0050273 S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 647956

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 []	M. J. Kupfer, LMHC, H5-49, 376-6631	[] Yes [X] No	9/15/98
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-U-106	NA	NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	HNF-SD-WM-ER-636, Rev. 0A	NA	NA

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)	NA	NA Design Authority/Cog. Engineer Signature & Date	NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

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

This ECN compiles all reconciliation changes made to the Best-Basis Inventory in FY 1998 and should replace Section 3.0 and Appendix D, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-U-106, of the Tank Characterization Report. The reconciliation process involved correction of errata, reassessment of data outlyers, verification of uranium isotopic distribution and other alpha isotope distribution, and removal of "less than" values, etc. Changes were made to both text and tables. The inventory estimates of several waste components were revised.

14a. Justification (mark one)

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

14b. Justification Details

Tank waste inventory estimates are being provided as standard source term for the various waste management activities. FY 1997 evaluation of available information for all 177 underground storage tanks was performed and published in TCRs, preliminary TCRs, or revisions to existing TCRs. In FY 1998, a reconciliation process is being performed to update the best-basis inventories. This process ensures that the latest inventory estimates are available as a consistent source-term to support the activities of TWRS disposal and other users.

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

Central Files	B1-07	K. M. Hodgson	R2-11
DIMC R1-41	~~H6-15~~	M. J. Kupfer	R3-75
DOE Reading Room	H2-53	M. D. LeClair (3)	R3-75
TCSRC	R1-10	T. M. Brown	R2-12
K. M. Hall	R2-12		

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STA: 30 ID: 25

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A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 647956

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	[]	Other	[X]
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
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. M. J. Kupfer	M J Kupfer	9-16-98	PE		
Cog. Mgr. K. M. Hodgson	K.M. Hodgson	9-16-98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other T. M. Brown R2-12	Todd Brown	9/16/98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

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

B. A. Higley
Numatec Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 647956 UC: 721
Org Code: 7A110 Charge Code: N4G3A
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Key Words: TCR, best-basis inventory, standard inventory

Abstract: The best-basis inventory provides waste inventory estimates that serve as standard characterization source terms for the various waste management activities. To establish a best-basis inventory for single-shell tank 241-U-106, an evaluation of available information was performed. This work follows the methodology established in *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A (Kupfer et al. 1997).

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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
0-A RS	Incorporate per ECN-635515.	T.M. Brown	K.M. Hall
		B.C. Simpson for T.M. Brown	Kathleen M. Hall 8/20/97
0-B RS	Incorporate per ECN-647956.	M.J.Kupfer	K.M. Hodgson
		M.J. Kupfer 9-16-98	K.M. Hodgson 9-16-98

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3.0 BEST BASIS INVENTORY ESTIMATE

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. 1997)
- Comparison with other tanks with SMMS1 saltcake.

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 saltcake.
- Historical records and the results from core samples indicate that the tank contains SMMS1 saltcake but contains little or no metal waste predicted by Agnew et al. (1997).
- 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.

For more information about the origin and quality of the sample-based numbers in Tables 3-1 and 3-2, refer to Appendix B. For more information about the model-based numbers in Table 3-1 and 3-2, refer to Agnew et al. (1997).

The best-basis inventory values for tank 241-U-106 are presented in Tables 3-1 and 3-2. The inventory values reported in Tables 3-1 and 3-2 are subject to change. Appendix D contains the complete narrative regarding the derivation of the inventory estimates shown in Tables 3-1 and 3-2. Refer to the Tank Characterization Database (TCD) (LMHC 1998) for the most current inventory values.

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]	Comment
Al	15,700	S	This value based on acid digest and may not represent all the aluminum present
Bi	0	E	No evidence of Bi bearing waste sample reports <56.8
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	0	E	Simpson (1998)
K	1,860	S	
La	51.6	S	
Mn	1,530	S	
Na	258,000	S	
Ni	389	S	
NO_2	68,700	S	
NO_3	286,000	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/E	Upper bounding value. No evidence of Sr bearing waste.

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]	Comment
TOC	29,600	S	
U	1,010	S	
Zr	133	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997)
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

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. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

