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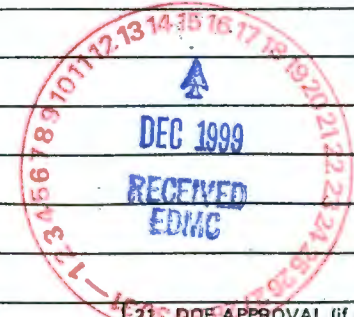
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# Auto Tank Interpretive Report for Tank 241-S-111

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Lockheed Martin Hanford, Corp., Richland, WA 99352  
U.S. Department of Energy Contract DE-AC06-96RL13200

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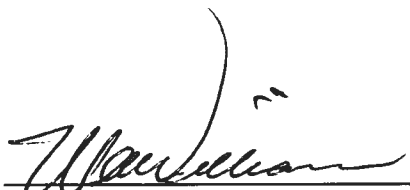
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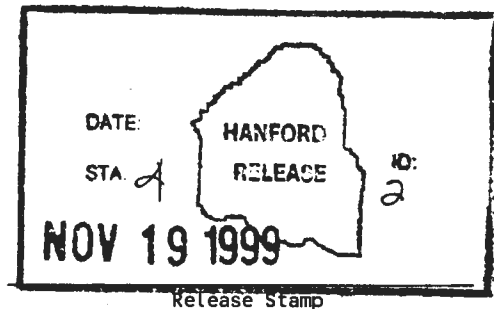
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Release Approval

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Date



**Approved for Public Release**

**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 4, 1999.**

Tank: 241-S-111

Sampling Events:

149

150

237

Reports:

Tank Interpretive Report

Constituent Groups:

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**Data Dictionary to Reports in this Document**

<b>Report</b>	<b>Field</b>	<b>Description</b>
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-111

### 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 single-shell tank 241-S-111 include the Flammable Gas data quality objective (DQO), Historical Model DQO, Compatibility DQO, Safety Screening DQO, Organic Complexant Safety Issue memorandum of understanding (MOU), Hazardous Vapor Screening DQO and the Organic Solvents DQO.

**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 1997). Analyses and evaluations will change according to program needs until this issue is resolved. Final resolution of the flammable gas safety issue is expected to be completed by September 30, 2001 (Johnson 1997).

Retained gas samples were taken and analyzed to address flammable gas issues. No specific notification limits have been determined to meet this DQO. Retained gas sampler (RGS) sampling showed that the insoluble retained gases in S-111 had an average composition of 20 mol % nitrogen, 68 mol % hydrogen, 11 mol % nitrous oxide, and 0.9 mol % ammonia, with other minor components (Mahoney et al. 1998). The measured ammonia levels were between 13,000 and 78,000  $\mu\text{mol/L}$  of waste. The RGS samples retained gas volume fractions between 0.0008 in the supernatant to 0.22 in the solids. The average gas fraction in the solids layer was 0.16, corresponding to an estimated inventory of 230  $\text{m}^3$  of gas in the tank solids (Mahoney et al. 1998).

A standard hydrogen monitoring system (SHMS) has been installed in tank 241-S-111 to monitor the hydrogen concentration in the headspace. The monitoring system has been operating since August 21, 1995. The highest concentration of hydrogen reported for the tank is 1,270 ppm on December 14, 1995 (McCain and Bauer 1998). In addition, several grab samples were taken through the SHMS from July, 1995 to April, 1998. The hydrogen concentrations in these samples varied from less than 5 ppm to 280 ppm (McCain and Bauer 1998).

A vapor sample was taken on March 21, 1995 via the Vapor Sampling System. Analyses indicated that the ammonia concentration was 122 ppm and the hydrogen concentration was 391 ppm. The total concentration of positively identified organic compounds was 0.75 ppm (Huckaby and Bratzel 1995).

The Lower Flammability Limit (LFL) for hydrogen in air is 25,000 ppm, and the LFL for ammonia is 150,000 ppm. The action level stated in the safety screening DQO is 25 percent of the LFL (by gas specific monitoring gauges or gas chromatography/mass spectrometry). McCain and Bauer (1998) gives an action limit for hydrogen of 6,250 ppm, adjusted to account for the effect of other flammable gases. All reported results for this tank are well below this action limit. The results are variable, indicating that the concentration of hydrogen in the vapor space fluctuates. McCain and Bauer (1998) estimates that the tank is at 1.1 percent of the LFL, based on data from the March 21, 1995 vapor sample.

