S 0050230

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 644471

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	08/12/98
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-AP-105	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-360, Rev. 2	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 Double-Shell Tank 241-AP-105, 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	H6-15	M. J. Kupfer	~~H5-49~~ R3-75
DOE Reading Room	H2-53	M. D. LeClair (3)	~~H5-49~~ R3-75
TCSRC	R1-10	T. A. Hu	R2-11
K. M. Hall	R2-12	~~Central Files~~ ~~B1-07~~ ga	

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 644471

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	9-8-98	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	9-8-98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other T. A. Hu R2-11	Albert Hu	9-8-98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Double-Shell Tank 241-AP-105

S. L. Lambert
COGEMA Engineering Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 644471 UC: 721
Org Code: 7A110 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: ~~225~~ 177 9-18-98

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 double-shell tank 241-AP-105, 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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Christine Willingham 9-18-98
Release Approval Date

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Approved for Public Release

RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-360	Page 1

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AP-105

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 09/13/94 on EDT-608063.	B.C. Simpson	C.S. Haller	
1 RS	Incorporate per ECN-635469.	T. A. Hu	K.M. Hall	5/21/97
1-A RS	Incorporate per ECN-635520.	T.A. Hu	K.M. Hall	8/20/97
2 RS	Incorporate per ECN-635593.	T.A. Hu	K.M. Hall	
2A RS.	Incorporate per ECN-644471	M.J. Kupfer	K.M. Hodgson	

A-7320-005 (08/91) WEF168

3.0 BEST BASIS INVENTORY ESTIMATE

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These 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 them into a form that is suitable for long-term storage.

Chemical and radiological inventory information are generally derived using three approaches: 1) component inventories are estimated using the results of sample analyses; 2) component inventories are predicted using the HDW model based on process knowledge and historical information; or 3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data.

An effort is underway to provide best-basis waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-AP-105 was performed. The engineering assessment done in this evaluation should serve as the basis for the best estimate inventory for tank 241-AP-105 for the following reasons.

- The July 1997 core sampling of tank 241-AP-105 and the May 1997 grab sampling of supernatant in tank 241-AW-106 are the most recent samplings events for the waste currently in tank 241-AP-105 (Supernatant from 241-AW-106 was transferred to 241-AP-105 in August 1997 which is subsequent to the core sample event).

- The HDW model estimate is outdated because of the large number of waste transfers that have occurred subsequent to the date that the HDW model estimate is valid for the inventory of tank 241-AP-105.

- The reported solids volume (Hanlon 1997) conflicts with the sludge level determinations from previous sampling events. The Hanlon-reported solids volume overstates the amount of solids in the tank.

Best-basis inventory estimates for tank 241-AP-105 are presented in Tables 3-1 and 3-2. Where sample data were not available, best-basis estimates for solids are based on an average of solids inventories in tanks 241-AN-104 and 241-AN-105 ratioed to 337 kL (89 kgal). Where sample data were not available for the supernatant, best-basis estimates are based on an average of supernatant inventories in tanks 241-AN-104, 241-AN-105, and 241-AW-101

ratioed to a supernatant volume of 2,582 kL (682 kgal). Additional modeling data were derived from an average of the HDW model estimates for tanks 241-AN-104, 241-AN-105, and 241-AW-101 ratioed to total volume of 2,920 kL (771 kgal). Because tank 241-AP-105 is an active tank, the inventory values reported in Tables 3-1 and 3-2 are subject to change. 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-AP-105 as of October 31, 1997. (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	71,300	S/E	
Bi	0	E	Bi is relatively insoluble in the supernate added to this tank
Ca	257	S/E	
Cl	18,500	S/E	
TIC as CO_3	83,800	S/E	
Cr	976	S/E	Upper bounding estimate
F	19,100	S/E	
Fe	97	S/E	Upper bounding estimate
Hg	0	E	Simpson 1998
K	37,000	S/E	
La	0	E	La is relatively insoluble in the supernate added to this tank
Mn	20	S/E	
Na	583,000	S/E	
Ni	48	S/E	Upper bounding estimate
NO_2	346,000	S/E	
NO_3	798,000	S/E	
OH	137,000	C	
Pb	161	S/E	
PO_4	11,300	S/E	IC analysis
Si	394	S/E	
SO_4	22,500	S/E	IC analysis
Sr	0.326	S/E	Estimated assuming 30% of Sr is ^{90}Sr
TOC	8,130	S/E	

