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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 663664

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	J. H. Rasmussen, Data Development and Interpretation, R2-12, 373-1128	[] Yes [X] No	08/28/01
	6. Project Title/No./Work Order No. Tank 241-AP-107	7. Bldg./Sys./Fac. No. 241-AP-107	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) ~~WHC~~-SD-WM-ER-362, Rev. 1-C HNF 8/30/01	10. Related ECN No(s). ECNs: 635439, 635522, 644496, 653808	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

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14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

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ENGINEERING CHANGE NOTICE	Page 2 of 2	1. ECN (use no. from pg. 1) ECN-663664

16. Design Verification Required	17. Cost Impact						18. Schedule Impact (days)	
	ENGINEERING			CONSTRUCTION				
[] Yes	Additional	[]	$	Additional	[]	$	Improvement	[]
[X] No	Savings	[]	$	Savings	[]	$	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J. H. Rasmussen	J H Rasmussen	8-29-01	PE		
Cog. Mgr. J. G. Field	J G Field	8-28-01	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		
N. L. Hulse	N L Hulse	8-28-01			

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Data Development and Interpretation	Date 08/28/01
Project Title/Work Order		EDT No. N/A
HNF-SD-WM-ER-362, Rev. 2, "Tank Characterization Report for Double-Shell Tank 241-AP-107."		ECN No. ECN-663664

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
CH2M HILL Hanford Group, Inc.					
M. R. Adams	R2-12	X			
J. G. Field	R2-12	X			
N. L. Hulse	R2-12	X			
J. H. Rasmussen	R2-12	X			
A. M. Templeton	R2-12	X			
ERC (Environmental Resource Center)	R1-51	X			
TCSRC	R1-10	X			
Office of River Protection					
W. S. Liou	S7-54	X			
DOE/RL Reading Room	H2-53	X			

Tank Characterization Report for Double-Shell Tank 241-AP-107

J. H. Rasmussen
CH2M Hill Hanford Group, Inc., Richland, WA 99352
U.S. Department of Energy Contract 8023764-9-K001

EDT/ECN: ECN-663664 UC: 2070
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Abstract: N/A

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RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-362	Page 1

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AP-107

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
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HNF-SD-WM-ER-362, REV. 2

This report prepared especially for Archive TIR on 8/21/01

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 16, 2001.

Tank: 241-AP-107

Sampling Events:

107AP0B1
107AP0B2
107AP1A
107AP1B
107AP1C
107AP1D
107AP2A
107AP2B
107AP2C
107AP2D
107AP3A
107AP3B
107AP3C
107AP3D
107AP4A
107AP4B
107AP5A
107AP5B
107AP6
107APFB
107APTB1
107APTB2
7AP-00-0B2
7AP-00-1
7AP-00-2A
7AP-00-2B
7AP-00-2C
7AP-00-3A
7AP-00-3B
7AP-00-3C
7AP-00-4A
7AP-00-4B
7AP-00-4C
7AP-00-IB1
7AP-00-IB2
7AP-00-OB1
7AP-00-TB1

7AP-00-TB2
7AP-01-1
7AP-01-2A
7AP-01-2C
7AP-01-3A
7AP-01-3B
7AP-01-4A
7AP-01-4B
7AP-01-B1
7AP-01-B2
7AP-01-TB
7AP-97-1
7AP-97-2
7AP-97-3
7AP-99-1
7AP-99-2
7AP-99-3
7AP-99-4
R3619
R3621
R3623
R3625
R3627
R3629

Reports:
Tank Interpretive Report

Constituent Groups:
Anions
Inorganics
Metals/Nonmetals
Organics
PCBs
Physical Properties
Radionuclides

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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 eight 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-AP-107

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-AP-107 include the 242-A Evaporator Data Quality Objective (DQO), Data Quality Objectives for Tank Farms Waste Compatibility Program (Compatibility DQO), and Data Quality Objectives for Regulatory Requirements for Hazardous and Radioactive Air Emissions Sampling and Analysis (Air Emissions DQO).

Closed issues and issues previously addressed for tank 241-AP-107 include the Tank Safety Screening DQO.

