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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 612292

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision PS [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	S. L. Lambert, SESC, H5-27 376-8730	[] Yes [X] No	08/21/97
	6. Project Title/No./Work Order No. Tank 241-C-106	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-615, Rev. 0	10. Related ECN No(s). NA	11. Related PO No. 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

Add Appendix F, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-C-106.

NOV 1998 RECEIVED EDMC

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

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-C-106 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

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

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	R. D. Schreiber	R2-12
File	H5-49		
S. L. Lambert	H5-27		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 612292

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	[]	N/A	[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	8-27-97	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	8-27-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other R. D. Schreiber	Rudy D. Schreiber	8/27/97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

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

S. L. Lambert
SGN Eurisys Services Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-C-106 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-615	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-C-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 9/25/96 on EDT 617548.	R. D. Schreiber	J. G. Kristofzski
RS 0A	Incorporate per ECN-612292.	M. J. Kupfer 8-27-97	K. M. Hodgson 8-27-97

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APPENDIX F

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

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APPENDIX F

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-C-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 single-shell tank 241-C-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.

F1.0 CHEMICAL INFORMATION SOURCES

Appendix A provides characterization results from the most recent sampling event for this tank. Multiple grab samples were obtained from different elevations and analyzed in 1996, while a full-depth core sample was taken in 1986 and grab samples in 1974, 1977, and 1980. Tables 4-2 and 4-3 summarize the 1996 sampling results for supernatant and sludge, respectively, while Table 4-4 provides a summary of the projected tank inventory estimates. Component inventories can be calculated by multiplying the concentration of an analyte by the current tank volume and by the density of the waste. The Hanford Defined Waste (HDW) model (Agnew et al. 1996) provides independent estimates, derived from the Los Alamos National Laboratory (LANL) model, of the tank component concentrations and inventories.

F2.0 COMPARISON OF COMPONENT INVENTORY VALUES

F2.1 SAMPLE INVENTORY ESTIMATES

Sixteen grab samples were obtained from risers 1 and 7 in February/March 1996 from the supernatant layer and top 60 percent of the sludge inventory in tank 241-C-106. From this population, five centrifuged and filtered sludge samples, four interstitial liquid samples, and three supernatant samples were analyzed for various components, with the metals being determined by inductively coupled plasma spectroscopy (ICP) acid digestion and anions by water digestion and ion chromatography (IC). Radionuclides were determined by alkali fusion (sodium or potassium fusion) and dilute hydrochloric acid dissolution (with several of the metals such as silver also being analyzed by fusion digestion procedure by Pacific

Northwest National Laboratory). The results were statistically analyzed and sample mean values were used to estimate tank inventories in Table 4-4.

Several samples of liquid and sludge were also obtained from tank 241-C-106 in 1977 and 1980, and a four segment core sample of sludge from riser 1 in 1986. About 1,300 g of sludge and 80 mL of liquid were recovered from the 1986 core sample. Based on the physical properties of the core, the sludge layer appeared to be 193 cm (76 in.) thick at the sampling location. This sludge layer is consistent with sludge level measurements that, at the time of sampling, indicate the sludge layer was 196.3 cm (77.3 in.) thick. A composite sample of 239.5 g of sludge was formed from the core material. Water washing and acid leaching tests (with HNO_3 and HNO_3-HF-HCl) were performed using a centrifuge separation/liquid decant procedure. The 1986 composite sample may not accurately represent the composition of the sludge layer because (1) several large chunks of material were not crushed and added to the composite sample, (2) sample blending methods that were under development at that time may not have successfully blended all of the material in the sample composite, and (3) about 10 percent of the material remaining after the HNO_3 leach was not dissolved and analyzed in the HNO_3-HF-HCl acid digestion procedure. Significant differences were also found between the 1986 (Weiss 1987 and 1988) analysis and later analyses (McCown 1988, Hara 1990) of Al, Ba, Ca, Mg, Si, Ag, and Zr in the same composite sample. This indicates that the 1986 composite sample may not have been completely homogenized during the sample preparation process. Tables F2-1 and F2-2 show a comparison between the 1996 sample inventory estimates and those derived from the 1986 core sample composite. The chemical species are reported without charge designation per the best-basis inventory convention.

Table F2-1. Sample-Based Inventory Estimates for Nonradioactive Components in Tank 241-C-106. (2 Sheets)

Analyte	1996 sample inventory estimate[a] (MT)	1986 sample inventory estimate[b] (MT)	Analyte	1996 sample inventory estimate[a] (MT)	1986 sample inventory estimate[b] (MT)
Ag	1.39	0.56	Na	145.0	124.87
Al	36.0	43.6	Nd	0.12	NR
Ba	0.22	5.2	Ni	0.46	1.04
Bi	0.007	0.53	NO_2	21.7	13.3[c]
Ca	0.98	12.7	NO_3	1.92	0.86[c]
Ce	0.16	NR	Pb	1.74	2.56
Cd	0.02	0.39	P as PO_4	5.5	9.5
Cl	0.32	0.13[c]	Si	18.4	75.7
Co	NR	0.005	S as SO_4	6.1	2.61[c]

Table F2-1. Sample-Based Inventory Estimates for Nonradioactive Components in Tank 241-C-106. (2 Sheets)

Analyte	1996 sample inventory estimate[a] (MT)	1986 sample inventory estimate[b] (MT)	Analyte	1996 sample inventory estimate[a] (MT)	1986 sample inventory estimate[b] (MT)
Cr	0.48	1.05	Sr	0.03	0.1
Cu	0.08	0.14	TIC as CO_3	147.5	47.86[c]
F	0.27	0.1[c]	TOC	15.2	3.8[c]
Fe	46.8	55.5	U_{TOTAL}	1.4	0.44
K	0.78	1.57	Zn	0.05	0.05
La	0.06	NR	Zr	0.59	2.31
Mg	0.2	7.0	H_20 (Wt%)	50.6	52.5
Mn	1.61	1.96	Density (kg/L)	1.55	1.43

NR = Not reported

[a] Section 4.0 of this TCR

[b] Weiss (1988)

[c] McCown (1988) (sample values reported on dry basis, converted to wet basis to match the Weiss sample results).

