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ENGINEERING DATA TRANSMITTAL

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Page 1 of 2

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2	RPP-5418	N/A	0	Auto Tank Interpretive Report for Tank 241-AN-104	N/A	2	1	1
3	RPP-5419	N/A	0	Auto Tank Interpretive Report for Tank 241-AN-105	N/A	2	1	1
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5	RPP-5421	N/A	0	Auto Tank Interpretive Report for Tank 241-BY-105	N/A	2	1	1
6	RPP-5422	N/A	0	Auto Tank Interpretive Report for Tank 241-S-110	N/A	2	1	1
7	RPP-5423	N/A	0	Auto Tank Interpretive Report for Tank 241-S-111	N/A	2	1	1
8	RPP-5424	N/A	0	Auto Tank Interpretive Report for Tank 241-SX-102	N/A	2	1	1
9	RPP-5425	N/A	0	Auto Tank Interpretive Report for Tank 241-SX-105	N/A	2	1	1
10	RPP-5426	N/A	0	Auto Tank Interpretive Report for Tank 241-T-110	N/A	2	1	1
11	RPP-5427	N/A	0	Auto Tank Interpretive Report for Tank 241-U-107	N/A	2	1	1
12	RPP-5428	N/A	0	Auto Tank Interpretive Report for Tank 241-U-109	N/A	2	1	1
13	RPP-5429	N/A	0	Auto Tank Interpretive Report for Tank 241-U-112	N/A	2	1	1

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Auto Tank Interpretive Report for Tank 241-S-110

M. R. Adams
Lockheed Martin Hanford, Corp., Richland, WA 99352
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This report prepared especially for AUTO TIR on 11/8/99

Some of the reports herein may contain data that has not been reviewed or edited. The data will have been reviewed or edited as of the date that a Tank Interpretive Report (TIR) is prepared and approved. The TIR for this tank was approved on August 23, 1999.

Tank: 241-S-110

Sampling Events:
- 140
- 240
- 241

Reports:
- Tank Interpretive Report

Constituent Groups:

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Data Dictionary to Reports in this Document

Report	Field	Description
Tank Interpretive Report		Interprets information about the tank answering a series of six questions covering areas such as information drivers, tank history, tank comparisons, disposal implications, data quality and quantity, and unique aspects of the tank.

Tank Interpretive Report For 241-S-110

Tank Information Drivers

Question 1: What are the information drivers applicable to this tank? What type of information does each driver require from this tank? (Examples of drivers are Data Quality Objectives, Mid-Level Disposal Logic, RPP Operation and Utilization Plan, test plans and Letters of Instruction.) To what extent have the information and data required in the driving document been satisfied to date by the analytical and interpretive work done on this tank?

The information drivers for tank 241-S-110 include the Historical Model Data Quality Objective (DQO) (Simpson and McCain 1997), the Safety Screening DQO (Dukelow et al. 1995), the Organic Complexant Safety Issue memorandum of understanding (MOU) (Schreiber 1997), and the Hazardous Vapor Screening DQO (Hewitt 1996). Tank material was requested to be archived in support of future pretreatment needs.

Safety Screening DQO: Does the waste pose or contribute to any recognized potential safety problems?

The data needed to screen the waste in tank 241-S-110 for potential safety problems are documented in *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). These potential safety problems are exothermic conditions in the waste, flammable gases in the waste and/or tank headspace, and criticality conditions in the waste. Sampling and analysis satisfied all requirements of the safety screening DQO.

The safety screening DQO limit for energetics is 480 J/g on a dry weight basis. The maximum value observed was 392 J/g dry weight. The "95 percent upper confidence interval on the mean" for this sample was 563 J/g dry weight. The maximum total organic carbon (TOC) result for this sample was 2,780 μg/g, well below the TOC notification limit of 45,000 μg/g. The percent water for this sample was 39.3 weight percent ("*Analytical Results*" standard report). No propagating reaction is expected.