242-A Evaporator DQO: Is the tank 241-AP-107 waste compatible with feed tank, slurry tank, and 242-A Evaporator requirements?

The *242-A Evaporator Data Quality Objectives* (Von Bargen 1998, Bowman 2000a) and *242-A Evaporator Data Quality Assurance Project Plan* (Bowman 1998, 2000b) present the sampling and analysis requirements that support the 242-A Evaporator operations. The sampling decision requirements in support of the 242-A Evaporator DQO are listed in *Tank 241-AP-107 Sampling Requirements in Support of Evaporator Campaign 02-01* (Le 2000), and include the number and location of grab samples to be taken. Tank 241-AP-107 waste was sampled in December 2000, and the characterization results will be used to support Evaporator Campaign 02-01 as directed in the *Tank 241-AP-107 Sampling and Analysis Plan in Support of Evaporator Campaign 02-01* (TSAP) (Rasmussen 2000a). The samples taken were designated for semi-volatile and volatile organic analyses, inorganic/radiological analyses, polychlorinated biphenyl (PCB) analysis, and mixing/boildown studies.

The analytical results were reported in the *Tank 241-AP-107 Grab Samples in Support of 242-A Evaporator Campaign 02-01 Analytical Results for the Final Report* (Bell 2001). No analytical results exceeded notification limits as reported in Bell (2001), but some results exceeded the evaporator action levels for total organic carbon, total inorganic carbon, total carbon, and technetium-99. The results for radium-226 were less than detectable; the detection limit for this analyte was greater than the evaporator action level.

The 242-A Evaporator Program will determine if the sampling results reported in Bell (2001) meet the requirements stated in Von Bargen (1998) and Bowman (1998, 2000a, 2000b) in the process control plan for the upcoming 242-A Evaporator Campaign; therefore, only a brief evaluation is reported above. The process control plan is scheduled to be completed in October 2001.

Boildown studies, required by the TSAP (Rasmussen 2000a), had not been completed at the time this report was prepared. The "Letter of Instruction for 241-AP-107 Composite Boildown Studies in Support of 242-A Evaporator Campaign 02-01" (Bowman 2001) provided direction for completion of these studies.

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?

Two transfers of waste from tank 241-SY-102 into tank 241-AP-107 were completed in September and November 2000 to stage for the 242-A Evaporator Campaign 02-01. Waste compatibility assessments (Fowler 2000b, Fort 2000) were completed for the waste in tanks 241-AP-107 and 241-SY-102 prior to each transfer in accordance with the *Tank Farm Waste Transfer Compatibility Program* (Fowler 2000a). Safety considerations included energetics, flammable gas generation and accumulation, and corrosion and leakage (Mulkey et al. 1999). Operational considerations included heat generation rate, phosphate and sodium inventories, plugged pipelines and equipment, and complexant waste segregation (Fowler 1995).

In September 2000, a waste compatibility assessment was performed to determine the safety and operational implications of transferring approximately 2,650 kL (700 kgal) of tank 241-SY-102 waste into tank 241-AP-107 (Fowler 2000b). The results met the requirements stated in Mulkey et al. (1999) and Fowler (1995), and 1,442 kL (381 kgal) of waste from 241-SY-102 and 98 kL (26 kgal) of water was subsequently transferred into 241-AP-107.

In November 2000, a second waste compatibility assessment was performed to determine the safety and operational implications of transferring approximately 2,593 kL (685 kgal) of tank 241-SY-102 waste into tank 241-AP-107 (Fort 2000). This assessment reflects the current contents of tank 241-AP-107. Data from the May 18, 1999 grab samples (Bell 1999) of tank 241-AP-107 and knowledge of the waste from 241-SY-102 currently in the tank were applied to these implications, and the results are shown in Table 1-1. The waste in tank 241-SY-102 that was assessed per Fort (2000) was subsequently transferred to tank 241-AP-107 in preparation for the 02-01 Evaporator Campaign. The actual volumes transferred to tank 241-AP-107 were 1,953 kL (516 kgal) of waste and 114 kL (30 kgal) of flush water.