Table F2-2. Sample-Based Inventory Estimates for Radioactive Components in Tank 241-C-106.

Analyte	1996 sample inventory estimate[a] (Ci)	1986 sample inventory estimate (Ci)	Analyte	1996 sample inventory estimate[a] (Ci)	1986 sample inventory estimate (Ci)
^{14}C	NR	0.023[b]	^{154}Eu	NR	2,300[c]
^{60}Co	<328	342[b]	^{129}I	NR	0.1[b]
^{90}Sr	407,000	1.74 E+06[b]	$^{239/240}Pu$	1,240	2,865[b]
^{99}Tc	24.8	221[b]	^{241}Am	1,190	1,118[b]
^{125}Sb	NR	1,730[b]	^{137}Cs	501,000	292,000[b]

NR = Not reported

[a] Section 4.0 of this TCR, radionuclides reported as of the sample analysis date

[b] Weiss (1988)

[c] Hara (1990) (sample values apparently reported on dry basis, converted to wet basis to match the Weiss sample results).

Note: the 1986 samples decayed to January 1, 1994.

Note the significant differences between the 1996 and 1986 tank inventory estimates for Al, Ca, Cr, F, Fe, Na, NO_2, PO_4, Si, SO_4, TIC, TOC, and U. The 1996 grab samples only represent the supernatant and upper 60 percent of the sludge layer, while the 1986 core sample does not appear to have been well enough mixed (together with noted deficiencies in the analytical procedure) to accurately represent component inventories the tank.

F2.2 COMPARISON OF SAMPLE INVENTORY ESTIMATES

Based on the waste transaction records (Agnew et al. 1995) and fuel records for the plutonium-uranium extraction (PUREX) process and PUREX waste receiver tanks, 1,691.7 MTU of PUREX coating waste were transferred to tank 241-C-106. The aluminum alloy jacket around the fuel normally contains 0.046 kg Si/MTU, while the Al-Si braze metal used in the bonding layer adds another 1.269 kg Si/MTU (see the silica discussion in section 5.19 and the coating waste discussion for aluminum clad fuel from the $BiPO_4$ and reduction and oxidation (REDOX) processes in Appendix D). The PUREX coating waste or CWP1 layer in tank 241-C-106 thus contains about 2.22 MT of Si. The uranium recovery (UR) layer adds only a negligible amount of Si based on analysis of the UR sludge layer in tank 241-TY-105 (only 42 kg of Si are projected to be in the 241-C-106 UR waste based on the measured composition of tank 241-TY-105 sludge). If the UR and CWP1 sludge layers represent 25 percent of the sludge in tank 241-C-106, and the 1996 samples represent the remaining 75 percent, the total Si inventory would be 16.06 MT, compared to 18.4 MT estimated from the 1996 samples and 75.7 MT based on the 1986 core composite. Moreover, if all of the Si in tank 241-C-105 waste is attributed to the CWP1 sludge layer,

approximately 2.706 MT of Si would have been added to the CWP1 layer in tank 241-C-106 based on the relative volumes of CWP1 waste added to each tank (420 kgal to 241-C-106 compared to 3,151 kgal to 241-C-105). Based on this comparison, the total Si inventory in 241-C-106 would be 16.51 MT, which is good agreement with the 1996 sample estimate. Thus, the 1996 samples provide a more reliable estimate for Si based on a common sludge layer in 241-C-105 and the PUREX fuel fabrication and production records and waste transaction records (Agnew et al. 1995) for tank 241-C-106.

Table F2-3 compares the 1996 and 1986 sample-based inventories with projected estimates provided by the 1974, 1977, and 1980 grab samples obtained from tank 241-C-106.

Table F2-3. Comparison of Sample-Based Inventory Estimates for Tank 241-C-106.

Analyte	1974 sample (Allen 1976) (MT)	1977 sample (Horton 1977) (MT)	1980 sample (Bratzel 1980) (MT)	1986 core (Weiss 1988) (MT)	1996 samples (Table 4-3) (MT)
Al	39.3	41.3	32.0	43.6	36.0
Ca	5.9	NR	NR	12.7	0.98
Cr	NR	13.6	0.1	1.05	0.48
Fe	74.2	53.7	68.4	55.5	46.8
La	NR	NR	0.6	NR	0.06
Mg	1.6	1.1	0.5	7.0	0.2
Si	2.8	20.8	21.9	75.7	18.4

Note: Horton's results were normalized to a density of 1.43 to match the 1986 core sample.

The 1996 samples appear to offer a more reasonable basis for estimating the composition of the waste because (1) these samples provide a statistical basis for estimating individual component inventories in the tank, (2) the 1996 estimates for Si are consistent with fuel fabrication and production records, waste transaction records and common sludge layers from other tanks (241-TY-105 and 241-C-105, which will be described later) and (3) the 1996 samples appear to be more consistent with most of the Al, Ca, Cr, Mg, and Si estimates derived from the 1974, 1977 and 1980 sludge samples (Allen 1976, Horton 1977, and Bratzel 1980).

While the 1996 grab samples were chosen as the best sample inventory basis for chemicals, the 1986 (Weiss 1988) composite core results were chosen to represent the sample inventory basis for radionuclides (with the exception of ^{90}Sr and ^{137}Cs). The 1980 ^{90}Sr and ^{137}Cs values (Table D-4) were chosen because they are consistent with heat load calculations based on historical water additions to tank 241-C-106 to control the waste temperature. The 1996 samples indicate a mean value 1,240 Ci of $^{239/240}Pu$, while the mass weighted average of

these samples indicates 2,386 Ci of $^{239/240}Pu$ in the tank (Lumetta et al. 1996). The latter estimate is consistent with the 1986 composite core sample result (2,865 Ci of $^{239/240}Pu$).

