EDMC # 47727

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ENGINEERING CHANGE NOTICE

1. ECN 635515

Proj. ECN

2. ECN Category (mark one) Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. Todd M. Brown, Data Assessment and Interpretation, R2-12, 373-4437	4. USQ Required? [] Yes [X] No	5. Date 07/28/97
	6. Project Title/No./Work Order No. Tank 241-U-106	7. Bldg./Sys./Fac. No. 241-U-106	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-636, Rev. 0	10. Related ECN No(s). N/A	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

This ECN was generated to include additional explanatory text in the best-basis narrative, and to update the comprehensive radionuclide inventory estimates for the tank.

14a. Justification (mark one)

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

14b. Justification Details

Initial release of this document was deficient.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

RELEASE STAMP

DATE HANFORD STA 4 RELEASE ID:

AUG 22 1997

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-635515

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. T.M. Brown	Brett Simpson /for T.M. Brown	8-20-97	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall	8/20/97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

A-7900-013-3 (05/96) GEF096

Tank Characterization Report for Single-Shell Tank 241-U-106

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

EDT/ECN: ECN-635515 UC: 2070
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Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-U-106, 241-U-106, U-106, U Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-U-106. This report supports the requirements of the Tri-Party Agreement Milestone M-44-10.

8/22/97

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Release Approval Date Release Stamp

Approved for Public Release

RECORD OF REVISION

(1) Document Number: HNF-SD-WM-ER-636 | Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-U-106

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 04/15/97 on EDT-617592.	T.M. Brown	K.M. Hall
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		B.C. Simpson for T.M. Brown	Kathleen M. Hall 8/20/97

A-7320-005 (08/91) WEF168

3.0 BEST-BASIS INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, as well as to address regulatory issues. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing the wastes into a form that is suitable for long-term storage.

Chemical inventory information generally is derived using two approaches: 1) component inventories are estimated using the results of sample analyses; and 2) component inventories are predicted using a model based on process knowledge and historical information. The most recent model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1997). Not surprisingly, information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization information for the various waste management activities (Hodgson and LeClair 1996). Appendix D contains the complete narrative regarding the derivation of the inventory estimates presented in Tables 3-1 and 3-2.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-U-106 (January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C or E)[1,2]	Comment
Al	15,650	S	This value based on acid digest and may not represent all the aluminum present.
Bi	< 56.8	S	
Ca	510	S	
Cl	3,810	S	
CO_3	54,400	S	
Cr	3,520	S	
F	4,180	S	
Fe	4,050	S	
Hg	1.54	M	
K	1,860	S	

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-U-106 (January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C or E)[1,2]	Comment
La	51.6	S	
Mn	1,530	S	
Na	2.58E+05	S	
Ni	389	S	
NO_2	68,700	S	
NO_3	2.86E+05	S	
OH	66,100	C	Derived from charge balance
Pb	422	S	
PO_4	12,300	S	Used phosphorous data.
Si	228	S	This value based on acid digest and may not represent all the silicon present.
SO_4	12,800	S	Used sulfur data, about the same
Sr	< 6.70	S	
TOC	29,600	S	
U	1,010	S	
Zr	133	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.
E = Engineering assessment-based

[2]For more information about the origin and quality of the sample-based numbers in this table, refer to Appendix B. For more information about the model-based numbers in this table refer to Agnew et al. (1996).