The threshold limit for criticality, based on total alpha activity, is 1 g ^{239}Pu/L. Assuming that all alpha activity is from ^{239}Pu, and assuming a density of 1.92 g/mL (the highest result measured for the core samples), 1 g/L of ^{239}Pu is equivalent to 32.0 μCi/g of alpha activity. As required by the safety screening DQO, the upper limit to a one-sided 95 percent confidence interval on the mean was calculated for each sub-sample. The highest analytical value obtained was 0.895 μCi/g. The highest upper limit on the mean for total alpha was 1.32 μCi/g, more than 20 times below the limit. The total alpha sample results on the drainable liquid from core 140 (segment 1) and core 240 (segments 2, 3, and 4) were below detection limits. The highest detection limit value was 0.0158 μCi/mL. Since all results were well below the action limit, the waste does not pose a criticality hazard.

Tests performed with a combustible gas meter in support of the 1996 sampling event show a flammable gas reading of one percent of the lower flammability limit (LFL) (*IH Sniff Data* standard report). This is below the safety screening limit of 25 percent of the LFL.

Organic Complexants MOU: Does the possibility exist for a point source ignition in the waste followed by a propagation of the reaction in the solid/liquid phase of the waste?

The data required for the organic complexant issue are documented in *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirement* (Schreiber 1997). Energetics by differential scanning calorimetry (DSC), TOC, and sample moisture analyses were conducted to address the organic complexant issue.

DSC was applied to all sub-samples from cores 140, 240, and 241. All results were well below 480 J/g. The maximum TOC concentration was 27,509 μg/g (dry basis) for core 241, segment 4, lower half, which is below the 45,000 μg/g (dry weight basis) action limit for TOC for the organic complexants issue. The data indicate that a propagating reaction in the waste is unlikely and not a concern.

This issue was closed for all tanks in December 1998 (Owendoff 1998).

Hazardous Vapor Screening DQO: Do hazardous storage conditions exist associated with gases and vapors in the tank?

Tank 241-S-110 was vapor sampled on December 5, 1995. All results were below action limits, and no headspace constituents exceeded industrial hygiene notification limits ("*Vapor Data*" standard report) (Thomas et al. 1996). The LFL was 0.45 percent (McCain and Bauer 1998).

Hazardous vapor screening is no longer an issue because headspace vapor (sniff) tests are required for the safety screening DQO (Dukelow et al. 1995), and the toxicity issue was closed for all tanks (Hewitt 1996).

Historical Model DQO: Is the waste inventory generated by a model based on process knowledge and historical information (Agnew et al. 1997a) representative of the current tank waste inventory?

The purpose of the historical evaluation is to determine whether the Hanford defined waste (HDW) model, based on process knowledge and historical information (Agnew et al. 1997a), agrees with current descriptions of tank inventories based on sample results. If the historical model accurately predicts the waste characteristics as observed through sample characterization, the possibility exists to reduce the amount of total sampling and analysis needed. Data requirements for this evaluation are documented in *Historical Model Evaluation Data Requirements* (Simpson and McCain 1997).

A specified set of analyses, "gateway analyses," were completed on all solid sub-samples. If the sample fails the criteria, further analyses as directed by the historical DQO are not required. The gateway analysis consists of two sets of criteria. The first criterion (Criterion 1) is to check the sum of the mass of a set of analytes to see if this group contributes over 85% by mass of the waste in the sample. The second criterion (Criterion 2) compares segment level data to a set of "fingerprint" analytes to identify waste layers in the tank. The second comparison examines the results from the fingerprint analytes for the specified wastes. If the results exceed 10% of the levels specified in the DQO, it was considered agreement between the model predicted values and the analytical data.

Cores 240 and 241 were evaluated for Reduction and Oxidation extraction (REDOX) waste (R) and evaporator concentrate waste generated from 1973 to 1976 in the 242-S Evaporator (SMMS1) waste. Inspection of the data revealed two distinct layers in general agreement with predicted volumes and location. However, no samples passed the first criterion for R sludge and only 3 samples (core 240, segment 8L, core 241, segment 2 and core 241, segment 3) passed the second criterion. For SMMS1, only segments 3U, 4L, 5L and 7L from core 240 passed both criteria (see Tables 1-1 and 1-2 below).