F3.0 COMPONENT INVENTORY EVALUATION

Sample-based inventories derived from analytical data, and HDW model inventories, generated by the LANL HDW model (Agnew et al. 1996), may be compared in Tables F3-1 and F3-2. The inventory estimates are based on 867 kL (229 kgal) of waste, including 121 kL (32 kgal) of supernatant and 746 kL (197 kgal) of sludge (Hanlon 1996). The density used to calculate the sampling-based component inventories is 1.55 g/ml, while the HDW model density is estimated to be 1.44 g/mL (Agnew et al. 1996). Note the significant differences between the sample-based and HDW model inventories for several of the bulk components, e.g., Al, Ca, Fe, Mn, Na, Ni, NO_3, PO_4, TIC, and U.

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

Table F3-1. Sampling- and Historical Tank Content-Based Inventory Estimates for Nonradioactive Components in Tank 241-C-106. (2 Sheets)

Analyte	1996 sample inventory estimate[a] (MT)	HDW model inventory estimate[b] (MT)	Analyte	1996 sample inventory estimate[a] (MT)	HDW model inventory estimate[b] (MT)
Ag	1.39	NR	Nd	0.12	NR
Al	36.0	51.1	NH_3	NR	1.49
Ba	0.22	NR	Ni	0.46	16.9
Bi	0.007	0.0007	NO_2	21.7	24.7
Ca	0.98	4.61	NO_3	1.92	14.1
Ce	0.16	NR	OH	NR	176
Cd	0.02	NR	Pb	1.74	3.14
Cl	0.32	0.7	P as PO_4	5.5	1.44
Cr	0.48	0.29	Si	18.4	36.4
Cu	0.08	NR	S as SO_4	6.1	3.77
F	0.27	0.002	Sr	0.03	2.46 E-17
Fe	46.8	56.9	TIC as CO_3	147.5	12
Hg	NR	0.065	TOC	15.2	0.777

Table F3-1. Sampling- and Historical Tank Content-Based Inventory Estimates for Nonradioactive Components in Tank 241-C-106. (2 Sheets)

Analyte	1996 sample inventory estimate[a] (MT)	HDW model inventory estimate[b] (MT)	Analyte	1996 sample inventory estimate[a] (MT)	HDW model inventory estimate[b] (MT)
K	0.78	0.2	U_{TOTAL}	1.4	31.4
La	0.06	1.17 E-16	Zn	0.05	NR
Mg	0.2	NR	Zr	0.59	1.14 E-04
Mn	1.61	0.044	H_2O (Wt%)	50.6	58.5
Na	145.0	89.1	density (kg/L)	1.55	1.44

NR = Not reported
[a] Table 4-4
[b] Agnew et al. (1996).

Table F3-2. Sample- and Historical Tank Content-Based Inventory Estimates for Radioactive Components in Tank 241-C-106.[a]

Analyte	Sample inventory estimate (Ci)	HDW model inventory estimate[b] (Ci)	Analyte	Sample inventory estimate (Ci)	HDW model inventory estimate[b] (Ci)
^{90}Sr	4.77 E+06[c]	5.23 E+06	$^{239/240}Pu$	2,860[d]	4,550
^{99}Tc	221[d]	NR	^{241}Am	1,190[e]	NR
^{129}I	0.1[d]	NR	^{154}Eu	1,730[d]	NR
^{137}Cs	227,000[e]	83,700			

HDW = Hanford Defined Waste
NR = Not reported
[a] Sample and HDW model radionuclide estimates decayed to January 1, 1994
[b] Agnew et al. (1996)
[c] Table 4-4
[d] Weiss (1988)
[e] Table D-4.

F3.1 CONTRIBUTING WASTE TYPES

Tank 241-C-106 is the last tank in a cascade that includes tanks 241-C-104 and 241-C-105. Tank 241-C-106 first received metal waste (MW) from the bismuth phosphate process in 1947. Metal waste was later sluiced from this tank and other tanks in the cascade for UR in 1953 and this tank was used as the metal waste supernatant blend tank (last tank in the 241-C-104/C-105/C-106 cascade where metal wastes from other tanks were blended for the UR process). During the third quarter of 1954, tank 241-C-106 received 2,036 kL (538 kgal) of UR waste. In the second quarter of 1957, most of the supernatant from tank 241-C-106 was transferred to tanks 241-C-109 and 241-C-112 for ferrocyanide scavenging of radiocesium. Later, in 1958, tank 241-C-106 received 1,590 kL (420 kgal) of PUREX coating waste (CWP1). From 1969 to 1972, this tank also received 4,565 kL (1,206 kgal) of washed PUREX sludge (AR sludge); this sludge is thought to be the primary source of the heat-generating ^{90}Sr in the tank (Agnew et al. 1996). During the period from 1974 to 1976, 11,116 kL (2,937 kgal) of B Plant low-level waste (BL waste) were transferred to this tank, with later transfers of B Plant strontium recovery waste (B waste), supernatant and complexed evaporator wastes from tank 241-A-102. Water was also periodically added to this tank to control the temperature of the waste.

F3.1.1 Predicted Sludge Types

Anderson (1990): MW, Tributyl phosphate waste (TBP), Cladding waste (CW), PUREX sludge supernatant (PSS), BL, Sr sludge

Agnew et al. (1996), Agnew et al. (1995): UR, CWP1, AR, BL, Unknown assigned to B Plant Low Level waste (Unk [BL]), Unknown assigned to washed PUREX sludge (Unk [AR]), and supernatant.

F3.1.2 Predicted Sludge Volume (Agnew et al. 1996)

Table F3-3 shows sludge layers that, according to the HDW model, were produced in tank 241-C-106.