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-106 (January 31, 1997). (Decayed to January 1, 1994) (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{3}H	279	M	
^{14}C	42.0	M	
^{59}Ni	2.57	M	
^{60}Co	182	S	
^{63}Ni	252	M	
^{79}Se	4.07	M	
^{90}Sr	1.06E+05	S	
^{90}Y	1.06E+05	S	Based on ^{90}Sr
^{93}Zr	19.9	M	
^{93m}Nb	14.5	M	
^{99}Tc	297	M	
^{106}Ru	8.63	M	
^{113m}Cd	105	M	
^{125}Sb	205	M	
^{126}Sn	6.15	M	
^{129}I	0.574	M	
^{134}Cs	3.00	M	
^{137}Cs	2.15E+05	S	
^{137m}Ba	2.00E+05	S	Based on ^{137}Cs
^{151}Sm	14,300	M	
^{152}Eu	4.86	M	
^{154}Eu	759	S	
^{155}Eu	288	S	
^{226}Ra	1.82E-04	M	
^{227}Ac	1.10E-03	M	
^{228}Ra	0.166	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-106 (January 31, 1997). (Decayed to January 1, 1994) (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{229}Th	3.91E-03	M	
^{231}Pa	4.97E-03	M	
^{232}Th	1.18E-02	M	
^{232}U	0.830	M	
^{233}U	3.18	M	
^{234}U	14.4	M	
^{235}U	0.645	M	
^{236}U	0.115	M	
^{237}Np	1.07	M	
^{238}Pu	1.71	M	
^{238}U	14.8	M	
^{239}Pu	57.0	M	
^{240}Pu	9.74	M	
^{241}Am	<2,280	S	
^{241}Pu	1.17	M	
^{242}Cm	0.186	M	
^{242}Pu	6.44E-04	M	
^{243}Am	2.56E-03	M	
^{243}Cm	1.74E-02	M	
^{244}Cm	0.172	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based

[2]For more information about the origin and quality of the sample-based numbers in this table, refer to Appendix B, Section B6.0. For more information about the model-based numbers in this table refer to Agnew et al. (1997)

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-U-106

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-U-106

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-U-106 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Chemical waste information for tank 241-U-106 included:

- Data from two push mode cores samples that were collected in 1996.
- Data from pre-1989 analyses used for informational purposes only.
- The inventory estimate for this tank generated from the Hanford Defined Waste model (HDW) (Agnew et al. 1996).
- The Tank Characterization Report (TCR) data from other tanks that have the same saltcake waste types.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Tables D2-1 and D2-2 compare sample-based inventories derived from the analytical concentration data from the core samples and the HDW model inventories. Table D2-1 compares nonradioactive components on a kilogram (kg) basis, and Table D2-2 compares the radioactive components on a total curie basis. The sample-based inventory listed in Table D2-1 and D2-2 were calculated according to the method outlined in Appendix B. A density of 1.62 g/mL was used for analytical inventory. The HDW inventory estimate listed in Tables D2-1 and D2-2 was calculated by the method outlined in Agnew et al. (1996). Both the sample-based inventory estimate and the HDW inventory estimate assigned a supernatant layer of 57 kL (15 kgal). The sample-based estimate assumes that the entire solids portion of the waste is saltcake, and the HDW estimate assumes that the bottom 98 kL (26 kgal) of solid waste is metal waste (MW) and the top 700 kL (185 kgal) of the waste is salt cake. Both estimates assume a total waste volume of 855 kL (226 kgal).

Table D2-1. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-U-106. (2 Sheets)

Analyte	Sampling[1] inventory estimate (kg)	HDW[2] inventory estimate (kg)	Analyte	Sampling[1] inventory estimate (kg)	HDW[2] inventory estimate (kg)
Al	15,650	38,800	NH_3	NR	830
Ag	32.7	NR	Ni	390	345
As	< 67	NR	NO_2	68,700	97,400
Ba	< 33.5	NR	NO_3	2.86E+05	2.86E+05
Be	< 3.35	NR	OH	NR	1.28E+05
Bi	< 56.8	220	oxalate	12,700	3.37
Ca	510	1,570	Pb	425	184
Ce	94.7	NR	Pd	NR	NR
Cd	71.3	NR	P as PO_4	12,300	11,400
Cl	3,810	6,690	Pt	NR	NR
Co	< 13.4	NR	Rh	NR	NR
Cr	3,520	NR	Ru	NR	NR
Cr^{+3}	NR	2,730	Sb	< 40.2	NR
Cr^{+6}	NR	NR	Se	< 61.3	NR
Cu	27.7	NR	Si	228	2,110
F	4,180	1,130	S as SO_4	12,810	22,700
Fe	4,050	1,030	Sr	6.13	1.31
Hg	NR	1.54	TIC as CO_3	54,400	37,200
K	1,860	1,990	TOC	28,980	14,300
La	51.6	6.22	U_{TOTAL}	1,010	49,300
Mg	66.9	NR	V	33.5	NR
Mn	1,530	205	Zn	52.9	NR
Mo	45.5	NR	Zr	133	64.1
Na	2.45E+05	2.57E+05	H_2O (wt%)	42.9	31.2