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-105 as of October 31, 1997. (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
U_{TOTAL}	289	S/E	
Zr	18	S/E	

Note:

[1]S = Sample-based, M = HDW model-based, E = Engineering assessment-based, C = Charge balance

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of October 31, 1997 (Decayed to January 1, 1994). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	19.1	S/E	
^{14}C	2.20	S/E	
^{59}Ni	5.60	M/E	
^{60}Co	52.4	S/E	Upper bounding estimate
^{63}Ni	551	M/E	
^{79}Se	11.3	M/E	
^{90}Sr	13,600	S/E	
^{90}Y	13,600	S/E	Referenced to ^{90}Sr
^{93}Zr	54.6	M/E	
^{93m}Nb	39.9	M/E	
^{99}Tc	348	S/E	
^{106}Ru	0.0351	M/E	
^{113m}Cd	283	M/E	
^{125}Sb	765	M/E	
^{126}Sn	17.1	M/E	
^{129}I	1.45	M/E	
^{134}Cs	141	M/E	
^{137}Cs	6.21E+05	S/E	
^{137m}Ba	5.90E+05	S/E	Referenced to ^{137}Cs
^{151}Sm	39,800	M/E	
^{152}Eu	13.9	M/E	
^{154}Eu	192	S/E	Upper bounding estimate
^{155}Eu	869	M/E	
^{226}Ra	4.73E-04	M/E	
^{227}Ac	0.00294	M/E	
^{228}Ra	1.03	M/E	
^{229}Th	0.0201	M/E	
^{231}Pa	0.0129	M/E	
^{232}Th	0.0997	M/E	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of October 31, 1997 (Decayed to January 1, 1994). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}U	0.0379	S/E/M	Based on total U: Used HDW isotopic ratios
^{233}U	0.145	S/E/M	Based on total U: Used HDW isotopic ratios
^{234}U	0.133	S/E/M	Based on total U: Used HDW isotopic ratios
^{235}U	0.00509	S/E/M	Based on total U: Used HDW isotopic ratios
^{236}U	0.00969	S/E/M	Based on total U: Used HDW isotopic ratios
^{237}Np	2.66	M/E	
^{238}U	0.0963	S/E/M	Based on total U: Used HDW isotopic ratios
^{238}Pu	0.109	S/E/M	Based on ^{239}Pu: Used HDW isotopic ratios
^{239}Pu	1.42	S/E/M	Based on $^{239/240}Pu$: Used HDW isotopic ratios
^{240}Pu	0.344	S/E/M	Based on $^{239/240}Pu$: Used HDW isotopic ratios
^{241}Pu	10.3	S/E/M	Based on ^{239}Pu: Used HDW isotopic ratios
^{241}Am	6.20	S/E	Upper bounding estimate
^{242}Pu	4.25E-05	S/E/M	Based on ^{239}Pu: Used HDW isotopic ratios
^{242}Cm	0.00995	S/E/M	Based on ^{241}Am: Used HDW isotopic ratios
^{243}Am	5.91E-04	S/E/M	Based on ^{241}Am: Used HDW isotopic ratios

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of October 31, 1997 (Decayed to January 1, 1994). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{243}Cm	0.0716	M/E	Based on $^{243/244}$Cm: Used HDW isotopic ratios
^{244}Cm	1.72	M/E	Based on $^{243/244}$Cm: Used HDW isotopic ratios

Note:

[1]S = Sample-based (based on 1996 core samples; see Appendix B), M = HDW model-based, 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 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).