Table F3-3. Predicted Current Inventory in Tank 241-C-106 (Agnew et al. 1996). (2 Sheets)

Waste type	Waste volume m^3 (kgal)	Sludge elevation* (cm)	Percent of sludge layer
UR	56.7 (15)	0 - 13.7	0 - 7.6%
CWP1	128.7 (34)	13.7 - 45.2	7.6 - 24.9%
AR	242.2 (64)	45.2 - 104.1	24.9 - 57.3%

Table F3-3. Predicted Current Inventory in Tank 241-C-106 (Agnew et al. 1996). (2 Sheets)

Waste type	Waste volume m^3 (kgal)	Sludge elevation[a] (cm)	Percent of sludge layer
BL	75.7 (20)	104.1 - 122.7	57.3 - 67.6%
Unk (BL)	121.1 (32)	122.7 - 152.1	67.6 - 83.8%
Unk (AR)	121.1 (32)	152.1 - 181.6	83.8 - 100%
Supernatant	121.1 (32)		

AR = B Plant AR vault sludge
BL = B Plant low-level waste
CWP1 = PUREX coating waste (1956 - 1960)
PUREX = Plutonium-uranium extraction
UR = Uranium recovery
[a] Referenced to the bottom edge of the tank assuming a flat bottom configuration. The bottom centerline of tank 241-C-106 is actually 30.5 cm (12 in.) below the bottom edge of the tank due to a dished bottom configuration. Since the top surface of the sludge is known to be indented or pancaked in the middle, a flat bottom tank configuration will be assumed in this analysis. Actually, the dished bottom contains about 12,000 gal of sludge, which corresponds to about 6 percent of the total sludge inventory.

Based on the current inventory projections from LANL (Agnew et al. 1996), the 1996 sludge samples, which represent about 60 percent of the upper sludge inventory, include about one-half of the AR layer and all of the BL, Unk (BL), and Unk (AR) layers, where the Unk (AR) notation refers to the unknown layer being tentatively assigned to AR sludge. Current estimates based on the 1996 samples do not include sample data from the UR and CWP1 layers at the bottom of tank 241-C-106. These layers were produced from 2,036 kL (538 kgal) of UR waste and 1,590 kL (420 kgal) of CWP1 waste that were added to this tank.

The sample-based and HDW-based inventories can be compared by using two different methods to develop a better picture of the best-basis inventory for this tank. The first method involves comparing the 1996 sample-based inventory to the HDW model inventory of the top 60 percent of the sludge layer where the sample estimates are considered to be valid. The second method relies on the use of common sludge layers in other tanks to represent the UR and CWP1 sludge layers in 241-C-106 and the 1996 samples to represent the other layers, with the combined sample-based estimate being compared to the HDW estimates for this tank.

Another possible method that might be considered is to compute concentration factors for various components based on the UR and PUREX flowsheets and to compare these estimates to sample-based estimates and to HDW model for this waste. This approach does

not appear to be very promising because the UR process flows and component concentrations were not consistent, but varied widely because of large changes in the volume of water used in the metal waste sluicing campaigns and inconsistent variations in the concentration factors (CFs) achieved in the UR process waste evaporator. The UR and PUREX (CWP1) flowsheet and HDW defined waste compositions are presented in Table F3-4. Generally, the PUREX flowsheet and HDW PUREX coating waste (CWP1) compositions are similar and largely indistinguishable from one another, while the UR flowsheet and HDW UR estimates vary by a factors of 1.67 to 1.91, but cannot be readily compared because of large perturbations in the UR process flows.

Table F3-4. Process Flowsheet and Hanford Defined Waste Stream Compositions in Tank 241-C-106.

Analyte	Flowsheet UR waste[a] (*M*)	HDW UR composition[b] (*M*)	Flowsheet CWP1 waste[c] (*M*)	HDW CWP1 composition[b] (*M*)
NO_3	6.18	3.4	0.6	0.68
NO_2	0	0	0.9	0.78
SO_4	0.346	0.14	0	0.012
Al	0	0	1.2	1.2
Bi	0	0	0	0
Fe	0.024	0.046	0	0.015
Si	0	0	0.02	0.02
U	0.0026	0.0078	0.006	0.01
Cr	0	0.0032	0	0.003
PO_4	0.374	0.13	0	0
Na	7.57	4.51	5.74	2.34
K	0	0.0017	0	0.014

CWP1 = PUREX coating waste (1956 - 1960)
HDW = Hanford Defined Waste
PUREX = Plutonium-uranium extraction
UR = Uranium recovery
[a] GE (1951)
[b] Appendix B of Agnew et al. (1996)
[c] GE (1955).

F3.2 COMPARE SAMPLE AND HANFORD DEFINED WASTE ESTIMATES FOR THE TOP SLUDGE LAYER

HDW inventories can be computed by multiplying the volume and density of the characteristic layer by the concentration of each component in the sludge, based on the values in Appendix B of Agnew et al. (1996). The top sludge layer consists of 242 kL (64 kgal) of AR waste (density of 1.30082 kg/L) and 196 kL (52 kgal) of BL waste (density of 1.98656 kg/L). It should be noted that this top layer contains about two-thirds of the AR waste in the tank. The results are summarized in Table F3-5.

Table F3-5. Hanford Defined Waste-Based Estimates for AR and BL Wastes in Tank 241-C-106.

Analyte	AR Waste[a]		BL Waste[a]	
	Analyte concentrate (ppm)	Analyte inventory (MT)	Analyte concentrate (ppm)	Analyte inventory (MT)
Na	99,013	31.2	77,493	30.3
Al	1,475	0.46	82,370	32.2
Fe	55,888	17.58	62,067	24.3
Cr	567	0.18	0.003	0
Ni	6,273	1.98	35,690	13.9
Ca	3,377	1.06	4,104	1.6
K	185	0.06	153	0.06
NO_3	0.0002	0	26.86	0.01
NO_2	22,630	7.13	23,000	9.0
PO_4	1,422	0.45	275	0.1
SO_4	5,017	1.58	1,227	0.48

AR = B Plant AR vault sludge
BL = B Plant low-level waste
[a] Agnew et al. (1996).

Table F3-6 compares the HDW predictions for the upper sludge layer (from Table F3-5) to the 1996 sample estimates (normalized to 60 percent of the sludge volume).

Table F3-6. Comparison of the 1996 Sample and Hanford Defined Waste Inventories for the Upper Sludge Layer in Tank 241-C-106.