Table 1-1. Safety and Operation Criteria for the Waste Compatibility Program. (2 Sheets)

Criteria	Primary Decision Variable	Decision Criteria Threshold	Result
Bulk Chemical Runaway Reaction	Heat load/ Total Organic Carbon (TOC)	heat load <21,700 watts (74,000 Btu/hr) TOC <52 g/L	Criteria met.[1] Tank 241-AP-107 heat load = 5,863 W (20,010 Btu/hr) TOC = 10.14 g/L
Energetics/ Organic layer	Total fuel content/ organic layer	1.0 exotherm/endotherm ratio Presence of organic layer	Criteria met. < 1.0 for all ratios No organic layer
Flammable gas accumulation	Specific Gravity (SpG)	Solids depth (in.) * SpG < 148	Criteria met. 0 inches*1.3 SpG = 0
Corrosion Control[2]	Concentration of nitrate, hydroxide, and nitrite	$1.0<[NO_3^-] \leq 3.0$ M; and $0.01^* [NO_3^-] \leq [OH^-] \leq 10.0$ M; and $0.4^* [NO_3^-] \leq [OH^-]+[NO_2^-]$	Criteria met.[1] $[NO_3^-] = 1.87$ M $[OH^-] = 0.76$ M $[NO_2^-] = 1.55$ M
Waste Feed Envelope	Waste Feed Envelope Specifications	Envelope A: <0.5 mole TOC/mole sodium <4.4E7 Bq ^{90}Sr/mole sodium <4.8E5 Bq TRU/mole sodium	Criteria not met.[1,3] TOC/Na = 0.15 ^{90}Sr/Na = 9.42E7 TRU/Na = 4.7E5
Heat Generation Rate	Heat Load	AP tanks ≤ 70,000 Btu/hr	Criteria met.[1] Tank 241-AP-107 heat load = 5,863 W (20,010 Btu/hr)
Phosphate Waste	Concentration of phosphate and sodium	($[PO_4^{-3}]>0.1$M) waste not to be mixed with ($[Na^+]>8.0$M) waste	Criteria met. Tank 241-AP-107 $[PO_4^{-3}] \leq 0.04$ M, $[Na^+] \leq 6.4$ M Tank 241-SY-102 $[PO_4^{-3}] \leq 0.04$ M, $[Na^+] \leq 5.5$ M
Line Plugging	Volume percent solids and SpG	SpG ≤ 1.35 and <5 volume percent solids	Criteria met. Tank 241-SY-102 SpG = 1.31, no solids
Waste Segregation	Waste classification	Segregate complexed and TRU wastes	Criteria met. Tanks 241-AP-107 and 241-SY-102 contain non-complexed, non-TRU supernatant

Table 1-1. Safety and Operation Criteria for the Waste Compatibility Program. (2 Sheets)

Criteria	Primary Decision Variable	Decision Criteria Threshold	Result

Notes:

SpG = Specific gravity
TOC = Total organic carbon
TRU = transuranic

[1]These results are the calculated end state of tank 241-AP-107 after the projected addition of 2,495 kL (660 kgal) of supernatant from tank 241-SY-102 and 95 kL (25 kgal) flush water to 1,675 kL (443 kgal) of waste in 241-AP-107.
[2]The corrosion criteria apply for receiving tank operating temperatures of ≤ 100 °C (212 °F).
[3]The projected concentration of Bq ^{90}Sr/mole sodium exceeded Envelope A criteria. Notification was made to the Retrieval Engineering Group on November 2, 2000.

Air Emissions DQO: Are there known or potentially known analytes present in vapor spaces that need to be addressed for regulatory air emission issues?

The AP tank farm ventilation system exhauster duct was vapor sampled in support of the Air Emissions DQO (Mulkey 1999) per the vapor sampling and analysis plan (Sasaki 2000) on June 22, 2000. Tank vapor samples were collected from a test port on the AP tank farm exhaust ventilation system using a type-4 vapor sampling cart. The AP exhaust system ventilates the tanks in the AP tank farm. The sampling and analysis data package (Bonfoey et al. 2000) was issued on December 14, 2000. The results were compared to the action limits in Appendix C of Mulkey (1999). None of the analytes exceeded these limits.