**Historical Model DQO:** Is the waste inventory generated by a model based on process knowledge and historical information (Agnew et al. 1997) 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., 1997), 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).

Because tank 241-S-111 is considered a "spatially complex tank," specific waste types are not required to be investigated. Rather, a specified set of analyses were completed on all solid sub-samples, along with a larger set of analyses on composites of each core. These analyses are expected to indicate where different waste layers are within the tank and provide overall tank composition data for comparison to the predicted inventory from the historical model.

Inspection of the data (See standard reports "*Analytical Results*" and "*Tank Sub-sampling Scheme and Sample Description*") reveals that at least three distinct layers are present in the tank - a liquid pool, a high sodium, high nitrate saltcake layer that constitutes the bulk of the solids, and a high aluminum sludge layer on the bottom. In Table 1-1, core sample data are compared with predicted waste type compositions. The data indicate that the saltcake is consistent with the SMMS1 waste type. The sludge results appear much closer to REDOX cladding waste (CWR) than R sludge, but the agreement is poor if compared on a dry basis.

The data from tank 241-S-111 will be used in multi-tank statistical comparisons of sampling data and modeling predictions that are beyond the scope of this report.

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

Analyte	Unit	Core 149 Seg. 4-8	Core 237 Seg. 4-8	S1 Saltcake <sup>1</sup>	Core 149 Seg. 10-11	CWR <sup>1</sup>	R <sup>1</sup>
Na	ppm	216,000 <sup>2</sup>	201,000 <sup>2</sup>	195,400	69,000 <sup>3</sup>	52,500	33,000
Al	ppm	15,000 <sup>2</sup>	22,000 <sup>2</sup>	31,000	249,000 <sup>3</sup>	114,000	58,200+
Fe	ppm	-	-	-	< 1100 <sup>3</sup>	-	38,100+
Cr	ppm	5,460 <sup>2</sup>	8,160 <sup>2</sup>	3,000	2,685 <sup>3</sup>	-	30,600+
H <sub>2</sub> O	percent	29.9	36.5	32.1	11.1	69.4	44+
NO <sub>3</sub>	ppm	281,000	196,000	274,300	-	-	-
CO <sub>3</sub>	ppm	61,700	41,950	17,000	4,690	-	8700
SO <sub>4</sub>	ppm	22,000	18,400	13,000	-	-	-
<sup>137</sup> Cs	μCi/g	-	-	-	67.7	-	41+
<sup>90</sup> Sr	μCi/g	-	-	-	-	-	94+
U	Ppm	-	-	-	< 11,000 <sup>3,4</sup>	28,200	3500+

## Notes:

<sup>1</sup>Simpson and McCain 1997<sup>2</sup>Acid digest-Inductively coupled plasma (ICP) results<sup>3</sup>Fusion digest-ICP results<sup>4</sup>Acid digestion results were < 235 ppm.

**Waste 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-S-111 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 1997 and Fowler 1995) were applied to liquids recovered from the core samples.

Compatibility analyses are typically performed on liquid grab samples. However, for tank 241-S-111, analyses were performed on drainable liquid sub-samples from core 149 and core 237. Results were compared against the decision rules stated in the Compatibility DQO. No results exceeded action limits derived from the Compatibility DQO. The data are compared to the applicable compatibility limits in Table 1-2. No comparison is made if information on the receiver tank is necessary to determine compatibility.

Table 1-2. Waste Compatibility Data Quality Objective Criteria.<sup>1</sup>

Issue	Program Requirement <sup>2</sup>	Analytical Result <sup>3</sup>
Criticality	Pu < 0.001 g/L	< 3.14 E-6 g/L <sup>4</sup>
Flammable gas accumulation	SpG < 1.3 or Commingled waste < 1.41	1.36
Energetics	Exotherm/endothrm ratio < 1	0 (no exotherms)
	no separable organic phase	no separable organics
TRU segregation	TRU < 100 nCi/g	< 0.41 nCi/g (sum of <sup>239/240</sup> Pu and <sup>241</sup> Am)
Corrosion control <sup>5</sup>	If NO <sub>3</sub> < 1.0 mol/L: then 0.01 mol/L < OH < 8.0 mol/L and 0.011 mol/L ≤ NO <sub>2</sub> ≤ 5.5 mol/L  If 1.0 < NO <sub>3</sub> ≤ 3.0 mol/L: then 0.1 x NO <sub>3</sub> ≤ OH < 10 mol/L and OH + NO <sub>2</sub> ≥ 0.4 x NO <sub>3</sub>  For NO <sub>3</sub> > 3.0 mol/L: then 0.3 mol/L ≤ OH < 10 mol/L and OH + NO <sub>2</sub> ≥ 1.2 mol/L and NO <sub>3</sub> ≤ 5.5 mol/L	OH = 2.4 mol/L NO <sub>2</sub> = 1.45 mol/L NO <sub>3</sub> = 3.11 mol/L
Phosphate waste	If PO <sub>4</sub> > 0.1 mol/L, then do not mix with high salt (Na > 8.0 mol/L) waste	0.047 mol/L PO <sub>4</sub>

