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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-U-109

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U.S. Department of Energy Contract DE-AC06-96RL13200

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This report prepared especially for Auto TIR on 11/09/99

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 June 24, 1999.

Tank: 241-U-109

Sampling Events:
- 123
- 124
- 128
- 238

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-U-109

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-U-109 include the Safety Screening DQO, the Flammable Gas DQO, the Organic Solvents DQO, the Organic Complexant Safety Issue Memorandum of Understanding (MOU), the Historical DQO, the Compatibility DQO, the Hazardous Vapor Safety Screening DQO, and the Pretreatment DQO.

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-U-109 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. In the 1995-1996 sample event, three full-depth cores were obtained, and analyzed in accordance with safety screening requirements. Safety screening analyses were also performed on 1998 core samples.

Results obtained using differential scanning calorimetry (DSC) indicated that none of the core samples obtained from tank 241-U-109 during 1995-1996 exceeded the safety screening decision threshold of 480 J/g. The highest individual sample result was 301.9 J/g (dry weight). The highest upper limit to a one-sided 95 percent confidence interval on the mean was 493.4 J/g (dry weight), slightly above the Safety Screening and Organic Complexant Safety DQO decision threshold. However, this result was attributed to variability in the data (Baldwin 1996a). Differential scanning calorimetry results were not available for 1998 core samples because of laboratory instrument problems (Steen 1998). As a result, total organic carbon (TOC) was measured, in accordance with (Simpson 1998a). No samples exceeded the TOC threshold of 45,000 μg/g (see "*Analytical Results*" standard report).

Flammable gas in the tank headspace was detected at 1 percent of the lower flammability limit (LFL) prior to 1995 core sampling. During core sampling, and prior to August 1995 vapor sampling, the LFL in the tank headspace reached 9 percent. All headspace measurements were below the safety screening limit of 25 percent of the LFL (see "*IH Sniff Data*" standard report).

The threshold limit for criticality, based on the total alpha activity, is 1 g/L. Assuming that all alpha is from ^{239}Pu, for a sample density of 1.97 g/mL, 1 g/L of ^{239}Pu is 31.2 μCi/g of alpha activity. The maximum total alpha result was 0.151 μCi/g. Therefore, criticality is not a concern for this tank.

Flammable Gas DQO: Does a possibility exist for releasing flammable gases into the headspace of the tank or releasing chemical or radioactive materials into the environment?

The Flammable Gas DQO has been extended to apply to all tanks (Bauer and Jackson 1998). Analyses and evaluations will change according to program needs until this issue is resolved. Final resolution of the flammable gas safety issue is expected by September 30, 2001 (Johnson 1997).

Retained gas samples (RGS) were analyzed for segments 2, 4, 6, and 8 of the 1998 core samples to address flammable gas issues. The results of RGS testing are reported in Mahoney et al. (1998). The total standard gas volume in tank 241-U-109 was 230 ± 120 m^3 at 1 atm. This corresponds to an average gas volume fraction in the solids layer of 0.16 ± 0.08. The gas composition included: 46 mole % N_2, 25 mole % H_2, 27 mole % N_2O, and 0.7 mole % ammonia. The remaining gas is composed of methane and other hydrocarbons. Measured local ammonia concentrations ranged from 33,000 to 84,000 μmole/L of waste, more than 99.9 % of which dissolved in the liquid.

Chemical analyses and physical property measurements were performed to evaluate the gas generation and release characteristics of the waste. These analyses were performed only on the non-RGS segments of core 238 obtained in 1998. The RGS segments were not analyzed because the RGS sample extrusion and analysis procedure alters the characteristics of the samples and would have compromised the post-RGS extrusion results (Hall 1998b). The sludge viscosity was not measured because the analytical method did not become available until several months after the samples had been extruded. The samples had visibly changed by then, negating the value of performing the analysis. Also, at the request of the Flammable Gas Program (Hall 1998a), the solids settling rate test was not performed.

Tank 241-U-109 is equipped with a standard hydrogen monitoring system (SHMS) for the collection of vapor-phase data that support resolution of flammable gas issues. The SHMS monitors hydrogen continuously. From December 1995 to June 1998, eleven hydrogen gas release events (GREs) were documented for tank 241-U-109 based on SHMS data. The maximum concentration of hydrogen released was 2,190 ppm on December 13, 1995. This is well below the action level of 6,250 ppm of hydrogen. These releases are documented in the report *Results of Vapor Space Monitoring of Flammable Gas Watch List Tanks* (McCain and Bauer 1998).