Analyte	HDW model inventory[a] (MT)	1996 sample inventory (MT)
Na	61.5	87
Al	32.7	21.6
Fe	41.9	28.1
Cr	0.18	0.29
Ni	15.88	0.28
Ca	2.66	0.59
K	0.12	0.47
NO_3	0.01	1.15
NO_2	16.13	13.02
PO_4	0.55	3.3
SO_4	2.06	3.7

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

The HDW model tends to underestimate the amount of Na, K, NO_3, and PO_4 and overestimate the amount of Al, Fe, Ni, and Ca compared to the 1996 samples from the upper sludge layer in this tank. HDW results for Al and Fe are approximately 50 percent higher than sample derived estimates, while estimates for Ca and Ni are considerably higher than sample values. This seems to be a common problem with the HDW model since inflated values of Ca and Fe, Cr and Ni have been added to many of the characteristic wastes to compensate for Ca impurities in the water supply and corrosion processes in the production plants. HDW estimates for Al, Ca, Fe, and Ni should be reduced for the BL sludge layer (Table F3-5), while estimates for Na, K, NO_3, and PO_4 need to be raised for the AR and BL sludge layers to match sample results from this tank.

F3.3 COMPARE SAMPLE-BASED AND HANFORD DEFINED WASTE ESTIMATES FOR THE ENTIRE SLUDGE VOLUME

A similar analysis can also be performed where HDW estimates for the remaining portion of the AR layer, together with estimates for the UR and CWP1 layers are included in the overall HDW estimates for the tank. Sample-based values can be developed for this tank by using the 1996 samples to represent the upper 75 percent of the sludge layer and common sludge layers from other tanks to represent the UR and CWP1 layers in this tank. This approach is considered to be an engineering assessment because sample values from other

tanks were used in this analysis. The UR layer is represented by the composition of UR waste in tank 241-TY-105 because UR waste was the only waste added to this tank. Tank 241-C-105 was chosen to represent the CWP1 layer because CWP1 waste is the dominate waste in this tank, with small amounts of UR, organic wash waste from PUREX (1963-1967) (OWW2), PSS, and AR waste.

F3.3.1 Composition Estimates for the Uranium Recovery Layer

According to the HDW model, 56.7 kL (15 kgal) of UR and 128.7 kL (34 kgal) of CWP1 sludge precipitated in tank 241-C-106. The UR waste has average density of 1.3156 kg/L, while the assumed density of the CWP1 waste is 1.41131 kg/L. Table F3-7 summarizes the HDW estimates for the UR and CWP1 wastes in this tank.

Table F3-7. Hanford Defined Waste-Based Estimates for Uranium Recovery and PUREX Coating Wastes in Tank 241-C-106.

Analyte	Uranium recovery waste[a]		CWP1 waste[a]	
	Analyte concentrate (ppm)	Analyte inventory (MT)	Analyte concentrate (ppm)	Analyte inventory (MT)
Na	62,431	4.66	32,279	5.86
Al	0	0	98,538	17.9
Fe	66,802	4.99	6,527	1.19
Cr	116	0.01	95	0.02
Ni	65	0.005	53	0.01
Ca	10,513	0.78	3,420	0.62
K	470	0.04	33	0.006
NO_3	103,244	7.71	24,765	4.5
NO_2	12,915	0.96	21,948	3.99
PO_4	8,601	0.64	0	0
SO_4	9,476	0.71	720	0.13

CWP1 = PUREX cladding waste
[a] Agnew et al. (1996).

Sample-based estimates also can be derived from common sludge layers in tanks 241-TY-105 and 241-C-105. Approximately 23,607 kL (6,237 kgal) of UR waste were added to tank 241-TY-105 and 2,036 kL (538 kgal) to tank 241-C-106 in 1953 and 1954. Based on the ratio of these feeds, the composition of the UR sludge layer in 241-C-106 should be relatively consistent with the known composition of the UR sludge layer in 241-TY-105 (Colton 1995). The results of this comparison are summarized in Table F3-8, together with HDW estimates for the UR layer in 241-C-106 (from Table F3-7).

Table F3-8. Comparison of Sample-Based to Hanford Defined Waste-Based Estimates for Uranium Recovery Waste in Tank 241-C-106.

Analyte	Analyte inventories in tank 241-TY-105[a] (MT)	Sample-based estimates for UR waste in tank 241-C-106[b] (MT)	HDW model-based estimates for UR waste in tank 241-C-106[c] (MT)
Na	154.24	13.30	4.66
Al	2.56	0.22	0
Fe	27.96	2.41	4.99
Cr	0.18	0.02	0.01
Ni	0.11	0.01	0.005
Ca	NR	NR	0.78
K	NR	NR	0.04
NO_3	238.11	20.54	7.71
NO_2	NR	NR	0.96
PO_4	155.79	13.44	0.64
SO_4	NR	NR	0.71

HDW = Hanford Defined Waste
NR = Not reported
UR = Uranium recovery
[a] Colton (19950
[b] Based on the composition of UR waste in tank 241-TY-105 multiplied by the ratio of UR waste fed to tanks 241-C-106 and 241-TY-105.
[c] Agnew et al. (1996).

The HDW model once again appears to have overestimated the amount of Fe and seriously underestimated the amount of Na, NO_3, and PO_4 compared to the sample-based estimate of UR waste from 241-TY-105. HDW model results for Fe are approximately 100 percent higher than sample-based estimates, while the results for Na and NO_3 are only 35 percent of the sample values. HDW estimates for Na, NO_3, and PO_4 may be low because

of errors in the assumed solubility limits or errors in estimating the appropriate flowsheet values for these components (and for Fe). These errors should be corrected by modifying the component concentrations in the UR layer to match sample values from tank 241-TY-105.

F3.3.2 Composition Estimates for the PUREX Coating Waste (CWP) Layer

The composition of the CWP1 layer also can be estimated from the known composition of tank 241-C-105 waste. Waste transaction records (Agnew et al. 1995) for tank 241-C-105 show that the following wastes were added to this tank:

1,745 kL (461 kgal) of UR waste
2,385 kL (630 kgal) of secondary CWP1 waste
11,926 kL (3,151 kgal) of primary CWP1 waste
946 kL (250 kgal) of secondary OWW2 waste
6,010 kL (1,588 kgal) of PUREX sludge supernatant (PSS)
329 kL (87 kgal) of AR waste.