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AP-105

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AP-105

An effort is underway to provide waste "best-basis" (baseline) inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). Kupfer et al. (1997) presents the methodology used to perform these inventory estimates. Following that methodology, this appendix summarizes the best-basis estimate effort for this tank and includes:

- A review of the data — process-based, model-based, and sample-based for tank 241-AP-105 to identify any errors and inconsistencies in the data and to reconcile the data if possible.

- An assessment of the data for tank 241-AP-105 in their entirety to define the best-basis inventory for the tank.

In summary, the estimate of the total waste inventory in a tank requires an estimate of the waste volume and estimates of the concentrations of the chemical and radiochemical species of interest. If the tank waste consists of multiple phases, then volume and concentration estimates of each phase are required. The remainder of this appendix presents the waste volume estimates, species concentration data, and the logic to support the best-basis estimate.

Since the last best-basis inventory was generated for tank 241-AP-105, waste has been transferred to and from the tank and new core sample data have become available. Therefore, the best-basis inventory presented in this appendix supersedes previous best-basis inventory estimates.

D1.0 CHEMICAL INFORMATION SOURCES

Data sources for the waste in tank 241-AP-105 include the following:

- Data from the July 1997 core sampling of tank 241-AP-105 described in Appendix B.

- Data from the May 1997 grab sampling of supernatant in tank 241-AW-106 (Esch 1997), also presented in Appendix B. Tank 241-AW-106 data are included because 2,298 kL (607 kgal) of this supernatant were transferred to tank 241-AP-105 in August 1997 after the July 1997 core sampling of tank 241-AP-105.

- Tank inventory estimates generated from the HDW model (Agnew et al. 1997).

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The estimate made by the HDW model attempts to describe the contents of tank 241-AP-105 as of January 1, 1994. Transfers into and out of tank 241-AP-105 since January 1994 have invalidated the HDW model estimate. Therefore, no comparisons between the latest sample data and the HDW model for tank 241-AP-105 are made in this evaluation.

D3.0 COMPONENT INVENTORY EVALUATION

This section summarizes the logic, calculations, and bases used to arrive at the best-basis inventory for tank 241-AP-105. Section D3.1 presents the basis for the solids in the tank and Section D3.2 the basis for the supernatant. Section D3.3 provides the basis for the total tank waste.

D3.1 EVALUATION OF SOLIDS LAYER IN TANK 241-AP-105

This section provides estimates of the solids layer volume and the species concentrations within the solids layer. These estimates are required to generate the chemical and radiochemical best-basis inventory in the solids portion of tank waste in tank 241-AP-105. Section D3.1.1 summarizes how the waste volume was derived for use in the solids inventory. Section D3.1.2 lists the waste types that contributed to the solids in tank 241-AP-105. Section D3.1.3 presents inventory values based on the analytical results from July 1997 core sampling.

D3.1.1 Solids Layer: Waste Volume Estimate

Hanlon (1997) lists the solids volume in tank 241-AP-105 as 583 kL (154 kgal). However, sufficient evidence exists that the solids volume is actually less than the Hanlon estimate. This section provides the justification for a solids volume estimate of 337 kL (89 kgal).

In September 1995, a video of the interior of tank 241-AP-105 indicated the presence of grayish-white, crystalline solids at a level of about 142 cm (56 in.) from the bottom of the tank (White 1996). This level measurement corresponds to a tank volume of 583 kL (154 kgal). Based on this information, the volume of the solids layer was set at 583 kL (Hanlon 1997).

The solids volume estimate of 583 kL conflicts with the March 1993 grab sampling of tank 241-AP-105. During the March 1993 sampling, two supernatant samples, G238 and G250, were obtained at depths below the 142 cm elevation in the tank. Sample G238 was taken through riser 1E, 6.1 m (20 ft) from the center of the tank, at an elevation of 42 cm (17 in.) from the bottom of the tank. Sample G250 was obtained through riser 1NW at an elevation of 107 cm (42 in.) from the bottom of the tank. Both samples were characterized as supernatant samples although approximately 12 volume percent solids were present in the G238 sample.

A closer inspection of the September 1995 video indicated that exposed solids appear along the tank walls. These solids appear to slope downward toward the center of the tank to form a bowl-like formation partially filled with supernatant. Thus, the actual volume of solids appears to be less than 583 kL.