Closed Issues and Issues Previously Addressed:

Issues addressed previously include the Tank Safety Screening DQO (Dukelow et al. 1995). The tank was sampled in August 1997 and the data applied to this issue. Reynolds et al. (1999) performed a formal review of tank 241-AP-107 data and determined the sampling and analysis performed were consistent with the requirements of the Safety Screening DQO. Tank 241-AP-107 is an active tank, and current tank contents have met the safe operating limits and requirements (Fort 2000) for transfer and storage of waste per the compatibility DQOs (Fowler 1995, and Mulkey et al. 1999).

Heat Load Estimate:

A factor in assessing tank safety is the heat generation and temperature of the waste. The tank heat load based on the Best-Basis Inventory (See Standard Report *Best-Basis Inventory [Radioactive]*), decayed to January 1, 2001, was 2,994 W (10,218 Btu/hr). This heat load estimate is less than the 20,500 W (70,000 Btu/hr) operating specification limit for this tank (Fowler 2000a). The current tank contents have changed significantly because of transfers since Agnew et al. (1997a) and Kummerer (1995) evaluated tank 241-AP-107; those estimates are no

longer accurate representations of the current tank heat load and are, therefore, not included here for comparison.

Table 1-2. Heat Load Estimate Based on the Best-Basis Radionuclide Inventory.

Radionuclide	Waste Inventory	Decay Heat Generation[1]	Heat Load (Watts)
Strontium-90	9.49E+03 Ci	0.00669 W/Ci	63
Cesium-137	6.21E+05 Ci	0.00472 W/Ci	2,931
Total	-	-	2,994

Note: [1]Includes daughter isotopes.

Tank History

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

The AP Tank Farm was constructed from 1983 to 1986 in the 200 East Area and contains eight double-shell tanks (DSTs). Tank 241-AP-107 has a capacity of 4,390 kL (1,160 kgal), a diameter of 22.9 m (75.0 ft), and an operating depth of 10.7 m (35.2 ft). Tank 241-AP-107 was designed to hold concentrated supernate and is actively ventilated. Tank descriptions and figures are presented in standard reports *Description of Tank, Tank Plan View, Tank Profile View,* and *Riser Configuration Table.*

Tank 241-AP-107 entered service in 1986 as a dilute receiver tank and received flush water from miscellaneous sources. The tank received plutonium-uranium extraction (PUREX) process distillate discharge in 1990 (Bergmann 1990), which was transferred to tank 241-AW-102 as 242-A Evaporator feed in 1994. During October 1994 and January 1995, the tank received waste from tank 241-AW-103 and tank 241-AP-101. In May and June 1995, waste was transferred again from tank 241-AP-107 to tank 241-AW-102 (Agnew et al. 1997b).

In March, April, and August 1999, tank 241-AP-107 received waste from tank 241-SY-102, which was subsequently transferred to tank 241-AW-102 in December 1999 as part of Evaporator campaign 2000-01. In September 2000, tank 241-AP-107 received a transfer of saltwell liquor from tank 241-SY-102 in preparation for the 242-A Evaporator Campaign 02-01, causing a change in its waste classification from dilute non-complexed to dilute-complexed. In November 2000, tank 241-AP-107 again received waste from tank 241-SY-102 for Evaporator Campaign 02-01.

Tank 241-AP-107 is categorized as sound and currently contains 3,708 kL (980 kgal) of supernate classified as dilute complexed waste (DC) (Hanlon 2001). The waste in tank 241-AP-107 is currently scheduled to be processed in October 2001 as part of Evaporator Campaign 02-01.

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-AP-107 currently contains 3,708 kL (980 kgal) of waste designated as DC (Hanlon 2001). Three other double-shell tanks classified as dilute receiver tanks (tanks 241-AP-106, 241-AY-101, and 241-SY-102) currently contain DC waste, according to Hanlon (2001).