According to the HDW model, these wastes produced the following sludge layers:

56 kL (15 kgal) of UR waste
306 kL (81 kgal) of CWP1 waste
204 kL (54 kgal) of (CWP1) waste (tentatively assigned to the CWP1 category)

Based on the waste transaction records, the sludge layers in 241-C-105 should mostly consist of UR, CWP1 and AR wastes. Secondary wastes such as secondary CWP1 and OWW2 can be safely ignored because 80 to 90 percent of the solids in such wastes tend to precipitate in the first tank of the cascade. PUREX sludge supernatant (PSS) also can be ignored because this is a supernatant waste that will not readily precipitate sludge in the tank. The HDW model must be used to estimate the composition of the AR sludge layer because common layers have not been readily identified in other tanks from which samples have been obtained. The AR sludge composition estimates in Table F3-5 are based on an AR feed flow of 3,043 kL (804 kgal) to tank 241-C-106, while estimates for 241-C-105 should be based on a flow of 329 kL (87 kgal) of AR waste. UR sludge can be derived from the composition of UR sludge in tank 241-TY-105. The composition of the CWP1 layer can be estimated by subtracting the contributions of the AR and UR layers from the sample inventory estimates for 241-C-105. The results of this assessment are summarized in Table F3-9.

Table F3-9. Composition of Tank 241-C-105 CWP1 Waste (Based on Sample-Derived Estimates of Uranium Recovery Waste in Tank 241-TY-105 and Hanford Defined Waste Estimates of AR Waste).

Analyte	Tank 241-C-105 inventory[a] (MT)	Projected inventory of UR waste[b] (MT)	Projected inventory of AR waste[c] (MT)	Estimated inventory of CWP1 waste in 241-C-105 (MT)
Na	56.5	11.40	3.37	41.73
Al	31.5	0.19	0.05	31.26 (30.1)[d]
Fe	5.4	2.07	1.90	1.43 (2.3)[d]
Cr	0.68	0.01	0.02	0.65 (0.65)[d]
Ni	1.1	0.01	0.21	0.88 (1.05)[d]
Ca	3.97	NR	0.11	3.86 (3.88)[d]
K	1.57	NR	0.006	1.51
NO_3	11.3	17.60	0	0
NO_2	NR	NR	0.77	NR
PO_4	5.3	11.51	0.05	0
SO_4	NR	NR	0.17	NR

AR = B Plant AR vault sludge
CWP1 = PUREX coating waste (1956 - 1960)
NR = Not reported
UR = Uranium recovery
[a] (1) Weiss (1987), (2) Tusler (1995)
[b] Based on the inventory of UR waste in 241-TY-105 multiplied by the ratio of UR waste fed to 241-C-105 and 241-TY-105.
[c] Agnew et al. (1996), Table F3-5 multiplied by ratio 804 kgal/87 kgal
[d] Values in parenthesis derived from B Plant AR waste flowsheet compositions normalized to Na (Isochem 1967). Note: CWP1 estimates derived from HDW model AR and B Plant AR compositions are in reasonable agreement).

Table F3-10 compares the sample-derived estimate for CWP1 waste (from Table F3-9), corrected for the ratio of CWP1 waste fed to tanks 241-C-106 and 241-C-105, to the HDW estimate of CWP1 waste in tank 241-C-106 (from Table F3-7).

Table F3-10. Comparison of Sample-Derived and Hanford Defined Waste-Derived Estimates for CWP1 Waste in Tank 241-C-106.

Analyte	HDW model estimate for CWP1 waste in tank 241-C-106[a] (MT)	Sample derived estimate for CWP1 waste in tank 241-C-106[b] (MT)
Na	5.86	5.56
Al	17.9	4.17
Fe	1.19	0.19
Cr	0.02	0.09
Ni	0.01	0.12
Ca	0.62	0.51
K	0.006	0.20
NO_3	4.5	0
NO_2	3.99	NR
PO_4	0	0
SO_4	0.13	NR

CWP1 = PUREX coating waste (1956 - 1960)
HDW = Hanford Defined Waste
NR = Not reported
[a] Agnew et al. (1996)
[b] Based on the composition of CWP1 waste in 241-C-105 (Table F3-8) multiplied by the ratio of CWP1 waste fed to 241-C-105 and 241-C-106 (420 kgal/3,151 kgal).

The HDW model provides consistent estimates for Na and Ca, but tends to overpredict the amount of Cr and Ni and underpredict Al, Fe, and NO_3 compared to CWP1 estimates derived from tank 241-C-105 waste. This appears to be another example where the HDW model needs to be improved by modifying corrosion source term estimates for Fe, Ni, and Cr and reducing the solubility limit or raising the source term value for Na and raising the solubility limits or reducing the CWP1 inventory values for Al and NO_3. Composition estimates for CWP1 waste could also be developed from the CWP1 flowsheet (Table F3-4) and volume of CWP1 waste added to tank 241-C-106, but this method is generally unreliable and does not appear to be a useful approach for soluble and semi-soluble components in this waste.

F3.3.3 Composition Estimates for the Combined Layers

Current estimates can now be combined to generate a more comprehensive picture of the sludge layers in this tank. This effort is needed to provide a more complete comparison between sample-based and HDW estimates for this waste. Sample estimates for the AR/BL sludge layers will be based on the 1996 sample inventory normalized to 75 percent of the total sludge volume, while the UR and CWP1 layers will be derived from sample data in Tables F3-8 and F3-10, respectively. HDW layers will be derived from estimates in Table F3-5 for the AR and BL layers, and Table F3-7 for the UR and CWP1 layers. HDW values for AR waste (Table F3-5) need to be modified so that all of the AR waste in tank 241-C-106 is included in the HDW estimate (AR inventory values should be based on 96 kgal compared to an inventory of 64 kgal used for estimates in Table F3-5). The results are summarized in Table F3-11. Supernatant inventories are not included in these estimates, but are included in the 1996 sample inventory estimates in Table F2-1.

Table F3-11. Comparison of Sample-Derived and Hanford Defined Waste-Derived Estimates for Each Sludge Layer in Tank 241-C-106.