Using the September 1995 video and the March 1993 grab sampling information, a simple bowl-shaped geometric model of the solids was assumed and is depicted in Figure D3-1. If the solids layer is assumed to resemble Figure D3-1, and sample G238 was taken at the point where the downgrade levels out, a solids volume can be approximated by subtracting the partial cone A-F-G-D in Figure D3-1 from cylinder A-B-C-D. The volume of the partial cone A-F-G-D may be computed by subtracting the volume of the cone F-E-G from the volume of cone A-E-D. The resulting volume is 337 kL (89 kgal).

To test the validity of the model in Figure D3-1, the elevation of the solids surface level as determined from the model was compared to sludge-weight measurements and the July 1997 core sampling information.

Before the July 1997 core sampling of tank 241-AP-105, the solids surface level was determined under risers 21, 24, and 25 (LMHC 1997a); these data are summarized in Table D3-1.

Combining data from the July 1997 core sampling work package (LMHC 1997b and LMHC 1997c) with the extrusion information from the data package (Nuzum 1997) provides

additional estimates for the depths of the solids layer in the tank under risers 24 and 28. To estimate the depth of the tank solids from core sampling data, two pieces of information are required: 1) the elevation from the tank bottom to the bottom of the core sampler for the first core containing solids, and 2) the length of the solids contained in that core. These two values are then added together to estimate the solids depth at the core sample location.

Figure D3-1. Solids Level in Tank 241-AP-105.