## Notes:

<sup>1</sup>Results are from Steen (1996a and 1996b). Average results are used except where "less than" results were reported; the highest result or less than value was used in these cases.

<sup>2</sup>Mulkey and Miller 1997

<sup>3</sup>Liquid samples only

<sup>4</sup>Assumes all <sup>239/240</sup>Pu is <sup>239</sup>Pu and uses a specific activity of 0.0615 Ci/g.

Because of changes in saltwell pumping schedules, a compatibility assessment was not performed for the drainable liquid results for 241-S-111 core samples. Grab samples are scheduled to be taken to obtain additional analyses in support of saltwell pumping transfers to tank 241-SY-102, scheduled to begin in fiscal year 2001.

**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-111 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 for the Safety Screening DQO.

The threshold limit for energetics is 480 J/g on a dry weight basis. Results obtained using differential scanning calorimetry (DSC) showed that exotherms were apparent in 6 of the 19 sub-samples from core 149 and 2 of the 10 samples from core 237 (See standard report "*Analytical Results*"). No exotherm was detected in any liquid sample. The largest exotherm was 191 J/g (dry weight basis) for the core 237 segment 5, upper half solids sub-sample. Sample results are compared to the limit using the one-sided, upper 95% confidence interval. The highest 95% upper confidence limit on the mean was 209.5 J/g on a dry basis, which is well below the limit of 480 J/g.

The threshold limit for criticality, based on total alpha activity, is 1 g/L. Assuming that all alpha activity is from  $^{239}\text{Pu}$ , and assuming a density of 1.87 g/mL (the highest result measured for the core samples), 1 g/L of  $^{239}\text{Pu}$  is equivalent to 32.9  $\mu\text{Ci/g}$  of alpha activity.

As required by the DQO, the upper limit to a one-sided 95 percent confidence interval on the mean was calculated for each sub-sample. The highest upper limit on the mean was for total alpha was 0.207  $\mu\text{Ci/g}$ , or more than 100 times below the limit. The drainable liquid samples from core 149 (segments 1, 2, and 3) were also analyzed for  $^{239/240}\text{Pu}$ . All results were below detection limits. The highest detection limit value was 1.93E-04  $\mu\text{Ci/mL}$ .

All results were well below the action limit, suggesting that the waste does not pose a criticality hazard.

Combustible gas tests show a flammable gas reading of 2% of the LFL during core sampling. The *Industrial Hygiene Sniff Data* standard report from the 1995 vapor sample event shows an LFL of less than 1 percent. These values are below the safety screening limit of 25 percent of the LFL.

**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, total organic carbon, and sample moisture analyses were conducted to address the organic complexant issue.

Differential scanning calorimetry was applied to liquid sub-samples and homogenized half segments of the solids from core 149 and core 237. All results were well below 480 J/g. The action limit for total organic carbon (TOC) for the organic complexants issue is 45,000  $\mu\text{g/g}$  (dry weight basis). The results from core 149 and core 237 samples indicate that the maximum TOC concentration was 8,011  $\mu\text{g/g}$  (dry basis) for core 237, segment 5, lower half. The highest 95% confidence interval result (on a dry basis) for a single sub-sample was 12,800  $\mu\text{g/g}$ , which is well below the action limit. The data suggest that a propagating reaction in the waste is unlikely and is not a concern.

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

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

The data required to support the organic solvent screening issue are documented in *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997). The DQO requires that tank headspace samples be analyzed for total non-methane organic compounds to determine whether the organic extractant pool in the tank is a hazard. The purpose of this assessment is to ensure that an organic solvent pool fire or ignition of organic solvents cannot occur.

Although total non-methane hydrocarbon analyses were not performed, vapor samples taken in March 1995 showed that the organic vapor concentrations in tank 241-S-111 are low (Huckaby and Bratzel 1995). As a result, the organic solvent pool size in this tank was not calculated. The Organic Program has determined that even if an organic solvent pool does exist, the consequences of a fire or ignition of organic solvents is below risk evaluation guidelines for all of the tanks (Brown et al. 1998). The organic solvent safety issue is expected to be closed for all tanks in 1999.