Table 1-1. Gateway Analysis Results for 241-S-110, Core 240

SMMS1												
Segment	2L	3U	3L	4L	5L	6L	7L	8U	8L	9L	10U	10L
Criterion 1	F	P	P	P	P	P	P	P	F	F	F	F
Criterion 2	P	P	F	P	P	F	P	F	P	F	F	F
R												
Criterion 1	F	F	F	F	F	F	F	F	F	F	F	F
Criterion 2	F	F	F	F	F	F	F	F	P	F	F	F

"L" – Lower portion of segment.
"U" – Upper portion of segment.
"P" – Pass
"F" – Fail

Table 1-2. Gateway Analysis Results for 241-S-110, Core 241

SMMS1							
Segment	2	3	4	7U	7L	8U	8L
Criterion 1	F	F	F	F	F	F	F
Criterion 2	P	P	P	F	F	F	F
R							
Criterion 1	F	F	F	F	F	F	F
Criterion 2	P	P	F	F	F	F	F

"L" – Lower portion of segment.
"U" – Upper portion of segment.
"P" – Pass
"F" – Fail

The data indicate that the saltcake layer from the tank is largely consistent with the SMMS1 waste type. Nearly all the fingerprint analyte failures for SMMS1 saltcake are because of low carbonate. Chromium and iron failed nearly universally in the predicted sludge layers. This is consistent with the fact that the sludge is thought to also contain REDOX cladding waste (CWR) sludge (Agnew et al. 1997a) which is low in both these analytes. Furthermore, because the REDOX process evolved significantly during the course of operation, the process records used to develop a typical composition profile may not be sufficiently accurate to describe the waste. In addition, the typical composition documented in Agnew et al. (1997a) do not incorporate the effects of chemical reactions that occur over time while the waste is in storage.

Core 240, segment 4 and core 241, segment 2 were selected for further analysis per the historical DQO. Because only a high aluminum value prevented core 241, segment 2 from passing

Criterion 1, it was selected for further analysis ("*Analytical Results*" and "*Tank Sub-sampling Scheme and Sample Description*" standard reports). The results from these two segments are compared to the fingerprint analytes for saltcake in Table 1-3.

Table 1-3. Segment Analysis Per Historical DQO.

Analyte	Units	DQO[1]	10% gateway	240:4			241:2		
				Fusion	Acid	Water	Fusion	Acid	Water
Na	µg/g	195,400	19,540	254,000	245,000	253,000	92,500	88,000	102,000
Al	µg/g	31,000	3,100	8,110	7,060	7,280	115,000	106,000	3,270
Fe	µg/g	--	--	<1,030	270	<30.5	7,220	12,400	<30.4
Cr	µg/g	3,000	300	4,700	4,120	3,980	14,100	13,400	2,600
H_2O	%	32.1	3.21	12			48.3		
NO_3	µg/g	274,300	27,430	506,000			83,600		
CO_3	µg/g	17,000	1,700	11,600			5,340		
SO_4	µg/g	13,000	1,300	17,200			2,360		
^{137}Cs	µCi/g	--	--	58.1			83.3		
^{90}Sr	µCi/g	--	--	17.1			286		
U	µg/g	--	--	209			3,540		

Notes: [1] SMMS1 threshold Historical Model DQO (Simpson and McCain 1997)

Two core composites were prepared for 241-S-110. The compositing scheme was as follows:

core 240 : 25 g from segments 3, 6, 7, and 10.
core 241: 20 g from segments 2, 3, 4, and 10 g from the upper and lower portions of segments 7 and 8.

Based on the current best basis inventory, segments 9 and 10 from core 240 and segments 7 and 8 from core 241 are sludge. Segments 1 through 8 from core 240 and segments 1 through 6 from core 241 are saltcake. The composite from core 240 is 75% saltcake and 25% sludge and the composite sample from core 241 is 60% saltcake and 40% sludge. Agnew et al. (1997a) predicts 71% saltcake and 29% sludge, which compares well with the current best-basis estimates - 70% saltcake and 30% sludge (*Tank Interpretive Report (TIR) Question #7*).