Organic Solvents DQO: Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?

The data needed to address the organic solvent screening issue are documented in *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997). Based on semi-volatile analytical measurements during the 1995 vapor sampling event, the organic solvent surface area was estimated to be 0.45 m^2, below the 1 m^2 limit (Huckaby and Sklarew et al. 1997).

The organic program has determined that even if an organic solvent pool does exist, the consequence of a fire or ignition of organic solvents is below risk evaluation guidelines for all tanks (Brown et al. 1998). The organic solvent issue is expected to be closed for all tanks in 1999.

Organic Complexant Safety Issue 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 DSC, TOC and sample moisture analyses were conducted to address the organic complexant issue.

Differential scanning calorimetry was completed for 1995 core samples and TOC analyses were completed for 1995 and 1998 core samples. All DSC results were well below 480 J/g (dry weight basis) and TOC results were below 45,000 μg/g (dry weight basis). The maximum TOC concentration was 15,700 μg/g (dry weight basis) for core 123, segment 9A. This is below the action limit. The data suggest that a propagating reaction in the waste is unlikely and is not a concern.

The organic complexants safety issue was closed for all tanks in December 1998 (Owendoff 1998).

Historical 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 sampling. 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).

Tank 241-U-109 was selected for historical evaluation because it was expected to contain 242-S Evaporator saltcake (SMMS1) and 242-S Evaporator salt slurry (SMMS2) layers thick enough to provide entire segments composed of these two waste types (Agnew et al. 1997a). The first step in the evaluation is to compare the analytical results with DQO-defined concentration levels for the key analytes. This comparison indicates that the predicted waste type is in the tank and at the predicted location within the waste. If the analytical results are ≥ 10 percent of the DQO defined levels, and if the analytes shown in Table 1-1 compose at least 85% by weight of the waste, the waste type and layer identification are considered acceptable, and further analyses are not requested (Simpson and McCain 1997).

According to Agnew et al. (1997a), segments 1 through 4 should be SMMS2 salt slurry and segments 5 through 8 should consist of SMMS1 saltcake. Segment 9 was predicted to be REDOX cladding waste (CWR1) and metal waste (MW). The analytical results for the key analytes were compared to the historical model evaluation DQO-predicted concentrations for the SMMS2 salt slurry and SMMS1 saltcake waste types. The key analytes for these two waste types were sodium, aluminum, chromium (SMMS1 only), carbonate, nitrate, phosphate (SMMS2 only), sulfate, and water. The results (Table 1-1) indicate that all of the analytical results exceeded the 10 percent criterion specified in the DQO. However, because some of the segments were dry and the percent

water was low, some of the segments did not meet the 85% criteria. In general, it appears that the predicted waste types are present in the tank. Although the samples failed the 85% criterion, further historical assessments will be applied to the samples in accordance with the historical DQO (Simpson and McCain 1997).

Table 1-1. Comparison of Core Sample Data to Historical Waste Streams

Analyte	Unit	Minimum 1995 Cores Seg. 1-4	Minimum 1998 Cores Seg. 1-4	Minimum 1995 Cores Seg. 5-8	Minimum 1998 Cores Seg. 5-8	SMMS1[1]	SMMS2[1]
Na [2]	ppm	2.03E+05	1.87E+05	1.92E+05	2.11E+05	195,400	215,500
Al [2]	ppm	4,420	11,300	9,510	9,920	31,000	37,000
Cr [2]	ppm	1,350	2,680	2,430	2,570	3,000	
H_2O	percent	6.38	19.3	11.9	19.6	32.1	29.9
NO_3	ppm	1.68E+05	1.32E+05	1.06E+05	1.98E+05	274,300	174,500
CO_3 [3]	ppm	3,760	22,200	20,100	27,300	17,000	20,200
PO_4	ppm	NM	3,990	NM	7,110	n/a	18,000
SO_4	ppm	NM	8,790	NM	12,600	13,000	28,700

Notes: NM = not measured, n/a = not applicable.