Analyte	Sample-based inventory (MT)				HDW model-based inventory (MT)				
	UR	CWP1	AR/BL*	Total	UR	CWP1	AR	BL	Total
Na	13.30	5.56	99.0	117.86	4.66	5.86	46.8	30.3	87.62
Al	0.22	4.17	26.92	31.31	0	17.9	0.69	32.2	50.79
Fe	2.41	0.19	35.1	37.70	4.99	1.19	26.37	24.3	56.85
Cr	0.02	0.09	0.36	0.47	0.01	0.02	0.27	0	0.3
Ni	0.01	0.12	0.34	0.47	0.005	0.01	2.97	13.9	16.88
Ca	NR	0.51	0.73	1.24	0.78	0.62	1.59	1.6	4.59
K	NR	0.20	0.52	0.72	0.04	0.006	0.09	0.06	0.19
NO_3	20.54	0	1.32	21.86	7.71	4.5	0	0.01	12.22
NO_2	NR	NR	13.72	13.72	0.96	3.99	10.7	9.0	24.65
PO_4	13.44	0	0.86	14.30	0.64	0	0.68	0.1	1.42
SO_4	NR	NR	3.89	3.89	0.71	0.13	2.37	0.48	3.69

AR = B Plant AR vault sludge
BL = B Plant low-level waste
CWP1 = PUREX coating waste (1956 - 1960)
HDW = Hanford Defined Waste
NR = Not reported
UR = Uranium recovery
* Sample values for AR/BL waste were obtained from 1996 sample values for sludge and supernatant less supernatant values (Table 4-2), corrected to 75 percent of the total sludge inventory.

F3.3.4 Comparison of Inventory Estimates

Table F3-12 provides a summary of various inventory estimates for tank 241-C-106. These estimates include: (1) the 1996 sample derived inventory with supernatant (Table F2-1), (2) the 1986 core sample based inventory (Table F2-1), (3) the sample-based inventory with common sludge layers from other tanks representing the UR and CWP1 layers and the 1996 supernatant values for the supernatant (Table F3-11 and Table 4-2, respectively), and (4) HDW estimates (including supernatant contributions) for tank 241-C-106 (Agnew et al. 1996).

Table F3-12. Comparison of 1996 Sample Inventory, 1986 Core Sample Inventory, Sample-Based Inventory (With Common Sludge Layers) and Hanford Defined Waste Inventory Estimates for Tank 241-C-106.

Analyte	1996 samples (includes supernatant)[a] (MT)	1986 core sample[a] (MT)	Sample-based estimate (with common sludge layers and supernatant)[b] (MT)	HDW estimate[c] (MT)
Na	145.0	124.87	130.66	89.1
Al	36.0	43.6	31.31	51.1
Fe	46.8	55.5	37.70	56.9
Cr	0.48	1.05	0.471	0.29
Ni	0.46	1.04	0.472	16.9
Ca	0.98	12.7	1.25	4.61
K	0.78	1.57	0.80	0.2
NO_3	1.92	0.86	22.02	14.1
NO_2	21.7	13.3	17.08	24.7
PO_4	5.5	9.5	14.40	1.44
SO_4	6.1	2.61	4.78	3.77

HDW = Hanford Defined Waste

[a] Table F2-1

[b] Sum of the sample-derived sludge inventory (Table F3-11) and the supernate inventory (Table 4-2)

[c] Agnew et al. (1996).

Based on this comparison, the 1996 samples apparently provide the most consistent set of estimates for the main components in this waste, including Na, Al, Fe, Cr, Ni, K, NO_2,

and SO_4. The 1996 sample derived estimates are generally consistent with sample-based estimates developed in part from the analysis of common sludge layers in other tanks (using the UR and CWP1 layers in tanks 241-TY-105 and 241-C-105, respectively). Equally importantly, the 1996 estimates for Na, Al, and Fe vary by only +/- 20 percent from the 1986 core sample estimates for these components. The results for Cr, Ni, K, PO_4, NO_2, and NO_3 are less consistent, with the 1996 samples showing only 50 percent as much Cr, Ni, K, and PO_4 as the 1986 core, but 160 to 200 percent as much NO_2 and NO_3. These differences can not be easily reconciled for most components, but for PO_4 this difference is probably related to the large amount of PO_4 in the UR waste that was not represented in the 1996 sample population. For most components, the 1996 sample values should be regarded as the most consistent and reliable set of estimates currently available for this tank.

Sample-based values derived from the analysis of common sludge layers in other tanks appear to be better values for estimating the amount of Ca and PO_4 in the 241-C-106 waste. Large amounts of Ca and PO_4 seem to have concentrated in the CWP1 and UR layers that are represented in the sample-based estimates (Table F3-12). The sample-based PO_4 value (14.40 MT) is also smaller but generally consistent with the spreadsheet derived estimate for the UR sludge layer of tank 241-C-106 (20.35 MT of PO_4). This estimate is based on spreadsheet analysis of recently declassified sluicing records for the Uranium Recovery process, waste transaction records for tank 241-C-106, fuel production and Bismuth Phosphate metal waste (MW) flowsheet estimates (in Appendixes B and C, Kupfer et al. [1997]), the Uranium Recovery process flowsheet and cribbing records for the B-028 and B-030 cribs (Waite 1991).

Since the 1996 samples and sample-based estimates are generally consistent for most components, the 1996 samples will be used to generate best-basis estimates for all components except Ca and PO_4 in the waste. The 1996 samples are preferred because (1) these samples provide a statistical basis for estimating individual component inventories in the tank, (2) the 1996 estimate for Si is consistent with fuel fabrication and production records, waste transaction records and common sludge layers from other tanks (241-TY-105 and 241-C-105), and (3) the 1996 samples appear to be more consistent with many but not all of the components analyzed in the 1986 core sample and grab samples obtained in 1974, 1977, and 1980 (Weiss 1988, McCown 1988, Hara 1990, Allen 1976, Horton 1977, and Bratzel 1980).

While the 1996 grab samples will be used as the best sample inventory basis for chemicals, the radionuclide results from the 1986 composite core were chosen, with the exception of ^{137}Cs, for the best-basis estimate of radionuclides. The 1986 core sample obviously represents the entire sludge profile in the tank, while the 1996 samples only involved the upper sludge layer. The 1986 ^{90}Sr estimate also is more consistent with the thermal modelling results for this tank. Moreover, the 1986 results appear to be acceptable because the 1986 $^{239/240}Pu$ estimate (2,865 Ci) is consistent with the mass weighted average from the 1996 samples (2,386 Ci of $^{239/240}Pu$). The 1996 ^{137}Cs results were used for the best-basis estimate because these results include the Cs contribution from the supernatant.