Tank 241-AP-107 currently contains only supernatant waste, with no sludge or saltcake layers. Tank 241-AP-107 has primarily received waste destined for the 242-A Evaporator throughout its history. The residual heel in tank 241-AP-107 contains the remnants of waste from the PUREX process distillate discharge and transfers from tanks 241-AW-103, 241-AP-101 and 241-SY-102, which could be used in evaluating waste contained in the tank. Currently, tank 241-AP-107 contains saltwell liquor received from tank 241-SY-102, which will be fed into the 242-Evaporator as part of Evaporator Campaign 02-01.

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-AP-107 is a staging tank for the 242-A Evaporator, and its current contents are scheduled to provide feed for the 242-A Evaporator Campaign 02-01. Future sampling is scheduled in fiscal years 2002 and 2004 following transfers of waste into tank 241-AP-107 for future evaporator campaigns (Adams et al. 2001). Waste from tank 241-AP-107 is not scheduled to be delivered directly to the Waste Treatment Plant (Kirkbride et al. 2000).

The PCBs were measured in the 2000 grab samples and reported in Bell (2001). All results were below the detection limit of 15 μg/L. Therefore, PCBs are not expected to be an issue regarding treatment of the liquid waste.

No organic layers were observed in this tank during the 2000 grab sampling event (Bell 2001).

The industrial hygiene survey associated with the most recent sample event in December 2000 (*Tank 241-AP-107 IH Sniff Data* standard report) reported detecting values of 2.8 parts per million volume of organic vapor and 0 percent of the lower flammability limit for flammable gases. The extent that waste retrieval operations, such as pumping, will cause emission of organic vapors should be considered.

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 no additional sampling is necessary to satisfy current safety issue requirements. Boildown analyses must still be completed to satisfy the 242-A Evaporator DQO requirements.

In December 2000, eleven liquid grab samples were taken and analyzed in accordance with the *Tank 241-AP-107 Sampling and Analysis Plan in Support of Evaporator Campaign 02-01* (TSAP) (Rasmussen 2000a). Final results were reported in the *Tank 241-AP-107 Grab Samples in Support of 242-A Evaporator Campaign 02-01 Analytical Results for the Final Report* (Bell 2001). Several deviations from the TSAP during sampling were noted in the data package. The TSAP specified samples to be taken from risers 001 and 002 with riser 003 designated as an alternate. The grab samples originally designated to be taken from riser 001 were taken from riser 003 after consulting with the tank coordinator. In addition, sample 7AP-01-2B spilled at the laboratory; a replacement, sample 7AP-01-2C, was taken and analyzed as directed by Rasmussen (2000b). Data from previous sampling events are not addressed in this document because they add no information regarding the current drivers for tank 241-AP-107.

Tank 241-AP-107 is scheduled to have its current contents transferred to the 242-A Evaporator as part of Evaporator Campaign 02-01; therefore, the data from the current sampling event will not represent the future contents of tank 241-AP-107. Tank 241-AP-107 will continue to serve as a staging tank for the 242-A Evaporator, receiving waste from various tanks to serve as feed for future evaporator campaigns. The 242-A Evaporator DQO (Von Bargen 1998) requires sampling of all tank waste due to be processed through the 242-A Evaporator; information from archived samples, tank group studies, or tank modeling will not satisfy the requirements of this DQO. Therefore, sampling will be required to characterize the contents of tank 241-AP-107 prior to future evaporator campaigns (Adams 2001).

Data Quality

The analyses of the 2000 grab samples were performed using approved and recognized laboratory procedures and in accordance with the sampling and analysis plan (Rasmussen 2000a). Quality control (QC) parameters assessed in conjunction with tank 241-AP-107 included standard recoveries, spike recoveries, duplicate analyses, and blanks. Sample and

duplicate pairs with one or more QC results outside the specified criteria were identified by footnotes in the tables in the *Analytical Results* Standard Report. Analytical results and data quality is discussed in the tank 241-AP-107 data package (Bell 2001). The vast majority of QC results were within the required boundaries. Small discrepancies noted in the tank 241-AP-107 data package (Bell 2001) and footnoted in the *Analytical Results* Standard Report should not impact the data validity or use. Results that did not meet TSAP specifications are discussed below.