Table D2-1. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-U-106. (2 Sheets)

Analyte	Sampling[1] inventory estimate (kg)	HDW[2] inventory estimate (kg)	Analyte	Sampling[1] inventory estimate (kg)	HDW[2] inventory estimate (kg)
Nd	144	NR	density (kg/L)	1.62	1.67

Notes:

NR = Not reported. These analytes are not predicted by the HDW model
[1]Appendix B
[2]HDW = Hanford Defined Waste (Agnew et al. 1996)
[c]Fluoride based on water soluble portion only.

Table D2-2. Sampling and Hanford Defined Waste Predicted Inventory Estimates for Radioactive Components in Tank 241-U-106. (Decayed to January 1, 1994)

Analyte	Sampling[1] inventory estimate (Ci)	HDW[2] inventory estimate (Ci)	Analyte	Sampling[1] inventory estimate (Ci)	HDW[2] inventory estimate (Ci)
^{90}Sr	1.06E+05	1.17E+05	^{241}Am	<2,290	NR
^{137}Cs	2.15E+05	2.16E+05	Total α	1,570	NR
^{154}Eu	1,990	NR	Total β	4.3E+05	NR
$^{239/240}Pu$	NR	77.2			

NR = Not reported. These analytes are not predicted by the HDW model.
[1]Appendix B
[2]HDW = Hanford Defined Waste (Agnew et al. 1996).

D3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed to identify potential errors and/or missing information that would influence the sample-based and HDW model component inventories.

D3.1 CONTRIBUTING WASTE TYPES

Agnew et al. (1996) provided information about metal waste (MW) (98 kL [26 kgal]) and supernatant mixing model 242-S Evaporator period one waste (SMMS1) from 1974 to 1976. Hill et al. (1995) provided information about high-level REDOX waste, evaporator bottoms (same as SMMS1), B plant low-level waste, and PUREX low-level waste.

According to Rodenhizer (1987), tank 241-U-106 had been sluiced of MW and was empty by January 1957. If sludge is in the tank, it was deposited after that date, but the analytical results do not support the presence of a sludge layer. The composition based on Hill et al. (1995), assumes there is high-level REDOX sludge waste present, but recent analytical data do not agree; therefore, the assumption of a sludge layer is not supported.

The other tank waste identified by Hill et al. (1995) includes evaporator bottoms (saltcake), B plant low-level waste, and PUREX low-level waste.. Hill et al. provides process flowsheet molarity values for some analytes for B plant and PUREX low-level waste. The high molarities for some analytes in B plant low-level waste indicates little of this waste type in the tank based on analytical results. There is no flowsheet for SMMS1 (EB) since it is a mixture of concentrate supernatants from several tanks.

D3.2 ASSUMPTIONS USED

The following evaluation provides an engineering evaluation of tank 241-U-106 contents. For this evaluation, the following assumptions and observations are made:

- Total waste mass is calculated using the sampling-based measured density and the tank volume listed in Hanlon (1996). The analytical-based, HDW model and the engineering evaluation inventories are derived using this volume. The actual waste types contributing to the total volume are different in each case. As a result, inventory comparisons are not all made on the same mass or waste type basis.