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]	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	106,000	S	
^{90}Y	106,000	S	Based on ^{90}Sr
^{93}Zr	19.9	M	
^{93m}Nb	14.5	M	
^{99}Tc	297	M	
^{106}Ru	0.00863	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	215,000	S	
^{137m}Ba	203,000	S	Based on ^{137}Cs
^{151}Sm	14,300	M	
^{152}Eu	4.86	M	
^{154}Eu	1,990	S	
^{155}Eu	288	M	
^{226}Ra	1.82E-04	M	
^{227}Ac	0.00110	M	
^{228}Ra	0.166	M	
^{229}Th	0.00391	M	
^{231}Pa	0.00497	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]	Comment
^{232}Th	0.0118	M	
^{232}U	0.0193	S/M	From total U
^{233}U	0.0738	S/M	From total U
^{234}U	0.335	S/M	From total U
^{235}U	0.0150	S/M	From total U
^{236}U	0.00266	S/M	From total U
^{237}Np	1.07	M	
^{238}Pu	19.5	S/M	Total alpha distribution
^{238}U	0.337	S/M	From total U
^{239}Pu	650	S/M	Total alpha distribution
^{240}Pu	111	S/M	Total alpha distribution
^{241}Am	785	S/M	Total alpha distribution. Sample reports <2,280
^{241}Pu	1,330	S/M	Total alpha distribution
^{242}Cm	2.12	S/M	Total alpha distribution
^{242}Pu	0.00734	S/M	Total alpha distribution
^{243}Am	0.0291	S/M	Total alpha distribution
^{243}Cm	0.198	S/M	Total alpha distribution
^{244}Cm	1.97	S/M	Total alpha distribution

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997)
E = Engineering assessment-based

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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. 1997a).
- 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. (1997a). 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 saltcake. 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	47,200	NH_3	NR	1,450
Ag	32.7	NR	Ni	390	406
As	< 67	NR	NO_2	68,700	119,000
Ba	< 33.5	NR	NO_3	2.86E+05	318,000
Be	< 3.35	NR	OH	NR	199,000
Bi	< 56.8	270	oxalate	12,700	7.39
Ca	510	1,780	Pb	425	222
Ce	94.7	NR	Pd	NR	NR
Cd	71.3	NR	PO_4	12,300	12,800
Cl	3,810	9,220	Pt	NR	NR
Co	< 13.4	NR	Rh	NR	NR
Cr	3,520	NR	Ru	NR	NR
Cr^{+3}	NR	7,950	Sb	< 40.2	NR
Cr^{+6}	NR	NR	Se	< 61.3	NR
Cu	27.7	NR	Si	228	2,420
F	4,180	1,210	SO_4	12,810	26,600
Fe	4,050	1,330	Sr	6.13	0
Hg	NR	1.86	TIC as CO_3	54,400	41,200
K	1,860	2,780	TOC	28,980	15,500
La	51.6	8.90	U_{TOTAL}	1,010	43,500
Mg	66.9	NR	V	33.5	NR
Mn	1,530	241	Zn	52.9	NR
Mo	45.5	NR	Zr	133	19.8

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)
Na	2.45E+05	359,000	H_2O (wt%)	42.9	21.5
Nd	144	NR	density (kg/L)	1.62	1.83

Notes:

NR = Not reported
[1]Appendix B
[2]HDW = Hanford Defined Waste (Agnew et al. 1997a)
[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	106,000	137,000	^{241}Am	< 2,290	68.9
^{137}Cs	215,000	278,000	Total α	1,570	NR
^{154}Eu	1,990	NR	Total β	430,000	NR
$^{239/240}Pu$	NR	66.7			

NR = Not reported
[1]Appendix B
[2]HDW = Hanford Defined Waste (Agnew et al. 1997a).

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. (1997b) 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. (1995) 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 supematant 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.
Saltcake (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 saltcake 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 saltcake to determine an average composition. Multiplied by saltcake 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 Saltcake 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 saltcake 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 saltcake composition predicted by Agnew et al. (1997a) 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 saltcake 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 saltcake 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 saltcake 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 Saltcakes (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	33,400
Bi	71	76	NR	NR	74	144
Ca	273	237	336	NR	282	1,210
Cl	4,500	4,099	2,926	NR	3,840	2,905
Cr	10,000	4,359	3,170	4,233	5,441	7,870
F	500	13,596	4,669	NR	6,260	611
Fe	508	1,298	3,096	NR	1,634	539
K	1,109	898	1,309	NR	1,105	1,260
La	NR	37	43	NR	40	0.751
Mn	266	597	1,189	NR	684	175

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

Analyte	241-S-101	241-S-102	241-U-106	241-U-109	Average SMMS1[1]	HDW SMMS1[2]
Na	150,000	189,500	170,500	218,333	182,083	231,000
Ni	114	49	304	NR	155	340
NO_2	91,000	40,078	56,029	42,900	57,502	82,400
NO_3	110,000	99,152	147,200	296,667	163,255	257,000
Pb	91	137	348	NR	192	109
PO_4	9,500	114,500	5,888	5,970	33,965	5,310
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	18,669
SO_4	20,700	12,500	10,774	11,100	13,768	12,700
Sr	7	NR	NR	NR	7	0
TOC	1,900	5,340	24,626	3,920	8,947	6,130
U	560	1,403	781	NR	914	2,060
Zr	14	39	88	NR	47	109
Oxalate	15,400	15,674	9,881	NR	13,652	6,235
wt% H_2O	40.2	24.9	43.0	23.9	33.0	25.5
Density	1.58	1.69	1.57	1.67	1.63	1.84

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. 1997a)