Table 1-4 provides a comparison of 241-S-110 composite data with that predicted in Agnew et al. (1997a).

Table 1-4. Comparison of S-110 Composite Data with the Historical Model.

Analyte	Units	Predicted Value[1]	Core 240			Core 241		
			Fusion	Acid	Water	Fusion	Acid	Water
Na	µg/g	171,000	202,000	186,000	194,000	125,000	120,000	107,000
Al	µg/g	58,100	47,300	30,300	5,070	116,000	62,700	6,380
Fe	µg/g	8,450	2,830	2,140	<30.6	5,070	4,470	<20.8
Cr	µg/g	4,130	3,270	2,980	2.080	14,100	13,700	2,660
H_2O	%	32.1	14.2			29.9		
NO_3	µg/g	169,000	421,000			96,500		
CO_3	µg/g	11,600	4,350			6,180		
SO_4	µg/g	8,850	4,890			7,450		
^{137}Cs	µCi/g	121	47.3			83.4		
^{90}Sr	µCi/g	179	134			318		
U	µg/g	2,630	2,750			5,620		

Notes: [1] Agnew et al. (1997a)

The core 240 composite is closer in overall composition in sludge and saltcake to the actual tank composition.

In Table 1-5, average sample data are compared with predicted waste type compositions. In general, the analytical results agree with the values predicted in the saltcake layers. The sludge agreement is not as close for some of the analytes, which is likely a result of the additional CWR waste type in the sludge layers or incomplete description of the waste from process records.

Table 1-5. Comparison of Average Sample Data From Cores 140, 240 and 241 to the Historical DQO Waste Streams.

Analyte		Saltcake				Sludge			
	Units	Core 140 Seg. 1-4	Core 240 Seg. 2-8	Core 241 Seg 2-6	S1 Saltcake[1]	Core 240 Seg. 9-10	Core 241 Seg 7-8	CWR[1]	R[1]
Na	ppm	267,000[3]	251,000[3]	139,000[3]	195,400	85,200[3]	98,500[3]	52,500	33,000
Al	ppm	15,600[3]	6,220[3]	61,000[3]	31,000	158,000[3]	176,000[3]	114,000	58,200+
Fe	ppm	359[2]	1,581[2]	5,940[2]	-	6,433[3]	4,635[3]	-	38,100+
Cr	ppm	11,670[3]	3,372[3]	23,566[3]	3,000	1,730[3]	2,140[3]	-	30,600+
H_2O	%	28.3	9.94	43.6	32.1	35.4	28.6	69.4	44+
NO_3	ppm	333,000	536,000	110,000	274,300	92,800	106,000	-	-
CO_3	ppm	11,600	8,515	9,513	17,000	1,347	1,465	-	8,700
SO_4	ppm	12,564	14,381[4]	15,620	13,000	1,122[4]	1,310	-	-
^{137}Cs	µCi/g	130[3]	57.5[3]	87.9[3]	-	84.3[3]	85.8[3]	-	41+
^{90}Sr	µCi/g	23.0[3]	21.2[3]	209[3]	-	306[3]	345[3]	-	94+
U	ppm	241[2,4]	265	2,610	-	9,163	8,748	28,200	3,500+

Notes: [1] Simpson and McCain (1997)
[2] Acid digest-Inductively Coupled Plasma (ICP) results
[3] Fusion digest-ICP results
[4] "Less than" values used in calculation of the average.

Heat Load Estimate:
A factor in assessing tank safety is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. The heat load estimate based on the tank process history was 4,290 W (14,600 Btu/hr) (Agnew et al. 1997a). The heat load estimate based on the tank headspace temperature was 2,294 W (7,828 Btu/hr) (Kummerer 1995). The heat load estimated from the best basis inventory ("*Best-Basis Inventory Estimate (Radioactive)*" standard report) is 3,918 W (13,372 Btu/hr) (see Table 1-6).

Table 1-6. Heat Load Estimate Based on the Best-Basis Radionuclide Inventory.