For the 2000 grab sampling event, most of the analytical holding times were not met because of laboratory delays. However, the holding time failures did not appear to affect data quality; therefore, none of the data from these analyses were rejected. The impact on the data from exceeding holding times will be further assessed by the 242-A Evaporator Program as part of the process control plan. The required holding times and actual holding times are summarized in the tank 241-AP-107 data package (Bell 2001). The results for radium-226 were less than detectable; the detection limit for this analyte was greater than the evaporator action level. It may be noted that the pH results for tank 241-AP-107 supernatant were >13.50. Accuracy at pH higher than the calibration buffer of 12.50 may be questionable.

Clarification and Explanation of Data Tables and Figures

The *241-AP-107 HTCE Surface Levels* standard report: This graph shows tank waste surface level as a function of time, capturing the average level measured quarterly for each year reported to 1997. An increase in the surface level in the first quarter of 1990 is due to the addition of PUREX process distillate discharge (Bergmann 1990). The slow decrease in surface level from the first quarter of 1990 to the third quarter of 1994 is attributed to evaporation from the actively ventilated tank. The decrease in surface level in the third quarter of 1994 is due to a transfer of waste to tank 241-AW-102. The increase in surface level in the first quarter of 1995 is due to a transfer from tank 241-AP-101. The decrease in surface level in the third quarter of 1995 is due to a transfer to tank 241-AW-102. The changes in surface level due to transfers in 1999 and 2000 are not represented in this standard report. See the standard report *Tank 241-AP-107 Transfers (1994 to present)* for additional information.

The *241-AP-107 Average Monthly Tank Surface Level (after 1/1/96 only)* standard report: This graph shows the monthly average of the tank waste level as a function of time. Increases in the surface level in March and August 1999 are due to transfers into tank 241-AP-107 from tank 241-SY-102. The decrease in the surface level in December 1999 is due to the transfer of waste from tank 241-AP-107 into tank 241-AW-102 for Evaporator Campaign 2000-01. An increase in the surface level of tank 241-AP-107 due to transfers from tank 241-SY-102 in September and November 2000 are shown as a general increase in surface level in the last quarter of 2000. See the standard report *Tank 241-AP-107 Transfers (1994 to present)* for additional information.

The *241-AP-107 Tank Temperature Profile* standard report: This profile reports the maximum temperature for the thermocouples in the tank waste as a function of time. The fluctuations in waste temperature shown on the graph are attributed to seasonal temperature variations. The graph also shows an increase of approximately 10 C above normal temperature fluctuations in

September 2000. This increase in temperature is attributed to the addition of 1,442 kL (381 kgal) of supernatant from tank 241-SY-102 to tank 241-AP-107 during that month.

The *Tank 241-AP-107 Subsampling Scheme and Sample Description* standard report: This report details information about samples analyzed for tank 241-AP-107. Sample volumes are not listed for the grab samples taken in December 2000; the sample volume for each of these grab samples is 250-mL, as specified in the TSAP.

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 tank 241-AP-107 or its contents. While not unique, the following physical descriptions of the tank waste may be of interest. The grab sampling event in 2000 showed the supernatant to be a clear, light-yellow liquid with no organic layer (see *Subsampling Scheme and Sample Description* Standard Report). Tank 241-AP-107 currently contains 357 inches of waste, which is scheduled to be sent to the 242-Evaporator as part of Evaporator Campaign 02-01.

Tank 241-AP-107 has recently undergone two non-destructive examinations to assess the integrity of the primary tank. In July 1997, the interior of the tank was visually examined and videotaped while only about 110 kL (29 kgal) of waste was present in the tank (Anantatmula 1997). The major conclusions regarding corrosion of the primary liner were that no stress corrosion cracking was evident and that the tank exhibited low general corrosion. Some enhanced corrosion was observed in the vicinity of plate welds. Higher pitting density with possible deeper pitting was observed near a previous waste level at about 1.5 m (5 ft) above the tank bottom. The higher pit density near the previous waste level was attributed to the lower pH that occurs at the liquid-air boundary where atmospheric carbon dioxide neutralizes the caustic in the waste.