[1]Simpson and McCain (1997)
[2]Minimum average segment value for all fusion and acid digest analyses.
[3]Total inorganic carbon times 5.

Compatibility DQO:

Will safety problems be created as a result of mixing waste in interim storage? Do operations issues exist which should be addressed before waste is transferred?

Liquid will be pumped from tank 241-U-109 to stabilize the tank by removing the threat of significant leakage. Therefore, the requirements of the *Data Quality Objectives for Tank Farms Waste Compatibility Program* (Mulkey and Miller 1998, Fowler 1995) were applied to liquids recovered from the June 1995 grab samples and 1998 core samples.

Because of changes in saltwell pumping schedules, a compatibility assessment was not performed for the 1995 grab samples. Saltwell pumping of tank 241-U-109 is scheduled to begin in April 2000. A compatibility assessment using the 1998 drainable liquid core sample results will be completed before saltwell pumping begins.

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

Tank 241-U-109 was vapor sampled in August 1995. Flammability results (Evans et al. 1996) were well below action limits and no constituents, except ammonia (577 ppmv), exceeded industrial hygiene notification limits.

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).

Pretreatment DQO: What fraction of the waste is soluble when treated by sludge washing and leaching?

Samples were archived for future pretreatment analyses and evaluation in accordance with *Strategy for Sampling Hanford Site Tanks for Development of Disposal Technology* (Kupfer et al. 1995).

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 process history was 4.49 kW (15,300 Btu/hr) (Agnew et al. 1997a). The heat load estimate based on the tank headspace temperature was 1.72 kW (5,865 Btu/hr) (Kummerer 1995). The tank heat load based on the Best-Basis Inventory (See Standard Report "*Best-Basis Inventory [Radioactive]*") was 1.74 kW (5,930 Btu/hr). These estimates are below the limit of 7.6 kW (26,000 Btu/hr) that separates high and low heat load tanks (Noorani 1999).

Tank History

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

The 241-U Tank Farm was constructed during 1943 and 1944 in the 200 West Area. The U Tank Farm contains twelve 100-series tanks and four 200-series tanks. The 100-series tanks have a capacity of 2,010 kL (530 kgal), a diameter of 22.9 m (75.0 ft), and an operating depth of 4.9 m (16 ft) (Leach and Stahl 1993). Built according to the first-generation design, the 241-U Tank Farm was designed for non-boiling waste with a maximum fluid temperature of 104 °C (220 °F). A cascade overflow line 7.5 cm (3 in.) in diameter connects tank 241-U-109 as the third in a cascade series of three tanks, beginning with tanks 241-U-107 and -U-108. Each tank in the cascade series is set 0.3 m (1 ft) lower in elevation from the preceding tank. The cascade overflow height is approximately 4.9 m (16 ft) from the tank bottom and 610 mm (2 ft) below the top of the steel liner.

Tank 241-U-109 first received metal waste from tank 241-U-108 in March 1949 and was full by the third quarter of 1949. Removal of the metal waste started in 1953 and was completed in the first quarter of 1954. New metal waste started entering the tank in the third quarter of 1954, and the tank was full by the fourth quarter of the same year. Metal waste was sluiced from tank 241-U-109 in the second quarter of 1956, and the tank was declared empty (Agnew et al. 1997b).

In the third and fourth quarters of 1956, tank 241-U-109 received REDOX cladding waste supernatant. Except for a few additions of water, no tank transfers occurred until 1969 when most of the waste was sent to tank 241-TX-118. In the fourth quarter of 1969, supernatant was received from tank 241-U-107. No further transfers occurred until 1974 when much of the waste was sent to tank 241-S-110. In the fourth quarter of 1975, tank 241-U-109 received evaporator bottoms from the 242-S Evaporator Crystallizer. In the first quarter of 1977, residual liquor was received. Tank 241-U-109 was declared inactive in the first quarter of 1978.

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-U-109 is the third tank in a cascade consisting of tanks 241-U-107 , -U-108, and -U-109, and received metal waste essentially similar to that deposited in the other tanks of the cascade. However, following the removal of metal waste from the 241-U Tank Farm, the tanks in the cascade operated individually to receive and transfer waste. Tank 241-U-109 currently contains CWR1, SMMS1, and SMMS2 waste. Other tanks in the S, SX, SY, and U tank farms contain these same waste types.