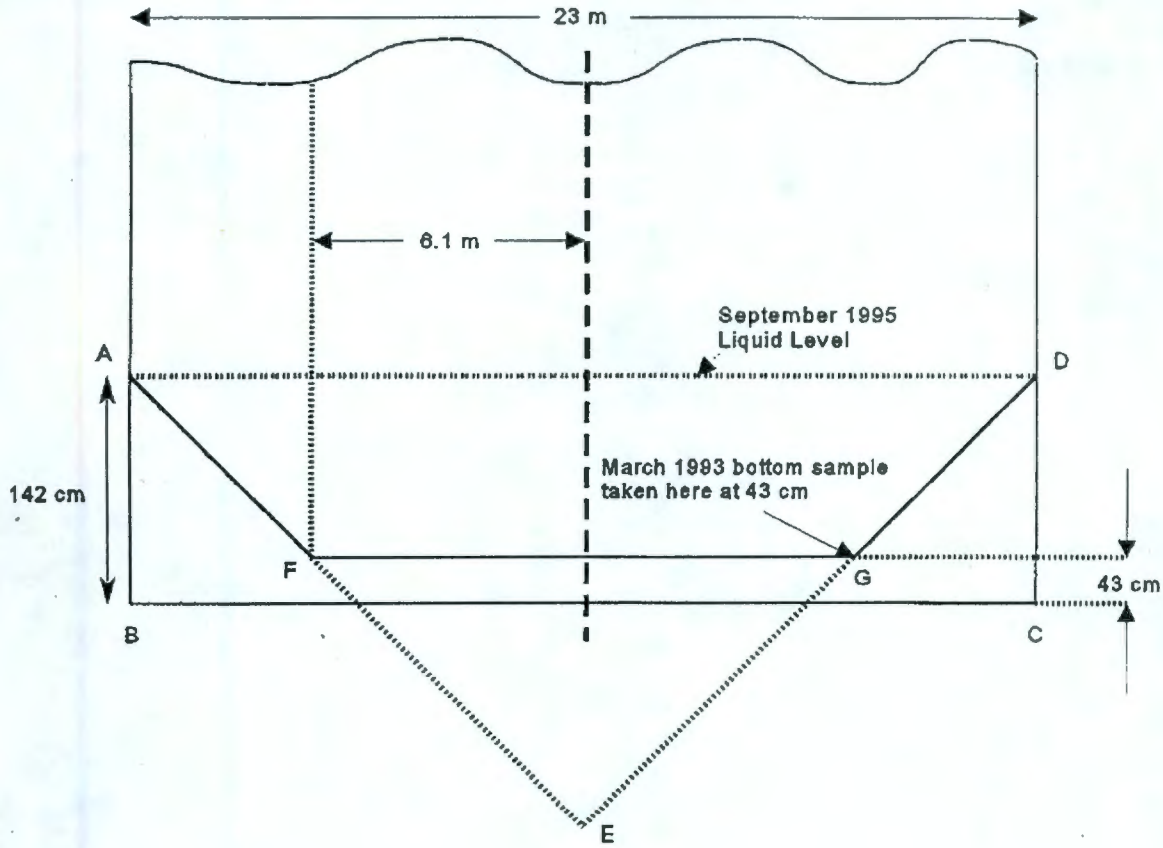

Table D3-1. Depths of Solids in Tank 241-AP-105 from Sludge-Weight Measurements.

Riser Number	Cable Length[1]		Riser Elevation[2]		Solids Depth[3]	
	m	(ft)	m	(ft)	cm	(in.)
21	16.103	(52.83)	206.688	(678.11)	39	(15.36)
24	15.596	(51.17)	206.691	(678.12)	90	(35.40)
28	15.621	(51.25)	206.691	(678.12)	87	(34.44)

Notes:

[1]As measured from the top of the riser flange to the bottom of the sludge weight (LMHC 1997a)
[2]Elevation of the riser flange above sea level (Salazar 1994)
[3]Solids depth computed as: riser elevation - cable length - tank bottom elevation where the tank bottom elevation is 190.195 m (624 ft) above sea level.

From the July 1997 core sampling work package, the elevation to the bottom of the first core segment from riser 24 containing solids (core 208, segment 2) was 71.7 cm (28.2 in.). The extruded length of solids from this core segment was 27.9 cm (11 in.); the sampler was estimated to be approximately 99 percent full at the time of extrusion. Adding the 71.7 cm value to the 27.9 cm value yields a solids layer depth at riser 24 of 99.6 cm (39.2 in.).

For riser 28, the first core segment (core 209, segment 1) with any solids was retrieved at an elevation (to the bottom of the core sampler) of 144.5 cm (56.9 in.). Approximately 1.3 cm (0.5 in.) of solids was recovered from this segment; the sampler was estimated to be 73 percent full at time of extrusion. Adding 1.3 cm and 144.5 cm gives a solids depth of 146 cm (57.4 in.).

Based on the model in Figure D3-1, the solids depth may be determined as a function of radial distance from the tank centerline using the following equation:

$$\text{solids depth (cm)} = 18.57 \times \text{radial distance (m)} - 70.03$$

where the radial distance in meters is the distance from the tank centerline to the center of the riser.

Table D3-2 compares the waste depth predicted from the Figure D3-1 model to the estimates obtained from the sludge-weight measurements and the core segment recoveries. For riser 24, the model prediction, the sludge-weight measurement, and the core sample data all agree reasonably well. The agreement for risers 21 and 28 is much less. However, with the exception of the core sample data for riser 28, the general trend appears to be that the solids depth is less than 142 cm and is not uniform across the diameter of the tank. This trend is in qualitative agreement with the model of Figure D3-1. Therefore the tank volume of 337 kL (89 kgal) is adopted as the best estimate for the amount of solids in tank 241-AP-105.

D3.1.2 Solids Layer: Contributing Waste Types

Tank 241-AP-105 went into service in the third quarter of 1986 with the addition of 64 kL (17 kgal) of flush water; two smaller additions of water followed in 1987. In first quarter of 1988, tank 241-AP-105 received 344 kL (91 kgal) of supernatant from tank 241-AW-106, a tank used primarily to hold waste from the 242-A Evaporator. This transfer was followed by an additional 64 kL (17 kgal) of flush water.

Table D3-2. Depth of Solids in Tank 241-AP-105: Comparison of Predicted, Sludge Weight, and Core Sample Values.