- Only the SMMS1 waste stream contributed to solids formation.

- No radiolysis of NO_3 to NO_2 and no additions of NO_2 to the waste for corrosion purposes are factored into this evaluation.

D3.3 BASIS FOR CALCULATIONS USED IN THIS EVALUATION

In this evaluation, Table D3-1 provides the method used for determining the inventory estimates of the supernatant and solid layers.

Table D3-1. Assessment Methodologies Used on Tank 241-U-106.

Type of waste	How calculated	Check method
Supernatant Volume = 57 kL (15 kgal)	Used sample-based values	None. There is no clear method of evaluating the because it is a blend of many waste supernatants. This portion of the waste is a small percent of the total waste. Its contribution to the total inventory is minimal.
Salt cake (SMMS1) Volume = 798.6 kL (211 kgal) Density = 1.62 g/L (Sample-based) Density = 1.63 g/L (Comparison tanks)	Used sample-based concentrations for tank 241-U-106, multiplied by salt cake total mass. The great majority of all the waste in this tank appears to be represented by this waste type.	Used sample-based concentrations for three comparison tanks containing SMMS1 salt cake to determine an average composition. Multiplied by salt cake total mass in tank 241-U-106. The density used was the average density of the tanks for which the concentrations were derived
Sludge (No sludge)	No sludge layer is observed in this tank by comparison to segment analytical data. The engineering assessment makes the same assumption.	Analytes characteristic of sludges such as iron, manganese, bismuth and uranium were not observed in significant (>5,000 ug/g) quantities in the samples analyzed. The core samples were essentially complete and provided a full length profile of the tank.

D3.3.1 Basis for Salt Cake Calculations Used In This Evaluation.

Tables D3-2 and D3-3 summarize sample-based characterization data for three tanks (241-S-101, 241-S-102, and 241-U-109) that contain the same SMMS1 saltcake waste type as tank 241-U-106. The analytical results for this tank were evaluated at the core segment level, and the SMMS1 salt cake was identified. The SMMS1 component concentrations for these tanks and for tank 241-U-106 were averaged to provide a generalized composition for SMMS1 saltcake. Tables D3-2 and D3-3 also show the SMMS1 salt cake composition predicted by Agnew et al. (1996) for tank 241-U-106 for comparision.

As shown in Table D3-2 the concentrations of major waste components (e.g., Na, Al, NO_3, NO_2, and SO_4) for the four tanks containing SMMS1 salt cake vary between tanks by no more than an approximate factor of three. An exception is phosphate which exhibits exceptionally high concentrations for tank 241-S-102 waste, thereby skewing the average concentration high for phosphate for the SMMS1 tanks used in this assessment. The variation between several minor components for the four tanks is quite high. Except for phosphate and silicon, the analyte concentrations for tank 241-U-106 are quite close to the average concentrations for the four tanks.

The analyte concentrations for tank 241-U-106 salt cake compare within approximately a factor of three for most major components with the predicted SMMS1 composition from the HDW model. However, significant difference occur for several components including F, Fe, Mn, Si, and oxalate. Except for silicon, the concentrations of these components for the other three salt cake tanks are closer to those for tank 241-U-106 than to the HDW model estimate. It is concluded that the concentrations of these components are best represented by the analytical results for tank 241-U-106.

Table D3-2. Chemical Composition of SMMS1 Salt Cakes (μg/g). (2 Sheets)

Analyte	241-S-101	241-S-102	241-U-106	241-U-109	Average SMMS1[1]	HDW SMMS1[2]
Al	18,000	15,085	13,620	13,625	15,083	30,900
Bi	71	76	NR	NR	74	175
Ca	273	237	336	NR	282	989
Cl	4,500	4,099	2,926	NR	3,840	5,320
Cr	10,000	4,359	3,170	4,233	5,441	2,170
F	500	13,596	4,669	NR	6,260	899
Fe	508	1,298	3,096	NR	1,634	303
K	1,109	898	1,309	NR	1,105	1,590
La	NR	37	43	NR	40	4.96