Analytical data from selected segments from tanks 241-U-109, -S-101, -S-102 and -U-106 were determined to be representative of SMMS1. Analytical results from these tanks provide insight into the composition of the SMMS1 layer in tank 241-U-109. Analytical data from tank 241-U-109 also provides information about the SMMS1 layer in other tanks. This is of particular value for estimating the compositions of tanks such as, 241-S-105, -S-108, -S-112, -SX-104, and -U-111, which are expected to contain significant quantities of SMMS1 waste, and for which only limited core sample data are available.

Analytical data from different segments from tanks 241-S-101, S-102, U-102, U-107, and U-109 were determined to be representative of SMMS2 waste. Analytical results from these tanks provide insight into the composition of the SMMS2 layer in tank 241-U-109. Analytical data from tank 241-U-109 also provides information about the SMMS2 layers in other tanks. This is of particular value for estimating the compositions of tanks such as 241-SX-104 and –U-111, which are expected to contain significant quantities of SMMS2 waste, and for which limited core sample data are available.

Analytical data from different segments from tanks 241-S-102, -S-104, and –S-107 were determined to be representative of CWR1 sludge. The small CWR1 sludge layer appears in tank 241-U-109 only in the lowest portions of segment 9 in cores 123, 128, and 238. In cores 123 and 238, the lowest few inches were darker than the remainder of the segment and were sub-sampled separately from the remainder of the segment. The lowest few inches of tank 241-U-109 core samples had a very high aluminum concentration and low sodium and nitrate levels, and may reflect less mixing with other waste types, compared to other tanks containing CWR1 sludge.

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?

Given what is known about the waste types and behaviors in tank 241-U-109, several items should be considered in regard to waste retrieval. Tank 241-U-109 is on the Watch List for the flammable gas issue (Public Law 101-510), and the waste retains ammonia and other flammable gases. The waste is at ambient temperature and consists of salt slurry, dry to moist saltcake, and a small sludge heel.

Tank 241-U-109 has not yet been interim stabilized. A compatibility assessment will specify measures required to safely transfer drainable liquids to the double-shell tank system. Localized high phosphate concentrations in the saltcake region immediately above the sludge layer may result in saturation of saltwell liquors with phosphate; this should be considered when assessing dilution and pumpability requirements. The low waste temperature reduces the likelihood of supersaturation and pluggage in the transfer line.

The remaining waste in tank 241-U-109 resembles a damp saltcake, which was readily penetrated by push-mode core samplers. This material may become quite hard as it drys out after completion of interim stabilization. The sludge layer beneath the saltcake is expected to retain most of its moisture and remain soft after interim stabilization.

Sample results showed that the tank waste has low total alpha concentrations greatly alleviating criticality concerns during retrieval and processing. Organic solvent surface areas are also low compared to threshold limits. The waste in the tank is not exothermic and the flammable gas concentrations in the tank headspace are low (1 percent of the LFL). The vapors of tank 241-U-109 were within health hazard threshold limits for all analytes measured except ammonia (Evans et al. 1996).

The primary concern for this tank is the retained gas in the crust, supernatant, and sludge waste layers. Standard Hydrogen Monitoring System (SHMS) data showed that the tank has experienced several gas release events in recent years. Retained gas sample (RGS) data indicate that flammable and toxic gases retained in the waste may be released when the waste is retrieved. Flammable gas issues should be carefully considered before saltwell pumping or other waste retrieval methods are implemented. Assessments that could be conducted to better address disposal implications include: evaluating potential impediments to pretreatment and estimating the number of glass logs that tank 241-U-109 will make. These assessments are beyond the scope of the current effort.

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 and Analysis

All appropriate DQO and waste issues have been addressed for this tank and accepted by the Project Hanford Management Contract River Protection Project. No additional sampling and analyses are necessary to satisfy current safety issue requirements for this tank. Additional sampling may be necessary to better understand the physical characteristics of the waste from a disposal perspective. Issues related to permits, retrieval of the saltcake, and retrieval of the sludge are not completely understood by the current analytical information. Given the schedule for Phase II disposal, this additional analytical/physical information has a moderate priority from a strictly technical point of view. This additional information on the behavior of the waste may be adequately understood by sampling tanks with similar waste types. None of the Disposal DQOs have been applied to this tank.