Radionuclide	Waste Inventory[1]	Specific Activity[2]	Heat Load (Watts)
Strontium-90	3.84+E5 Ci	0.00670 W/Ci	2,573
Cesium-137	2.85+E5 Ci	0.00472 W/Ci	1,345
Total	-	-	3,918

Notes: [1] From solids core composite data, and solids volume of 1,476 kL (390 kgal).
[2] Includes daughter isotopes.

Tank History

Question 2: What is known about the history of this tank as it relates to waste behavior?

The S Tank Farm was constructed during 1950 and 1951 in the 200 West Area on the Hanford Site. The farm contains twelve 100 series single-shell tanks. These tanks have a capacity of 2,870 kL (758 kgal) and a diameter of 22.9 m (75 feet). The 241-S Tank Farm was designed for non-boiling waste with a maximum fluid temperature of 104 °C (220 °F) (Leach and Stahl 1997). The single-shell tanks in the S Tank Farm are constructed of 38-cm (1.25-feet)-thick reinforced concrete with a 6.4 mm (1/4 inch) mild carbon steel liner on the bottom and sides and a 38-cm (1.25-feet)-thick domed concrete top. They have a dish bottom with a 1.2 m (4 feet) radius knuckle and a 7.6-m (24.9-feet) operating depth. Tank descriptions and figures are presented in standard reports "*Description of Tank,*" *Tank Plan View,*" "*Tank Profile View,*" and "*Riser Configuration Table.*"

Tank 241-S-110 is categorized as sound and was interim stabilized in 1997. Intrusion prevention (interim isolation) is not yet completed. The tank is passively ventilated and is not on the Watch List (Public Law 101-510). Tank 241-S-110 is the first tank in a three-tank cascade series, S-110 - S-111 - S-112 (Brevick et al. 1997).

The most recent photographs of tank 241-S-110 were taken in 1987. The waste in the photographs is not indicative of the waste currently in the tank as several pumping events have occurred since then. During installation of a saltwell pump in 1995, it was noted that the waste was "slushy" down to about six feet from the tank bottom and was much harder to penetrate after that. Nearly 17,000 gallons of waste was pumped in support of interim stabilization from February 24, 1996 to July 16, 1996 (Wicks 1997). In-tank videos were taken December 11, 1996, and June 9, 1998.

As of March 31, 1999, tank 241-S-110 contained an estimated 1,476 kL (390 kgal) of noncomplexed waste (Hanlon 1999). The waste volumes were estimated using a manual ENRAF surface-level gauge located in riser 3, drill string calculation results from two core sampling events (1996 and 1998), and photographic evaluation.

The *Major Transfers* standard report summarizes the waste transfer history of tank 241-S-110 (Agnew et al. 1997b). Waste was initially added to tank 241-S-110 in the second quarter of 1952 with the addition of R1 (R waste generated from 1952-1957) waste from S plant (Reduction and

Oxidation extraction plant [REDOX]). R1 and CWR1 waste was added from 1952 to 1957. Waste first cascaded from 241-S-110 to 241-S-111 in the second quarter of 1952 and continued intermittently until the first quarter of 1957. The tank remained static from 1957 to 1973. From 1973 to 1976 supernate waste was received from the 241-S, 241-U and 241-T tank farms and tanks 241-BX-104, 241-BX-105, 241-TX-104, 241-TY-104, 241-SY-102, and 241-SX-110. During this same time, waste was transferred to 241-S-101, 241-S-102, and 241-S-107. This tank was removed from active service in 1976. From 1979 to 1996, a total of 1,238 kL (327 kgal) had been pumped from the saltwell.

Tank Comparisons

Question 3: What other tanks have similar waste types and waste behaviors, and how does knowledge of the similar tanks contribute to the understanding of this tank?

Tank 241-S-110 contains REDOX (R1) waste, REDOX cladding waste (CWR1), and SMMS1 saltcake and is the first tank in a three tank cascade which includes tanks 241-S-111 and 241-S-112. Because of its position in the cascade, most of the large particles in the waste settled out in this tank. Tanks 241-S-111 and 241-S-112 contain similar waste types (Agnew et al. 1997a).

