92	<	314.92	N/A	99
Pb		3020.24		3055.06	1.15	107
S	<	157.46	<	157.46	N/A	99
Sb	<	94.48	<	94.48	N/A	94
Se	<	157.46	<	157.46	N/A	77
Si		952.49		699.29	30.66	105
Sm	<	157.46	<	157.46	N/A	95
Sr	<	15.75	<	15.75	N/A	103
Ti		67.23		42.37	45.36	102
Tl	<	314.92	<	314.92	N/A	88
U	<	787.31	<	787.31	N/A	155
V	<	78.73	<	78.73	N/A	100
Zn		446.91		475.99	6.30	107
Zr		54.49		19.67	93.92	103

Notes:

[a]Attributed to contamination resulting from KOH fusion.

[b]Possibly due to contamination from nickel-impregnated crucibles.

Table G-2. Core 81 Drainable Liquid ICP Data (in ppm) - 1995.

		Sample		Duplicate	RPD	Spike % Rec.
Ag	<	2.01e+00	<	2.01e+00	N/A	6.30e+01
Al		6.50e+02		6.34e+02	2.45e+00	9.97e+01
As	<	2.01e+01	<	2.01e+01	N/A	8.90e+01
B		1.02e+01	<	1.01e+01	1.34e+00	9.90e+01
Ba	<	1.01e+01	<	1.01e+01	N/A	9.56e+01
Be	<	1.01e+00	<	1.01e+00	N/A	1.02e+02
Bi	<	2.01e+01	<	2.01e+01	N/A	8.75e+01
Ca	<	2.01e+01	<	2.01e+01	N/A	9.46e+01
Cd	<	2.01e+00	<	2.01e+00	N/A	9.87e+01
Ce	<	2.01e+01	<	2.01e+01	N/A	8.76e+01
Co	<	4.02e+00	<	4.02e+00	N/A	9.79e+01
Cr		3.93e+02		3.85e+02	2.13e+00	9.79e+01
Cu	<	2.01e+00	<	2.01e+00	N/A	9.91e+01
Fe		1.83e+01		1.53e+01	1.76e+01	9.70e+01
K		2.17e+02		2.08e+02	3.79e+00	9.59e+01
La	<	1.01e+01	<	1.01e+01	N/A	9.62e+01
Li	<	2.01e+00	<	2.01e+00	N/A	9.74e+01
Mg	<	2.01e+01	<	2.01e+01	N/A	9.06e+01
Mn	<	2.01e+00	<	2.01e+00	N/A	9.79e+01
Mo	<	1.01e+01	<	1.01e+01	N/A	9.53e+01
Na		3.60e+04		3.57e+04	7.17e-01	3.53e+01
Nd	<	2.01e+01	<	2.01e+01	N/A	9.16e+01
Ni	<	4.02e+00	<	4.02e+00	N/A	9.68e+01
P		7.61e+02		7.50e+02	1.43e+00	1.07e+02
Pb		3.36e+01		3.10e+01	8.18e+00	9.82e+01
S		1.68e+02		1.64e+02	2.22e+00	9.83e+01

Table G-2. Core 81 Drainable Liquid ICP Data (in ppm) - 1995.

		Sample		Duplicate	RPD	Spike % Rec.
Sb	<	1.21e+01		1.51e+01	2.27e+01	8.67e+01
Se	<	2.01e+01	<	2.01e+01	N/A	7.05e+01
Si		5.03e+01		4.40e+01	1.33e+01	9.73e+01
Sm	<	2.01e+01	<	2.01e+01	N/A	8.33e+01
Sr	<	2.01e+00	<	2.01e+00	N/A	9.96e+01
Ti	<	2.01e+00	<	2.01e+00	N/A	9.63e+01
Tl	<	4.02e+01	<	4.02e+01	N/A	7.29e+01
U	<	1.01e+02	<	1.01e+02	N/A	6.49e+01
V	<	1.01e+01	<	1.01e+01	N/A	9.11e+01
Zn		4.90e+00		4.61e+00	6.15e+00	9.74e+01
Zr	<	2.01e+00	<	2.01e+00	N/A	9.84e+01

Table G-3. Core 82 Drainable Liquid ICP Data (in ppm) - 1995.