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

Tank 241-S-111 was sampled on March 21, 1995. Flammability results were well below action limits, and Huckaby and Bratzel (1995) reported that no headspace constituents 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:** What fraction of selected sludge analytes is soluble when treated by sludge washing and leaching?

A composite of core 149 solids was submitted for ICP metals analysis following a water digest. The results indicate that approximately 80 percent of the phosphorus, 25 percent of the chromium, and 25 percent of the aluminum is water-soluble (Lumetta et al. 1997). The aluminum concentration in the sludge is very high (249,000 µg/g) (see Analytical Data Standard Report).

Although not required in the *Strategy for Sampling Hanford Site Tank Wastes for Development of Disposal Technology* (Kupfer et al. 1995), a sludge sample from tank 241-S-111 was provided for sludge washing and leaching studies. Sample material from tank 241-S-111 was used because other tanks expected to contain REDOX sludge had not yet been sampled. The sample was a composite of segments 9-11 of core 149. Results showed that all of the phosphorous was removed from tank 241-S-111 samples by washing with dilute NaOH. Enhanced sludge washing by leaching the sludge with NaOH (2 to 3 M) then washing with dilute NaOH was required to remove aluminum and sodium

analytes from the sample. The  $^{137}\text{Cs}$  radionuclide was also removed to acceptable levels for the low level waste (LLW) form for glass logs. About half of the  $^{137}\text{Cs}$  was removed by dilute hydroxide washing and most of the rest was removed by caustic leaching. The  $^{90}\text{Sr}$  levels in the samples were below required LLW levels without washing or leaching.

Lumetta et al (1997) provides additional information regarding the sludge washing and leaching test procedure and results.

### 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 5,850 W (20,000 Btu/hr) (Brevick et al. 1997). The heat load estimate based on the tank headspace temperature was 1,870 W (6,380 Btu/hr) (Kummerer 1995). The heat load estimated from the best-basis inventory (See standard report "*Best-Basis Inventory Estimate (Radioactive)*") presented in Table 1-3 is 6,200 W (21,200 Btu/hr). All of these estimates are below the 11,700 W (40,000 Btu/hr) limit that separates high and low heat load tanks.

Table 1-3. Heat Load Estimate Based on the Best-Basis Radionuclide Inventory.

Radionuclide	Waste Inventory <sup>1</sup>	Specific Activity <sup>2</sup>	Heat Load
Strontium-90	6.74 + E5 Ci	0.00670 W/Ci	4,520
Cesium-137	3.55 + E5 Ci	0.00472 W/Ci	1,680
Total	-	-	6,200

### Notes:

<sup>1</sup>From solids core composite data, and solids volume of 2,040 kL (540 kgal).

<sup>2</sup>Includes daughter isotopes.

## Tank History

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

The 241-S Tank Farm was constructed during 1950 and 1951 in the 200 West Area on the Hanford Site. The farm contains 12 100 series single-shell tanks. Tank 241-S-111 is passively ventilated and is the second tank in a three-tank cascade series (Brevick et al. 1997). Tank descriptions and figures are presented in standard reports "*Description of Tank*", "*Tank Plan View*", "*Tank Profile View*", and "*Riser Configuration Table*".

The tank went into service in 1952 when it received high-level reduction-oxidation (REDOX) waste cascaded from tank 241-S-110. The tank received high-level REDOX waste and REDOX cladding waste intermittently until 1957. A small transfer of cladding waste was received from tank 241-S-107 in 1965. From 1974 to 1976, waste from the tank was pumped to tank 241-S-102 for evaporator feed. Evaporator bottoms were returned to the tank intermittently over this time period. The tank was removed from service and declared inactive in 1976. A total of 322 kL (85 kgal) of salt well liquor was pumped from the tank from 1985 to 1992 (Agnew et al 1997b). The tank was

partially interim isolated in 1982. Additional salt well pumping is scheduled to start in fiscal year 2001 to stabilize the tank.

Tank 241-S-111 has an operating capacity of 2,869 kL (758 kgal), and presently contains an estimated 2,044 kL (540 kgal) of non-complexed waste (Hanlon 1999). The tank is designated as sound and is on the Watch List for Flammable Gas (Public Law 101-510). Tank 241-S-111 was removed from the Watch List for Organics when the organic complexants safety issue was closed in December 1998 (Owendoff 1998).