Table D3-2. Chemical Composition of SMMS1 Salt Cakes ($\mu g/g$). (2 Sheets)

Analyte	241-S-101	241-S-102	241-U-106	241-U-109	Average SMMS1[1]	HDW SMMS1[2]
Mn	266	597	1,189	NR	684	164
Na	150,000	189,500	170,500	218,333	182,083	196,000
Ni	114	49	304	NR	155	272
NO_2	91,000	40,078	56,029	42,900	57,502	77,600
NO_3	110,000	99,152	147,200	296,667	163,255	227,000
Pb	91	137	348	NR	192	147
PO_4	9,500	114,500	5,888	5,970	33,965	6,140
P	2,290	33,984	1,949	NR	12,741	NR
S	5,940	2,683	3,878	NR	4,167	NR
Si	5,269	517	176	NR	1,987	1,680
SO_4	20,700	12,500	10,774	11,100	13,768	17,400
Sr	7	NR	NR	NR	7	1.04
TOC	1,900	5,340	24,626	3,920	8,947	11,300
U	560	1,403	781	NR	914	2,150
Zr	14	39	88	NR	47	51.1
Oxalate	15,400	15,674	9,881	NR	13,652	2.69
wt% H_2O	40.2	24.9	43.0	23.9	33.0	29.5
Density	1.58	1.69	1.57	1.67	1.63	1.66

Notes:

NR = Not reported

[1]Average concentrations for tanks 241-S-101, 241-S-102, 241-U-106, and 241-U-109

[2] HDW = Hanford Defined Waste Agnew et al. (1996)

Table D3-3 shows the concentrations for the radioactive components for SMMS1 salt cakes.

Table D3-3. Radionuclide Composition of SMMS1 Salt Cakes (uCi/g).

Analyte	241-S-101	241-S-102	241-U-106	241-U-109	Average SMMS1[1]	HDW SMMS1[2]
^{90}Sr	252	23	77	9	90	92.8
^{137}Cs	175	121	175	142	153	172

Notes:

[1]Average concentrations for tanks 241-S-101, 241-S-102, 241-U-106, and 241-U-109

[2] HDW = Hanford Defined Waste Agnew et al. (1996)

D3.4 ESTIMATED COMPONENT INVENTORIES

Table D3-4 summarizes estimated chemical inventories for tank 241-U-106. The tank 241-U-106 sample-based inventory and the inventory estimated by the HDW model are shown. As shown in Table D3-1, the supernatant inventory for tank 241-U-106 was calculated from the 241-U-106 supernatant samples and was added to the salt cake inventory. The predicted (engineering evaluation) inventory based on the average analytical values for the four SMMS1 tanks. Comments and observations regarding these inventories are provided by component in the following text.

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-U-106 Waste. (2 Sheets)

Component	Predicted (kg)[1]	241-U-106 Sample-based (kg)	HDW estimated (kg)
Bi	95.8	<56.8	220
Ca	365	510	1,570
K	1,430	1,860	1,990
La	51.8	51.6	6.22
Ni	201	389	345
NO_3	2.11E+05	2.86E+05	2.86E+05
NO_2	74,400	68,700	97,400
Mn	885	1,520	205
SO_4	17,800	12,800	22,700

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-U-106 Waste. (2 Sheets)

Component	Predicted (kg)[1]	241-U-106 Sample-based (kg)	HDW estimated (kg)
Cr	7,040	3,520	2,730
Sr	9	< 6.70	1.31
Pb	248	425	184
PO_4	44,000	12,300	11,400
F	8,140	4,180	1,130
Al	19,500	15,700	38,800
Fe	2,110	4,050	1,030
Cl	4,970	3,810	6,690
Si	2,570	228	2,110
TOC	11,600	29,600	14,300
U	1,180	1,010	49,300
Oxalate	17,700	12,600	3.37
Zr	60.8	133	64.1
Na	2.36E+05	2.58E+05	2.57E+05
H_2O (percent)	NR	42.9	31.2

HDW = Hanford Defined Waste
NR = Not reported
[1]Based on average analyte concentrations for tanks known to contain SMMS1 salt cake and used the solids mass only as a basis.