Data Quality

The data collected in both the core and vapor sampling events were collected and analyzed with approved and recognized sampling and laboratory procedures and in accordance with sampling and analysis plans (Homi 1995, Baldwin 1996b, Simpson 1998a). The laboratory procedures for the core sample analysis can be found in the standard report *"Analytical Methods and Procedures."* Quality Control (QC) parameters assessed in conjunction with tank 241-U-109 samples included standard recoveries, spike recoveries, duplicate analyses, and blanks. Appropriate QC footnotes were applied to data outside QC parameter limits. Analytical results and data quality are discussed in Baldwin (1996a) and Steen (1998).

The vast 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 should not impact the data validity or use.

Segments 2, 4, and 6 of core 238 were RGS samples. These samples were only used for flammable gas assessments because the data were compromised during processing.

It should be noted that the tank contained primarily dry salt, moist salt, wet salt and salt slurry in the upper segments and a small amount of dry sludge in the lower portion of the bottom segment. There were various colors of material present that were difficult to separate. Obtaining reproducible results with this non-homogenous material was difficult and may have been the main reason for the large differences between sample, duplicate, and triplicate (where applicable) measurements for many of the analyses. In many cases re-analysis and re-digestions did not improve the results (Steen 1998).

Clarification and Explanation of Data Tables and Figures

Description of Tank standard Report: The total volume of the tank differs slightly from the Hanlon (1999) volume. The volume is based on surface level measurements. The volumes of saltcake, supernatant, drainable liquid, and sludge also differ from Hanlon (1999) values and do not add up to the total waste volume. These values are based on extrusion results and tank photos, and do not include the 16 percent (269 kL [71 kgal]) of retained gas in the solids (See *"Core Profiles"* and *"Sub-Sampling Scheme and Sample Description"* standard reports). For additional discussion, refer to question 7, "Best-Basis Derivation."

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 unique chemical, physical, historical, operational, or other characteristics of this tank or its contents. The waste types in this tank are relatively well defined and understood with the same waste types found in a number of other tanks.

The 1988 photographic montage of the tank 241-U-109 interior shows the waste surface to be a mixture of solids and liquids, with what appears to be an orange-colored saltcake floating on top of the liquid. The volume of waste in the tank, 1,760 kL (465 kgal), has not changed since the photographs were taken; therefore, the photographic montage likely represents the current appearance of the tank waste surface.

The tank waste surface level and interstitial liquid level vary in conjunction with barometric pressure fluctuations. The correlation between waste level and atmospheric pressure variations may indicate the presence of gas trapped in the waste. Several gas release events have been identified in recent years from SHMS data.

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 River Protection Project 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-U-109, 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 based on analytical data from the December 1995, January 1996, and April 1998 push mode core samples from tank 241-U-109 (See *"Means and Confidence Intervals"* standard report).

- The Hanford Defined Waste (HDW) model document (Agnew et al. 1997a) which provides tank content estimates in terms of component concentrations and inventories.
- Engineering evaluations of S and U Farm tank data for SMMS1, SMMS2, and CWR1 waste types.
- Tank waste volume estimates based on surface level measurements, tank photos (Brevick et al. 1997) and extrusion results ("*Sub-sampling Scheme and Sample Description*" standard report).

The following table represents how the available data were used to derive best-basis inventories for tank 241-U-109.

Table 7-1. Tank 241-U-109 Best-Basis Inventory Source Data

Waste Phase	Waste Type	Applicable Concentration Data	Associated Density	Associated Volume
Saltcake Solids	SMMS1/ SMMS2	1995, 1996, and 1998 core sample results.	1.67 g/ml	1,306 kL (345 kgal)
Sludge	CWR1	1995, 1996, and 1998 core sample results	1.71 g/mL	114 kL (30 kgal)
Supernatant	SMMS2 drainable liquid	1998 core sample results	1.47 g/mL	72 kL (19 kgal)
Retained Gas	Retained Gas	None	0.00 g/mL	269 kL (71 kgal) from RGS
Total Tank	Aggregate of Tank Waste	1995 and 1996 core sample composite results	1.71 g/mL	1,760 kL (465 kgal)
		HDW Rev. 4	1.80 g/mL	