### **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-111 is the second tank, in a line of three cascading tanks, including tanks 241-S-110 and 241-S-112. Tank 241-S-110 has also been sampled and analyzed, and the resultant data contribute to understanding tank 241-S-111 process history and waste composition. Limited data are available for tank 241-S-112.

Tank 241-S-111 contains REDOX and REDOX cladding waste (R/CWR) and saltcake from the 242-S evaporator (SMMS2)(Agnew et al. 1997a). Tanks 241-S-101, S-104, S-107 and S-110 also contain R/CWR waste and contribute to an understanding of the sludge layer in tank 241-S-111.

Tanks 241-S-101, S-102, S-110, U-106 and U-109 contain SMMS2 expected to be similar to the salt cake waste in tank 241-S-111 based on statistical grouping studies (Remund et al 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?*

Tank 241-S-111 has been core sampled and grab sampled. Additional grab sampling and analyses are scheduled for compatibility analysis prior to beginning saltwell pumping. The tank is expected to be interim stabilized between 2001 and 2003. No problems are anticipated during saltwell pumping.

The waste was too hard to push using the push core method and sampling of riser #14, core 150 was abandoned after obtaining waste for only the top three of eleven potential segments. This indicates that some of the waste may require softening to be retrieved.

Although the tank is on the Watch List for flammable gas and was on the Watch List for organics, all dry weight exotherms were below the safety limit of 480 J/g, and total alpha and flammability were well below the safety limit. SHMS monitoring is ongoing for flammable gas levels in the tank.

Pretreatment sludge washing and leaching tests (Lumetta et al. 1997) showed that caustic leaching is required to remove aluminum, phosphorous and <sup>137</sup>Cs to meet required levels for LLW forms to produce glass logs.

Tank 241-S-111 is a Phase II tank. Therefore, disposal requirements for Phase I do not apply. Assessments that could be conducted to better address disposal implications include, investigating blending strategies, dilution levels, density, shear rates, shear strength and viscosity, and estimate the number of glass logs that tank 241-S-111 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/Analysis

All applicable DQO and waste issues have been addressed for this tank and accepted by the Project Hanford Management Contract Tank Waste Remediation System Program. No additional sampling and analysis are necessary to satisfy current safety issues for this tank. However, additional grab samples will be required for compatibility assessments prior to beginning transfers for interim stabilization.

Additional sampling may also be necessary to better understand the physical characteristics of the waste from a disposal perspective. Given the schedule for Phase II disposal, additional analytical/physical information has a moderate priority from a strictly technical point of view and 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-111 as of May, 1999.

Standard Hydrogen Monitoring System (SHMS) monitoring and flammable gas assessments are on going. The flammable gas issue is expected to be closed for all tanks by September 30, 2001.

#### Data Quality

The data from core, grab and vapor sample events were collected and analyzed following approved sampling and analysis plans and procedures (See standard report "*Analytical Methods and Procedures*"). Quality control (QC) parameters assessed in conjunction with tank 241-S-111 samples included standard recoveries, spike recoveries, duplicate analyses and blanks. Appropriate quality control footnotes were added to data outside quality control parameter limits. Analytical results are reported in Steen (1996 and 1998).

High relative percent differences (RPDs) between primary and duplicate analyses were reported for several of the analytes. Although reruns were performed for some core 237 samples and analyses, the high RPDs did not improve. The RPD's were attributed to results close to or below detection limits for many analytes and to sample inhomogeneity. Segments 2, 4, 6, 8 and 10 of core 237 were sampled using the RGS. During extraction of the retained gases, the samples were diluted with 300 mL of 0.04 M ammonium hydroxide solution. Because the integrity of the samples was compromised by the RGS methodology, only RGS analyses were performed on these samples. Retained gas sampler results are reported in Mahoney et al. (1998).

Because KOH fusion was conducted in a nickel crucible, potassium and nickel fusion results are suspect and were removed from the "*Analytical Results*" standard report. Some fusion results also had high detection levels. Consequently, acid digest results were determined to be more representative of tank contents.

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. Additional QC detail is included in the laboratory report for an applicable sample event.

Only three of 11 eleven segments were recovered for core 150 samples. Consequently, analytical data were not reported for Core 150 samples. This lack of information may bias the data interpretation.