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

Table D3-3. Radionuclide Composition of SMMS1 Saltcakes (μCi/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	110
^{137}Cs	175	121	175	142	153	175

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. 1997a)

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 saltcake 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)	241-U-106 Sample-based (kg)	HDW estimated (kg)
Bi	95.8	<56.8	270
Ca	365	510	1,780
K	1,430	1,860	2,780
La	51.8	51.6	8.90
Ni	201	389	406
NO_3	2.11E+05	2.86E+05	318,000
NO_2	74,400	68,700	119,000
Mn	885	1,520	241
SO_4	17,800	12,800	26,600

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

Component	Predicted (kg)	241-U-106 Sample-based (kg)	HDW estimated (kg)
Cr	7,040	3,520	7,950
Sr	9	<6.70	0
Pb	248	425	222
PO_4	44,000	12,300	12,800
F	8,140	4,180	1,210
Al	19,500	15,700	47,200
Fe	2,110	4,050	1,330
Cl	4,970	3,810	9,220
Si	2,570	228	2,420
TOC	11,600	29,600	15,500
U	1,180	1,010	43,500
Oxalate	17,700	12,600	7.39
Zr	60.8	133	19.8
Na	2.36E+05	2.58E+05	359,000
H_2O (percent)	NR	42.9	21.5

HDW = Hanford Defined Waste (Agnew et al. 1997a)
NR = Not reported
[1]Based on average analyte concentrations for tanks known to contain SMMS1 saltcake and used the solids mass only as a basis.

Nitrate. The HDW estimated inventory is within 15 percent of 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 twice the sample-based inventory. The Cr concentration in the four SMMS1 comparison samples bracket the HDW SMMS1.

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 saltcakes 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 saltcakes 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 40 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 TOC content of 241-U-106 is much higher than the TOC content of other SMMS1 saltcake tanks. 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 6 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 three times higher than the samplebased 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 three 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 eleven 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 40 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. 1997a)
- Comparison with other tanks with SMMS1 saltcake.

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 saltcake.
- Historical records and the results from core samples indicate that the tank contains SMMS1 saltcake but contains little or no metal waste predicted by Agnew et al. (1997a).
- 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.

For more information about the origin and quality of the sample-based numbers in Tables D4-1 and D4-2, refer to Appendix B. For more information about the model-based numbers in Table D4-1 and D4-2, refer to Agnew et al. (1997a).

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) (LMHC 1998) 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]	Comment
Al	15,700	S	This value based on acid digest and may not represent all the aluminum present
Bi	0	E	No evidence of Bi bearing waste sample reports <56.8
Ca	510	S	
Cl	3,810	S	
$C0_3$	54,400	S	
Cr	3,520	S	
F	4,180	S	
Fe	4,050	S	
Hg	0	E	Simpson (1998)
K	1,860	S	
La	51.6	S	
Mn	1,530	S	
Na	258,000	S	
Ni	389	S	
NO_2	68,700	S	
NO_3	286,000	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/E	Upper bounding value. No evidence of Sr bearing waste.

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]	Comment
TOC	29,600	S	
U	1,010	S	
Zr	133	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997a)
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

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. 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)	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	106,000	S	
^{90}Y	106,000	S	Based on ^{90}Sr
^{93}Zr	19.9	M	
^{93m}Nb	14.5	M	
^{99}Tc	297	M	
^{106}Ru	0.00863	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	215,000	S	
^{137m}Ba	203,000	S	Based on ^{137}Cs
^{151}Sm	14,300	M	
^{152}Eu	4.86	M	
^{154}Eu	1,990	S	
^{155}Eu	288	M	
^{226}Ra	1.82E-04	M	
^{227}Ac	0.00110	M	
^{228}Ra	0.166	M	
^{229}Th	0.00391	M	
^{231}Pa	0.00497	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]	Comment
^{232}Th	0.0118	M	
^{232}U	0.0193	S/M	From total U
^{233}U	0.0738	S/M	From total U
^{234}U	0.335	S/M	From total U
^{235}U	0.0150	S/M	From total U
^{236}U	0.00266	S/M	From total U
^{237}Np	1.07	M	
^{238}Pu	19.5	S/M	Total alpha distribution
^{238}U	0.337	S/M	From total U
^{239}Pu	650	S/M	Total alpha distribution
^{240}Pu	111	S/M	Total alpha distribution
^{241}Am	785	S/M	Total alpha distribution. Sample reports <2,280
^{241}Pu	1,330	S/M	Total alpha distribution
^{242}Cm	2.12	S/M	Total alpha distribution
^{242}Pu	0.00734	S/M	Total alpha distribution
^{243}Am	0.0291	S/M	Total alpha distribution
^{243}Cm	0.198	S/M	Total alpha distribution
^{244}Cm	1.97	S/M	Total alpha distribution

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997a)
E = Engineering assessment-based

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D5.0 APPENDIX D REFERENCES

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