Nitrate. The HDW estimated inventory is the same as the tank 241-U-106 sample-based inventory. This is reasonable because this evaluation and the HDW model predicts predominantly saltcake waste for this tank, which consists primarily of $NaNO_3$.

Sulfate. The HDW model estimate is approximately twice that of the tank 241-U-106 sample-based value. However, the data for the two core samples for tank 241-U-106 were consistent and were used as the best basis for this tank.

Chromium. The HDW estimated inventory is about 25 percent lower than the sample-based inventory. The Cr concentration in the four SMMS1 comparison samples was consistently higher than for the HDW SMMS1. This indicates that the Cr^{+6} solubility in REDOX waste may be higher than predicted by Agnew et al. (1996).

Phosphate. The sample-based inventory estimate was used as the best basis inventory. The HDW model agreed with this value. The average phosphate inventory for the four SMMS1 salt cakes is more than three times higher than the tank 241-U-106 and HDW model estimates. This is attributed to tank 241-S-102 that received very high levels of phosphate which substantially raised the average.

Fluoride. The sample-based estimate for tank 241-U-106 was used as the best basis and was almost four times higher than the HDW model estimate. The average fluoride inventory for the four SMMS1 salt cakes is much higher than the tank 241-U-106 estimate because the fluoride concentration in tank 241-S-102 is much higher than for the other SMMS1 comparison tanks, substantially raising the average..

Sodium. The HDW Model estimate is approximately 5 percent higher than the sample-based estimate which was used as the best basis. All estimates were reasonably close.

TOC. The HDW model predicts approximately half the TOC that is estimated for tank 241-U-106 samples. The data for the two core samples for tank 241-U-106 were consistent and were used as the best basis for this tank.

Manganese. The sampling-based estimate, which was used as the best basis, shows approximately 7.5 times as much as the HDW model estimate. All tanks analyzed as containing SMMS1 saltcake contain significantly higher concentrations of Mn than predicted by the HDW model for SMMS1.

Aluminum. The HDW model predicted an inventory almost 2.5 times higher than the sample-based best estimate. The other three tanks with SMMS1 agree with the tank 241-U-106 sample-based inventory. Because the acid preparation method was used, caution should be exercised in using this number, it may be biased low.

Iron. The sample-based inventory is used as the best basis. It is approximately four times higher than predicted by the HDW model. However, the SMMS1 tanks consistently contain higher iron concentrations than predicted by the HDW model.

Silicon. The sample-based inventory is used for the best basis and is more than nine times lower than that predicted by the HDW model; however, the average for the four sampled tanks is approximately the same as the HDW model. Because the acid preparation method was used, caution should be exercised in using this number, it may be biased low.

Uranium. The sample-based value is used as the best basis. The HDW model predicts approximately 49 times as much uranium as does the analytical data. The model predicts that MW (which contains uranium) to be in the tank, but there is no sludge evident in the sample.

Oxalate. The sample-based inventory is used as the best basis. This value is significantly higher than that predicted by the HDW model. No explanation has been found to explain the vast difference, except that oxalate is produced as a product of organic degradation, which is not specifically accounted for by the model.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

An evaluation of available chemical information for tank 241-U-106 was performed, including the following:

- Data from two push mode 1996 core samples
- An inventory estimate generated by the HDW model (Agnew et al. 1996)
- Comparison with other tanks with SMMS1 salt cake.