The second non-destructive examination was an ultrasonic inspection of the tank performed in June 2000 (Jensen and Lysher 2001). Selected, limited portions of the tank wall, welds, and primary tank knuckle were examined by means of a remotely controlled, steerable, magnetic crawler placed on the annular side of the primary tank. The tank contained approximately 144 kL (38 kgal) at the time of this inspection. The major conclusions of this inspection were that none of the scanned areas exhibited any reportable wall thinning, pitting, or cracking, and no crack-like indications were detected in the scanned welds.

Sample results from the 2000 grab sampling were screened against current bounding concentration limits used to develop the authorization source term. The instructions for evaluating bounding concentrations are found in the *CPO Requirements Planning and Support and Data Development and Interpretation Desk Instruction Manual* (Adams 2001). No sample results that were detected were found to exceed the limits.

Means and Confidence Intervals

Question 7: What statistical model was used to generate the means and confidence intervals? What data was included in the calculations?

A nested analysis of variance (ANOVA) model was fit to the data from the liquid portion of the laboratory samples. Mean analyte concentrations, and 95% confidence intervals on the mean, were estimated using results from the ANOVA. Two variance components were estimated and used in the computations. The variance components represent concentration differences between laboratory samples and between analytical replicates.

The model is:

$$Y_{ij} = \mu + L_i + A_{ij},$$

$$i=1,2,\ldots,a;\ j=1,2,\ldots,n_i;$$

where

Y_{ij}	=	concentration from the jth analytical result from the ith riser
μ	=	the mean
L_i	=	the effect of the ith laboratory sample
A_{ij}	=	the analytical error
a	=	the number of laboratory samples
n_i	=	the number of analytical results from the ith laboratory sample.

The variable L_i is a random effect. This variable and A_{ij} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(L)$, and $\sigma^2(A)$, respectively.

The restricted maximum likelihood method (REML) was used to estimate the mean concentration and standard deviation of the mean for all analytes that had 50 percent or more of their reported values greater than the detection limit. The mean concentrations and standard deviations of the mean were used to calculate the 95% confidence intervals. Each table in the *241-AP-107 Means and Confidence Intervals* Standard Report gives the estimate of the mean, degrees of freedom, and confidence interval on the mean.

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used for non-detected results. For analytes with a majority of results below the detection limit, a simple average is reported.

The lower and upper limits, LL(95%) and UL(95%), of a two-sided 95% confidence interval on the mean were calculated using:

$$LL(95\%): \hat{\mu} - t_{(df,\ 0.025)} \times \hat{\sigma}(\hat{\mu})$$

$$UL(95\%): \hat{\mu} + t_{(df,\ 0.025)} \times \hat{\sigma}(\hat{\mu}).$$

In these equations, $\hat{\mu}$ is the REML estimate of the mean concentration, $\hat{\sigma}(\hat{\mu})$ is the REML estimate of the standard deviation of the mean, and $t_{(df,\ 0.025)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom are the number of laboratory samples with data minus one. In cases where the lower limit of the confidence interval was negative, it was reported as zero.

The means for each data set are listed separately in the *241-AP-107 Means and Confidence Intervals* Standard Report. The *Tank 241-AP-107 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid 2000 Grab Samples* table refers to data generated from eleven grab samples taken December 19 to December 27, 2000. The *Tank 241-AP-107 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Aug 30 Grab (1999)* refers to data generated from thirteen grab samples taken August 30 to August 31, 1999. The *Tank 241-AP-107 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid May 18 Grab* and the *Tank 241-AP-107 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data* refers to data generated from four grab samples taken May 18, 1999. *Means and Confidence Intervals* tables are not included for sampling events prior to 1999, and the waste characterizations from those events are not representative of material currently in tank 241-AP-107.