Where available, the 1995, 1996, and 1998 sample data were considered the best source for analyte concentrations. Because the tank has been inactive since 1978, sample data from 1995, 1996, and 1998 push mode core samples were combined to generate the mean concentrations. Sample data are available for most of the 25 chemical species, but few radionuclide data are available. Template values were used when analytical data were not available. The SMMS1 saltcake template is based on average sample concentrations for tanks 241-S-101, -S-102, -U-106, and –U-109. The SMMS2 saltcake template is based on average sample concentrations for tanks 241-S-101, -S-102, -U-102, -U-107, and –U-109. In all cases, whenever tank 241-U-109 sample results were less than the detection limit, analytical detection limits were used as the best-basis concentration in preference to higher template values. Similarly, analytical detection limits were used as the best-basis in preference

to higher CWR1 sludge template values based on data from tanks 241-S-101, -S-104, -S-107, and –U-109. The 1998 core sample provided the only concentration data available for the supernatant phase. No template was available for the supernatant layer.

Where neither tank 241-U-109 sample data nor sample based template data were available, the analyte concentrations were estimated based on other tank 241-U-109 data or from HDW model values. For example, the Sr concentrations for supernatant and saltcake were calculated from the ^{90}Sr analytical data. The hydroxide concentration was calculated from a charge balance of the other ionic species present. Concentrations of short-lived radionuclides ^{90}Y and ^{137m}Ba were calculated from ^{90}Sr and ^{137}Cs sample data. Uranium isotopes were calculated from the uranium sample data using the isotopic distribution in the HDW model (Agnew et al. 1997a). The concentrations of Pu and other alpha-emitting isotopes were calculated from the sample uranium and total alpha concentrations, and the HDW model isotopic distribution. Because the concentration of mercury was not measured, mercury values were based on Simpson (1998b) estimates. Other radionuclide inventories were obtained from the HDW model.

The density values for the supernatant, saltcake, and sludge portions of the tank were sample-based means.

The total tank volume of 1,752 kL (463 kgal) in (Hanlon 1999) is slightly below recent surface level and neutron surveillance level readings, which correspond to a tank volume of 1,760 kL (465 kgal). The best-basis inventory assessment assumed a tank volume of 1,760 kL (465 kgal).

Based on the historical solids level data (see Standard Report *"241-U-109 HTCE Surface Levels"*), the sludge volume was calculated to be 114 kL (30 kgal). This overall sludge volume agrees well with the sharp demarcation in Al and Na concentrations noted in the core sample data, as well as with the core profiles (see Standard Report *"Core Profiles"*) and the neutron and gamma profiles. The overall volume of the supernatant was 72 kL (19 kgal) (Hanlon 1999). This volume was based on a photographic evaluation of the liquid pools covering approximately 60 percent of the waste surface. The overall volume of the saltcake phase is 1,306 kL (345 kgal), by difference. The RGS analysis estimated that retained gas comprises 16 percent of the solids volume (Mahoney et al. 1998). Although the RGS samples only measured the saltcake region, the volumes in Table 7-1 were adjusted to account for the RGS data, assuming that the supernatant retains no flammable gas, and that both the salt cake and the sludge contain 16 percent retained gas by volume. This equates to 269 kL (71 kgal) of retained gas that was was excluded from the inventory calculations. The total tank waste volume, including retained gas, is 1,760 kL (465 kgal). Mean sample concentrations for the overall saltcake phase were used in this assessment and compared with the individual SMMS1 and SMMS2 saltcake waste type templates.

The combined 1995, 1996, and 1998 sample data were preferred, where available. Where sample data are available, data for individual segments or subsegments were preferred over core composite data. The only core composite data used was the uranium phosphorescence analysis. No template data were used because the gaps in the sample data matched those in the template data. If no sample or template data were available for a given analyte, then HDW model results (Agnew 1997a) were used. All inventory calculations were performed using the Best-Basis Inventory Maintenance (BBIM) tool.

The best-basis inventory for tank 241-U-109 can be found in Standard Reports *"Best Basis Inventory Estimate (Nonradioactive),"* and *"Best Basis Inventory Estimate (Radioactive)."*

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