Based on this evaluation, a best-basis inventory was developed for tank 241-U-106 for which sampling information was available. The sample-based inventory was chosen as the best basis for those analytes for which sample-based analytical values were available for the following reasons:

- The sample-based inventory analytical concentrations compared favorably to those of other tanks containing SMMS1 salt cake.
- Historical records and the results from core samples indicate that the tank contains SMMS1 salt cake but contains little or no metal waste predicted by Agnew et al. (1996).
- For those few analytes where no values were available from the sampling-based inventory or the engineering assessment, the HDW model values were used with notation that they were of lower reliability.

The best-basis inventory for tank 241-U-106 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-U-106 (January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C or E)[1,2]	Comment
Al	15,650	S	This value based on acid digest and may not represent all the aluminum present.
Bi	< 56.8	S	
Ca	510	S	
Cl	3,810	S	
CO_3	54,400	S	
Cr	3,520	S	
F	4,180	S	
Fe	4,050	S	
Hg	1.54	M	
K	1,860	S	
La	51.6	S	
Mn	1,530	S	
Na	2.58E+05	S	
Ni	389	S	
NO_2	68,700	S	
NO_3	2.86E+05	S	
OH	66,100	C	Derived from charge balance
Pb	422	S	
PO_4	12,300	S	Used phosphorous data.
Si	228	S	This value based on acid digest and may not represent all the silicon present.
SO_4	12,800	S	Used sulfur data, about the same
Sr	< 6.70	S	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-U-106 (January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C or E)[1,2]	Comment
TOC	29,600	S	
U	1,010	S	
Zr	133	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.
E = Engineering assessment-based

[2]For more information about the origin and quality of the sample-based numbers in this table, refer to Appendix B. For more information about the model-based numbers in this table refer to Agnew et al. (1996).

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium, or (total beta and total alpha) while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model results (Agnew et al. 1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-106 (January 31, 1997). (Decayed to January 1, 1994) (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{3}H	279	M	
^{14}C	42.0	M	
^{59}Ni	2.57	M	
^{60}Co	182	S	
^{63}Ni	252	M	
^{79}Se	4.07	M	
^{90}Sr	1.06E+05	S	
^{90}Y	1.06E+05	S	Based on ^{90}Sr
^{93}Zr	19.9	M	
^{93m}Nb	14.5	M	
^{99}Tc	297	M	
^{106}Ru	8.63	M	
^{113m}Cd	105	M	
^{125}Sb	205	M	
^{126}Sn	6.15	M	
^{129}I	0.574	M	
^{134}Cs	3.00	M	
^{137}Cs	2.15E+05	S	
^{137m}Ba	2.00E+05	S	Based on ^{137}Cs
^{151}Sm	14,300	M	
^{152}Eu	4.86	M	
^{154}Eu	759	S	
^{155}Eu	288	S	
^{226}Ra	1.82E-04	M	
^{227}Ac	1.10E-03	M	
^{228}Ra	0.166	M	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-106 (January 31, 1997). (Decayed to January 1, 1994) (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{229}Th	3.91E-03	M	
^{231}Pa	4.97E-03	M	
^{232}Th	1.18E-02	M	
^{232}U	0.830	M	
^{233}U	3.18	M	
^{234}U	14.4	M	
^{235}U	0.645	M	
^{236}U	0.115	M	
^{237}Np	1.07	M	
^{238}Pu	1.71	M	
^{238}U	14.8	M	
^{239}Pu	57.0	M	
^{240}Pu	9.74	M	
^{241}Am	<2,280	S	
^{241}Pu	1.17	M	
^{242}Cm	0.186	M	
^{242}Pu	6.44E-04	M	
^{243}Am	2.56E-03	M	
^{243}Cm	1.74E-02	M	
^{244}Cm	0.172	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based
[2]For more information about the origin and quality of the sample-based numbers in this table, refer to Appendix B, Section B6.0. For more information about the model-based numbers in this table refer to Agnew et al. (1997)

D5.0 APPENDIX D REFERENCES

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