		Sample		Duplicate	RPD	Spike % Rec.
Ag	<	2.01e+00	<	2.01e+00	N/A	4.15e+01
Al		6.17e+02		5.99e+02	2.98e+00	9.96e+01
As	<	2.01e+01	<	2.01e+01	N/A	8.91e+01
B	<	1.01e+01	<	1.01e+01	N/A	1.00e+02
Ba	<	1.01e+01	<	1.01e+01	N/A	9.73e+01
Be	<	1.01e+00	<	1.01e+00	N/A	1.02e+02
Bi	<	2.01e+01	<	2.01e+01	N/A	9.23e+01
Ca	<	2.01e+01	<	2.01e+01	N/A	9.52e+01
Cd	<	2.01e+00	<	2.01e+00	N/A	9.87e+01
Ce	<	2.01e+01	<	2.01e+01	N/A	9.15e+01
Co	<	4.02e+00	<	4.02e+00	N/A	9.83e+01
Cr		3.95e+02		3.89e+02	1.48e+00	1.05e+02
Cu	<	2.01e+00	<	2.01e+00	N/A	1.01e+02
Fe		2.43e+01		1.60e+01	4.09e+01	9.64e+01
K		2.25e+02		2.30e+02	2.20e+00	1.04e+02
La	<	1.01e+01	<	1.01e+01	N/A	9.70e+01
Li	<	2.01e+00	<	2.01e+00	N/A	9.89e+01
Mg	<	2.01e+01	<	2.01e+01	N/A	9.08e+01
Mn	<	2.01e+00	<	2.01e+00	N/A	9.80e+01
Mo	<	1.01e+01	<	1.01e+01	N/A	9.57e+01
Na		3.75e+04		3.72e+04	9.33e-01	4.02e+02
Nd	<	2.01e+01	<	2.01e+01	N/A	9.77e+01
Ni	<	4.02e+00	<	4.02e+00	N/A	9.82e+01
P		8.27e+02		8.08e+02	2.40e+00	1.24e+02
Pb		4.65e+01		5.32e+01	1.33e+01	1.02e+02
S		1.78e+02		1.73e+02	3.13e+00	1.06e+02

Table G-3. Core 82 Drainable Liquid ICP Data (in ppm) - 1995.

		Sample		Duplicate	RPD	Spike % Rec.
Sb	<	1.21e+01	<	1.21e+01	N/A	9.12e+01
Se	<	2.01e+01	<	2.01e+01	N/A	7.08e+01
Si		5.58e+01		5.89e+01	5.39e+00	1.03e+02
Sm	<	2.01e+01	<	2.01e+01	N/A	9.69e+01
Sr	<	2.01e+00	<	2.01e+00	N/A	1.01e+02
Ti	<	2.01e+00	<	2.01e+00	N/A	9.64e+01
Tl	<	4.02e+01	<	4.02e+01	N/A	8.03e+01
U	<	1.01e+02	<	1.01e+02	N/A	7.58e+01
V	<	1.01e+01	<	1.01e+01	N/A	9.44e+01
Zn		3.09e+00		3.01e+00	2.65e+00	9.85e+01
Zr	<	2.01e+00	<	2.01e+00	N/A	9.98e+01

9613456.0766

DISTRIBUTION SHEET

To	From	Page 1 of 4
Distribution	Characterization Plans, Coordination and Reports	Date
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Tank Characterization Report for Single-Shell Tank 241-U-204, WHC-SD-WM-ER-486, Rev. 0		ECN No.

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Department of Energy - Richland Operations

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N. W. Willis	S7-54	X

ICF-Kaiser Hanford Company

L. A. Gaddis	S3-09	X
W. W. Pickett	S3-09	X

Pacific Northwest Laboratory

G. H. Beeman	S7-71	X

S. F. Bobrowski	K7-28	X	
N. G. Colton	K3-75	X	
J. R. Gormsen	K7-28		X
S. A. Hartley	K5-12	X	
J. G. Hill	K7-94	X	
L. K. Holton	K9-73	X	
G. J. Lumetta	P7-25	X	
B. D. McVeety	K6-84	X	
A. F. Noonan	K9-81	X	
K. M. Remund	K5-12	X	
J. T. Slankas	K9-81	X	

Westinghouse Hanford Company

D. A. Barnes	R1-80	X	
G. R. Bloom	H5-61	X	
T. M. Brown	R2-12	X	
T. H. Bushaw	T6-30	X	
R. J. Cash	S7-15	X	
C. S. 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
G. D. Forehand	S7-21	X	
J. S. Garfield	H5-49	X	
J. D. Guberski	R2-06		X
R. D. Gustavson	R1-51	X	
D. L. Herting	T6-09	X	
B. A. Higley	H5-27	X	
G. Jansen	H6-33	X	
L. Jensen	T6-07	X	
G. D. Johnson	S7-15	X	
K. K. Kawabata	S7-55	X	
T. J. Kelley	S7-21	X	
N. W. Kirch	R2-11	X	
J. G. Kristofzski	T6-06	X	
M. J. Kupfer	H5-49	X	
D. L. McGrew	R3-25	X	
W. C. Miller	R1-30	X	
C. T. Narquis	T6-16	X	
D. E. Place	H5-27	X	
G. F. Raphael (5)	R2-12	X	
D. A. Reynolds	R2-11	X	
L. M. Sasaki (10)	R2-12	X	
F. A. Schmittroth	H0-35	X	
N. J. Scott-Proctor	S5-01	X	
L. W. Shelton, Jr.	H5-49	X	
B. C. Simpson	R2-12	X	
G. L. Smith	H4-62		X
G. L. Troyer	T6-50	X	
D. A. Turner	S7-15	X	
D. J. Washenfelder	H5-27	X	
M. S. Waters	S6-30	X	
W. I. Winters (3)	T6-50	X	

TFIC (Tank Farm Information Center)	R1-20	X
Central Files	A3-88	X
EDMC	H6-08	X
TCRC (2)	R2-12	X