Prior to obtaining analytical results for 241-S-110, the results from the saltcake layers in tanks 241-S-101, 221-S-102, 241-U-106, and 241-U-109 were used as a basis for the engineering estimate for 241-S-110 saltcake composition. Similarly, results from the sludge layers in tanks 241-S-101, 241-S-104, and 241-S-107 were used as the basis for the engineering estimate for 241-S-110 sludge. The majority of these estimated results have since been replaced with sample data (*Best Basis Inventory Estimate for Nonradioactive Components* and *Best Basis Inventory Estimate for Radioactive Components* standard reports).

The transfer history of tank 241-S-110 indicates that waste was transferred from 241-S-110 to 241-S-101, 241-S-102, 241-S-107, and 241-AN-103. Therefore, tank 241-S-110 sample results could contribute to an understanding of the composition and behavior of these tanks.

Based on statistical grouping studies, tanks 241-S-101, 241-S-102, 241-S-111, 241-U-106, and 241-U-109 contain SMMS1 waste and are expected to be similar to the salt cake waste in tank 241-S-110 (Remund and Simpson 1996).

Disposal Implications

Question 4: Given what is known about the waste properties and waste behaviors in this tank, what are the implications of the waste properties and behaviors to the waste retrieval/processing methodologies and equipment selection?

The waste in the tank exhibited minimal exothermic activity (less than 480 J/g) and headspace gas concentrations are low with the exception of ammonia. The results for ammonia, 147 ppmv, were just under the notification limit of 150 ppmv. The tank waste also has low total alpha concentrations, greatly alleviating criticality concerns during retrieval and processing.

The waste in the tank consists of a relatively uniform REDOX (R1) and REDOX cladding (CWR1) sludge layer about 99 cm (39 inches) thick (equivalent to 447 kL [118 kgal]) at the bottom of the tank. This layer is covered by a SMMS1 saltcake layer approximately 251 cm (98.9) inches thick (equivalent to 1,030 kL [272 kgal]). There is a hard saltcake layer approximately 152 cm (60 inches) into the waste (at riser 11), hard enough to have prevented push mode sampling.

The waste level in the tank is low enough that none of the risers in the tank dome approach the waste surface, thereby alleviating obstructions to waste retrieval for mechanical equipment that may be used to sluice and pump the waste.

Scientists Assessment of Data Quality and Quantity

Question 5: Given the current state of understanding of the waste in this tank on the one hand and the information drivers on the other; should additional tank data be sought via sampling/analysis from a strictly technical point-of-view? Can the waste behavior in this tank be adequately understood by other means (eg. archive samples, tank grouping studies, modeling) without additional sampling and analysis? If so, what characteristics of the tank waste lend themselves to a non-sample alternative? Is the quality of the data from this tank adequate from a field sampling and analytical laboratory point-of-view? Are there any clarifications or explanations needed for the data tables and figures?

Sampling/Analysis

All appropriate DQO and waste issues have been addressed for this tank and accepted by the Project Hanford Management Contract (PHMC) River Protection Project (RPP). No additional sampling and analyses are necessary to satisfy current issue requirements for this tank.

Additional sampling may be necessary to better understand the physical and chemical characteristics of the waste from a disposal perspective. Given the schedule for Phase II disposal, additional analytical/physical information have a moderate priority from a strictly technical point of view. Behavior of the waste may be adequately understood by sampling tanks with similar waste types. None of the Disposal DQOs were applied to tank 241-S-110 as of June 1999.

Data Quality

The data collected in both the core and vapor sampling events were obtained with approved and recognized laboratory procedures (*Analyis Methods and Procedures* standard report). Quality Control (QC) parameters assessed in conjunction with tank 241-S-110 samples included standard recoveries, spike recoveries, duplicate analyses and blanks. Appropriate quality control footnotes were applied to data outside quality control parameter limits (*Analytical Results* standard report).

The majority of QC results were within the boundaries specified in the sampling and analysis plans. Small discrepancies noted in the analytical reports and footnoted in the analytical results standard report (*Analytical Results* standard report) should not impact the data validity or use.