Best-Basis Inventory Derivation

Question 8: 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 (BBI) effort involves developing and maintaining waste tank inventories comprising 25 chemical and 46 radionuclide components in the 177 Hanford Site underground storage tanks. These best-basis inventories provide waste composition data necessary as part of the River Protection Project (RPP) process flowsheet modeling work, safety analyses, risk assessments, and system design for waste retrieval, treatment, and disposal operations.

Development and maintenance of the BBI is an on-going effort. Since new sample data were recently made available for double-shell tank 241-AP-107, a re-evaluation of the BBI for this tank, as of July 1, 2001, was performed and is documented in the following text. The following information was used in this evaluation:

- Statistical means from analysis of the December 2000 grab sampling event of tank 241-AP-107 (Bell 2001). See the *Means and Confidence Intervals* Standard Report.

- Statistical means from analysis of the August 1999 grab sampling event of tank 241-AP-107 (Bell 1999). See the *Means and Confidence Intervals* Standard Report.

- Process knowledge of the tank 241-SY-102 supernatant composition and the volumes transferred to tank 241-AP-107 in September and November 2000.

Table 8-1 represents how the available data were used to derive the BBI for tank 241-AP-107.

Table 8-1. Tank 241-AP-107 Best-Basis Inventory Source Data.

Waste Phase	Waste Type	Applicable Concentration Data[1]	Multiplier	Associated Density	Associated Volume
Supernatant		2000 grab sample (S/AP107/08)	1.01	1.25 g/mL	3,708 kL (980 kgal)
		Process knowledge alpha distribution (P/AP107/01)	1.01	1.25 g/mL	
		Process knowledge 241-AP-107 Supernatant as of January 1, 2001 (P/AP107/09)	1.01	1.23 g/mL	
Total Tank					3708 kL (980 kgal)

Note:
[1]Vector handles, shown in parentheses, are unique serial identifiers for the vectors used in the BBIM database.

The tank waste is comprised entirely of supernatant. The July 1, 2001 tank volume was 3,708 kL (980 kgal), based on the ENRAF™ surface level gauge. This tank has not had any transfers since the January 1, 2001 update with the exception of minor losses of water due to evaporation. Prior to this, tank 241-AP-107 received transfers from tank 241-SY-102 in September and November 2000. Grab samples were collected from tank 241-AP-107 in December 2000.

The 2000 grab sample vector best represents the supernatant analyte concentrations. The process knowledge supernatant as of January 1, 2001 was used when data were unavailable from the 2000 grab sample vector or where there were large non-detected values. The process knowledge alpha distribution vector is used for the uranium and alpha isotope inventories where there is no sample data. It is calculated from the 2000 grab sample U total and total alpha results and from the isotope distribution from the process knowledge supernatant as of January 1, 2001.

The process knowledge supernatant as of January 1, 2001 vector was created to represent the waste inventory at the time of the last BBI update in January 1, 2001. It combined the means from tank 241-AP-107 August 1999 sample data with the BBI for tank 241-SY-102 for August 30, 2000 and October 31, 2000 (CHG 2001). Weighting factors were applied to each set of information based on their contributing volumes (specific volume divided by the total waste volume). The resulting concentrations were then added together to form the process knowledge vector. Flush water was assumed to have density of 1 g/mL and not to contribute to the constituent inventory.

The density value in Table 8-1 is based on the December 2000 analytical data (1.25 g/mL). This density was also applied to the process knowledge vectors.

A multiplier of 1.01 was used to account for the water evaporation that took place after the grab samples were taken and the process knowledge supernatant as of January 1, 2001 vector was calculated (3738 kL / 3708 kL = 1.01).

All inventory calculations were performed using the Best-Basis Inventory Maintenance Tool. The updated BBI values for tank 241-AP-107 can be found in the *Best-Basis Inventory (Non-Radionuclides)* and *Best Basis Inventory (Radionuclides)* Standard Reports.

The inventories in this BBI were reviewed in accordance with the BBI creation rules documented in Sasaki (2001) and found to be compliant.

Mercury: No mercury is expected in tank 241-AP-107. The chemistry of mercury makes its presence in the aqueous phase highly unlikely (Higley 2000).

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