### **Clarifications to Data Tables and Figures in Standard Reports**

*Description of Tank* standard report: The tank saltcake volume differs from Hanlon (1999) and is based on extrusion observations. Saltcake solids and liquid volumes presented are based on the relative amounts of liquid and solids observed in segments 1 to 9 of core 149 and core 237. An average of 16 percent gas voids in the solids was observed in RGS tests (Mahoney et al. 1998). This equates to 257 kL (68 kgal) of trapped gas in the saltcake and sludge, which, when combined with solid and liquid volumes presented in the table, adds up to a total volume of 2,044 kL (540 kgal).

*Tank Temperature Profile* standard report: No temperature data was available between 1983 and 1991.

*Core Profile* standard report: The designated waste types shown in this report are based on sample appearance during laboratory extrusions. Analytical results indicate that although the solids in core 149, segments 10 and 11 looked like moist salt and dry salt, respectively, the high levels of aluminum and chromium in these segments show that segments 10 and 11 were likely cladding waste (CWR) sludge.

### **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.

Core sampling recovery data (Steen 1996) indicate that the liquid pool in the tank is approximately 86 cm (34 in.) deep under riser 8 (near the middle of the tank). The August 1989 photographs indicate that most of the tank surface is liquid, with a band of saltcake approximately 2.4 m (8 feet) wide around the edge of the tank.

### **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 TWRS 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-111, 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:

- Average analytical results for 1996, core 149 and 1998, core 237 samples, segments 1 to 9 for saltcake and segments 10 and 11 for sludge. (see *Means and Variances* standard report) .
- Samples from other S and U farm tanks with similar SMMS1 saltcake waste types and R/CWR sludge waste types.
- The Hanford Defined Waste (HDW) model document (Agnew et al. 1997) provides tank content estimates in terms of component concentration and inventories.

Table 7-1 represents how the available data is used to derive best-basis inventories.

**Table 7-1. Tank 241-S-111 Source Data for Best-Basis Inventories.**

Waste Phase	Waste Type	Applicable Concentration Data	Associated Density	Associated Volume
<b>Saltcake</b>	SMMS1	1996 and 1998 core samples	1.62 g/mL	924 kL (244 kgal)
Liquid	SMMS1 Liquid	1996 and 1998 core samples	1.39	420 kL (111 kgal)
Sludge	CWR	1996 and 1998 core samples	1.67	443 kL (117 kgal)
Trapped Gas	N/A	RGS Sample Results	N/A	257 kL (68 kgal)
Total Tank		HDW model estimates	1.73	2,044 kL (540 kgal)

Waste phase and waste type designations are based on tank process history (Agnew et al 1997) and mean analytical results (*Means and Variances* standard report). Saltcake, liquid and sludge densities were the mean sample concentration for each waste phase.

The total waste volume and sludge volume for tank 241-S-111 is based on tank surface level measurements, gamma scans and analytical results, and is consistent with Agnew et al. (1997) and Hanlon (1999) tank volume estimates. The relative volume of saltcake solids and liquid was based on core 149 and core 237 sample extrusion results (see *Sub-sampling Scheme and Sample Extrusion* standard report). The tank appears to contain mostly saturated SMMS1 liquid in the top three segments, with few solids. Segments 4 through 9 were primarily solids, with little or no drainable liquid. Tank surface level photographs show saltcake solids built up on the side walls of the tank. However, for best-basis inventory estimates, it was assumed that sample extrusions are representative of the tank and 68.7 percent by volume of the saltcake/liquid is solid and 31.3 percent is liquid. The RGS analyses showed that approximately 16 percent by volume of the tank solids contained void spaces filled with trapped gas. The fraction of trapped gas was considered in calculating saltcake, liquid and sludge volumes shown in Table 7-1.

Concentration vectors were sample means, except where minimum detection levels were high or sample data was not available. Although templates have been developed based on sample results for other tanks containing R/CWR and SMMS1 waste types, no additional analytical information was available from the templates. Consequently, model based estimates (Agnew et al. 1997) were used as the best-basis for many of the radionuclides and for lanthanum because sample data was not available. The strontium inventory was based on <sup>89/90</sup>Sr sample results. Uranium isotope inventories were calculated based on the mean uranium ratioed to HDW uranium isotope estimates, and alpha isotopes were calculated based on total alpha sample concentrations ratioed to HDW model alpha isotope estimates. All calculations were performed using the best-basis inventory maintenance (BBIM) tool. Best-Basis inventory values for tank 241-S-111 are shown in the *Best-Basis Inventory (Non-Radionuclides)* and *Best Basis Inventory (Radionuclides)* standard reports.

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