High relative percent differences (RPD) on duplicate analyses were noted for several analytes, but, because of sample inhomogeneity and/or small sample sizes, no reruns were performed. Spike recoveries exceeded limits for a few analytes but were attributed to the high levels of analytes present in the sample as compared to the spiking levels (*Analytes With Spike Recoveries Outside 100% ± 25%* standard report).

The drainable liquid from core 140, segment 4 was not used in the calculation of the average results for the tank. Liquid was recovered only after 0.3 M LiBr had been added to the tank during sampling.

Unique Aspects of the Tank

Question 6: What are unique chemical, physical, historical, operational or other characteristics of this tank or its contents?

There are no exceptional or unique chemical, physical, historical, operational or other characteristics of this tank or its contents. The waste types in this tank have been previously examined in other tanks and are relatively well defined and understood.

The sampling date documented in the *Description of Tank* standard report does not agree with the dates in the *Core Profiles* standard report for core 241. The dates in the *Description of Tank* standard report are taken from the chain of custody forms received with samples at the laboratory. The dates in the *Core Profiles* standard report are obtained from the field work package. The first sample from core 241 was obtained on June 2, 1998, but since it was an empty, it was not received by the laboratory. The *Description of Tank* standard report therefore shows sampling beginning on June 3, 1998.

Video from inside the tank indicate at least two very small dark supernatant pools located roughly in the center of the tank. The surface of the waste is very rough and uneven. The waste level between risers can vary as much as 63 cm (25 inches) (*Core Profiles* standard report). Some debris, including old level measurement tapes or cable, has been discarded on the sludge surface and is partially imbedded in a cavity in the waste. The video also shows a section of pipe sticking out of the waste near the saltwell screen.

The data from two sampling events are addressed in this TIR – the attempted push mode core sample (core 140, riser 11) in 1996 and two push/rotary mode core samples obtained in 1998 (core 240, riser 14 and core 241, riser 6). During the 1996 sampling of core 140, a hard layer was encountered at segment 4. Three re-samples (segments 4A, 4B, and 4C) were attempted at this level, and each time high down forces (1499 – 2899 lbs) ended sampling efforts. As a result, a full depth core was not obtained and the sampling activity was rescheduled at a later date with rotary mode. LiBr traced water was added during the attempted sampling of core 140 segment 4 (1 cup), 4A (1 gallon), and 4B (2 gallons). Liner liquids were obtained with core 140 segments 4, 4A, and 4C. Drainable liquid, contaminated with bromide, was obtained from core 140, segment 4C. Cores 240 (10 segments) and 241 (8 segments) were obtained in 1998. In both cores, segment 1 was empty. Drainable liquids were obtained from core 241, segments 4, 5, and 6. No solids were obtained from core 241, segments 5 and 6.

Best-Basis Inventory Derivation

Question 7: What is the source data used to derive this tank's Best-Basis inventories by mass (kg) and activity (Ci) for the standard list of 25 chemicals and 46 radionuclides?

The Best-Basis Inventory program is chartered to develop and maintain best-basis inventories of 25 chemical and 46 radionuclide components in the 177 Hanford Site underground storage tanks. These best-basis inventories now serve as waste composition data for the RPP process flowsheet modeling work, safety analyses, risk assessments, and waste retrieval, treatment, and disposal system design.

Development and maintenance of the best-basis inventory is an on-going effort. Since new sample data was recently made available for single-shell tank 241-S-110, a re-evaluation of the best-basis inventories was performed and is documented in the following text. The following information was used in this evaluation:

- Statistical means for the following:
  1996, core 140, segments 1-4 saltcake,
  1998, core 240, segments 2-8, saltcake,
  1998, core 241, segments 2-6, saltcake,
  1998, core 240, segments 9-10, sludge,
  1998, core 241, segments 7-8, sludge,
  1998, core 241, segments 4-6, drainable liquids
  (*Means and Confidence Intervals* standard report).
- Samples from other S and U farm tanks, with similar SMMS1 saltcake and R/CWR sludge waste types (referred to as "templates").
- Hanford Defined Waste (HDW) Model document (Agnew et al. 1997a) which provides tank content estimates in terms of component concentration and inventories.