F4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Chemical and radionuclide inventory estimates are generally derived from one of three sources of information: (1) sample analysis and sample-derived inventory estimates, (2) component inventories predicted by the HDW model based on process knowledge and historical tank transfer information, or (3) a tank-specific process estimate based on process flowsheets, reactor fuel data, essential materials records or comparable sludge layers and sample information from other tanks. Such data are often inconsistent.

An effort is currently underway to provide waste inventory estimates that will serve as the standard characterization data for various waste management activities. As part of this effort, a survey and analysis of various sources of information relating to the chemical and radionuclide component inventories in tank 241-C-106 was performed, including the following:

- Data from the 1996 grab samples taken from different elevations in the tank
- Thermal modelling results in the tank 241-C-106 (Appendix E)
- Data from the 1986 core sample (Weiss 1988)
- Additional analyses from the 1986 core sample (McCown 1988, Hara 1990)
- Other grab samples obtained from tank 241-C-106 (Allen 1976, Horton 1977, Bratzel 1980)
- Component inventory estimates generated by the HDW model (Agnew et al. 1996)
- Evaluation of fuel fabrication and production records, waste transfer records and common sludge layers in other tanks (241-TY-105 and 241-C-105 for the UR and CWP1 layers, respectively)
- Spreadsheet analysis of recently declassified sluicing records for the UR process, waste transaction records, fuel records for the $BiPO_4$ processing period, UR process flowsheet and cribbing records for tank 241-C-106.

Based on this analysis, a best-basis inventory was developed. In general, the 1996 grab samples were used to generate estimates for most chemical components, while estimates for Ca and PO_4 were based in part on the analysis of common sludge layers from other tanks. Radionuclide estimates were derived, with the exception of ^{137}Cs, from analysis of 1986 core sample, while the 1996 grab samples including supernatant samples were used to estimate the inventory of ^{137}Cs.

The waste in tank 241-C-106 primary consists of high-level UR waste, CWP1, acid washed PUREX waste from B Plant Sr recovery operations (AR waste) and B Plant low-level waste (LLW) from similar operations (BL waste). The best-basis inventory for tank 241-C-106 is presented in Tables F4-1 and F4-2. The inventory values reported in Tables F4-1 and F4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases, this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, the number of significant figures is not increased. This charge balance approach is consistent with that used by Agnew et al. (1997).

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 HDW 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. (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.

Best-basis tables for chemicals and only four radionuclides (^{90}Sr, ^{137}Cs, Pu and U) were being generated in 1996, using values derived from an earlier version (Rev. 3) of the HDW model. When values for all 46 radionuclides became available in Rev. 4 of the HDW model, they were merged with draft best-basis chemical inventory documents. Defined scope of work in fiscal year 1997 did not permit Rev. 3 chemical values to be updated to Rev. 4 chemical values.

Table F4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-C-106 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	36,000	S	
Bi	7.3	S	
Ca	2,020	E	Table F3-11 plus the HDW UR contributions
Cl	325	S	
TIC as CO_3	147,500	S	
Cr	475	S	
F	271	S	
Fe	46,800	S	
Hg	24.7	S	Calculated using McCown (1988) and confirmed using $BiPO_4$ flowsheet analysis
K	774	S	
La	56.7	S	
Mn	1,610	S	
Na	145,000	S	
Ni	460	S	
NO_2	21,700	S	
NO_3	1,920	S	
OH_{TOTAL}	92,400	C	
Pb	1,740	S	
P as PO_4	14,400	S	
Si	18,400	S	
S as SO_4	6,080	S	
Sr	30.7	S	
TOC	15,200	S	
U_{TOTAL}	1,400	S	

Table F4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-C-106 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Zr	587	S	

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

Table F4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-C-106 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	5.75	M	
^{14}C	0.23	S	Weiss (1988)
^{59}Ni	77.9	M	
^{60}Co	342	S	Weiss (1988)
^{63}Ni	7,680	M	
^{79}Se	18.5	M	
^{90}Sr	4.77 E+06	S	Table D-4
^{90}Y	4.77 E+06	S	Referenced to ^{90}Sr
^{93m}Nb	70.3	M	
^{93}Zr	77.7	M	
^{99}Tc	221	S	Weiss (1988)
^{106}Ru	0.319	M	
^{113m}Cd	56.5	M	
^{125}Sb	1,730	S	Weiss (1988)
^{126}Sn	30.2	M	
^{129}I	0.01	S	Weiss (1988)
^{134}Cs	0.702	M	
^{137m}Ba	253,000	S	Referenced to ^{137}Cs
^{137}Cs	267,000	S	Table D-4
^{151}Sm	71,100	M	
^{152}Eu	56.7	M	
^{154}Eu	2,300	S	Hara (1990)
^{155}Eu	1,360	S	Lumetta et al. (1996)
^{226}Ra	0.00385	M	
^{227}Ac	0.019	M	
^{228}Ra	3.02 E-04	M	
^{229}Th	1.42 E-04	M	
^{231}Pa	0.0189	M	
^{232}Th	3.25 E-05	M	
^{232}U	0.0192	M	

Table F4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-C-106 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	0.0739	M	
^{234}U	1.46	M	
^{235}U	0.0621	M	
^{236}U	0.0259	M	
^{237}Np	0.0957	M	
^{238}Pu	53.2	M	
^{238}U	1.49	M	
$^{239/240}Pu$	2,860	S	Weiss (1988)
^{241}Am	1,120	S	Weiss (1988)
^{241}Pu	3,740	M	
^{242}Cm	2.22	M	
^{242}Pu	0.0237	M	
^{243}Am	0.0742	M	
^{243}Cm	16.2	S	Lumetta et al. (1996)
^{244}Cm	4.78	M	

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

F5.0 APPENDIX F REFERENCES

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