The following table represents how the available data is used to derive best-basis inventories.

Table 7-1. Tank 241-S-110 Best Basis Inventory Source Data.

Waste Phase	Waste Type	Applicable Concentration Data	Associated Density	Associated Volume
Saltcake Solids	SMMS1	1996/1998 core samples.	1.68 g/mL	242 kgal
		SMMS1 template.	1.63 g/mL	
Sludge	R1/CWR1	1996/1998 core samples – calculated.	1.73 g/mL	118 kgal
Drainable Liquid	SMMS1	1996/1998 core samples.	1.43 g/mL	30 kgal
		1998 Push Core Liquid Mean from U-109	1.47 g/mL	
Total Tank	N/A	HDW model estimates.	1.64 g/mL	390 kgal

Hanlon (1999) gives a total tank volume of 1,476 kL (390 kgal), which is equivalent to a waste depth of 379.2 cm (149.3 inches). This depth is in close agreement with the current level from the Food Instrument Corporation surface level device (FIC) obtained from the Personal Computer interface to the Surveillance Analysis Control System (PCSACS) of 377.4 cm (148.6 inches), and with zip cord measurements (documented in the associated work packages) obtained from riser 11 in 1996 (149.4 inches/379.5 cm), and riser 6 in 1998 (146.1 inches/371.1 cm). The reading obtained from riser 14 in 1998 (178.3 inches/452.9 cm) is high when compared to the other measurements, but riser 14 is near the tank wall and it was noted in the interim stabilization report that there appeared to be caving and crowning in the waste surface (Wicks 1997). Review of the in-tank video taken in 1998 shows a "frozen ocean" or very uneven surface. There appears to be enough low areas in the waste surface to offset the high areas; therefore, no volume adjustment is necessary.

The relative waste phase volumes were determined by comparing the depth profiles and the analytical results. There is a clear difference in the concentration of the major analytes ("fingerprint analytes") at about 97.8cm (38.5 inches), (2 segments = 38 inches + 3 inches for tank bottom offset - 2.5 inches to account for dish depth at this riser location = 38.5 inches) measured from the top of the dish. This equates to 447 kL (118 kgal) of sludge (38.5 inches x 2,750 + 12,500 = 118 kgal). Of the remaining 1,029 kL (272 kgal), 113 kL (30 kgal) is assigned to drainable liquid, based on the 1996 interim stabilization documentation (Wicks 1997). This leaves 916 kL (242 kgal) of saltcake to complete the tank waste inventory.

Close agreement is obtained from comparisons of tank 241-S-110 sample data with analyte concentrations based on process history and average sample data obtained from similar tanks. Best-basis inventory calculations are based on the 1996 and 1998 core sample where available. Where sample data are not available, then the SMMS1 (average analytical results from similar tanks) results are used. The SMMS1 template is based on the average results from tanks 241-S-101, 241-S-102, 241-U-106 and 241-U-109. If no sample data or template data are available for a given analyte, then the HDW model data are used (Agnew et al. 1997a). Other than gamma spectroscopy and gross alpha, analytical results for radionuclides are not available. These results are calculated from the gross alpha and total uranium results, or obtained from the template or model. Data for the liquid phase for total inorganic carbon, total organic carbon, Cs-137 and Sr-90 are obtained from the liquid sample data from tank 241-U-109. No analytical data were available for these analytes from the tank 241-S-110 analysis, and tank 241-U-109 has a projected inventory and process history similar to tank 241-S-110. All inventory calculations were performed using the Best-Basis Inventory Maintenance (BBIM) tool.

The density values for the saltcake and liquid portions of the tank were sample based. No density data for the sludge material are available from the analytical data. The result provided is calculated based on directions obtained from Schofield (1996) and the extrusion information from core 241, segment 7 (406.3g/235.1 mL = 1.73 g/mL).

The updated best-basis inventory for tank 241-S-110 can be found in Standard Reports "*Best Basis Inventory Estimate (Nonradioactive)*" and "*Best Basis Inventory Estimate (Radioactive)*".

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