Riser Number	Radial Distance from Tank Centerline[1] (m)	Solids Depth (cm)		
		Predicted[2]	Sludge Weight[3]	Core Sample
21	8.53	88.4	39	NA
24	9.14	99.7	90	100
28	10.1	117.5	87	146

Notes:

NA = not applicable

[1]WHC (1995)
[2]Computed as solids depth (cm) = 18.57 × radial distance (m) - 70.03
[3]LMHC (1997a)

During 1988 and 1989, a series of transfers occurred between tank 241-AP-105 and tank 241-AW-102, the feed tank for the 242-A Evaporator. Tank 241-AP-105 received a total of 2,211 kL (584 kgal) of supernatant from tank 241-AW-102 in the first quarter of 1988. During the third quarter of 1988, 2,616 kL (691 kgal) of supernatant was sent from tank 241-AP-105 to tank 241-AW-102 for processing in the 242-A Evaporator. In the first quarter of 1989, tank 241-AP-105 received 2,324 kL (614 kgal) of dilute noncomplexed waste from the 89-1 evaporator campaign via tank 241-AW-102, and 594 kL (157 kgal) of supernatant was sent to tank 241-AW-102. Precipitation from the supernatant from the 89-1 evaporator campaign appears to be the primary source of the solids in the tank.

In the third quarter of 1989, tank 241-AP-105 received 1,344 kL (355 kgal) of double-shell slurry feed (DSSF) from tank 241-AP-106. This waste is not likely to have contributed a significant amount to the solids layer in the tank.

In the third quarter of 1995, the contents of tank 241-AP-105 were transferred to tank 241-AP-101 leaving a tank heel in 241-AP-105 of 594 kL (157 kgal). In August 1996,

3,660 kL (967 kgal) of dilute noncomplexed waste from tank 241-AN-101 was temporarily stored in tank 241-AP-105 for the 97-1 evaporation campaign. In February/March 1997, 3,623 kL (957 kgal) of dilute noncomplexed waste was transferred to 241-AW-102 for the 97-1 evaporation campaign. In August 1997, after the July 1997 core sampling, 2,298 kL (607 kgal) of DSSF from the 97-1 evaporation campaign was transferred from tank 241-AW-106 to tank 241-AP-105.

D3.1.3 Solids Layer: Estimate of Composition

This section presents estimates for the concentrations of the various best-basis analytes in the solids layer. The approach adopted was to use the available data from the July 1997 push-mode core samples supplemented with data for similar waste types. The results of the July 1997 push-mode core sampling provide data for most of the major best-basis analytes (see Appendix B). However, data for one major constituent, potassium, and a number of the minor constituents were not available or were less-than values. To generate the missing data, data for solids with a similar process history were incorporated.

The following assumptions are used to generate estimates for the solids composition.

- The average composition of the solids represents all solids in the tank.
- The solids volume in the tank is 337 kL (89 kgal) (see Section D3.1.1).
- The solids density is 1.58 g/mL.
- No changes have occurred in the solids composition or volume since the addition of DSSF to the tank. The analytical results for the solids layer are assumed to still be valid even though DSSF was added to the tank after the July 1997 core sampling.
- The composition of the solids in tanks 241-AN-104 and 241-AN-105 are similar enough to those in tank 241-AP-105 to model the potassium and minor constituent composition of the tank 241-AP-105 solids.

Table D3-3 compares the composition of the solids in tanks 241-AN-104 and 241-AN-105 with the sample-based composition of the solids in tank 241-AP-105. The chemical species listed in Table D3-3 and subsequent tables are reported without charge designation according to the best-basis inventory convention. The table also presents an average composition of the solids based on the two reference tanks. The compositions of the tank solids do show some major differences, particularly for aluminum, fluoride, and chloride. To a lesser extent, nitrite, phosphate, and sulfate also show some differences. However, the concentrations of the many of the constituents do appear to be very similar among the three tanks.

Table D3-3. Comparison of Solids Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Nonradioactive Components. (2 Sheets)

Analyte	241-AN-104 Solids Conc.[1] (μg/g)	241-AN-105 Solids Conc.[2] (μg/g)	Average Solids Conc.[3] (μg/g)	241-AP-105 Solids Conc.[4] (μg/g)
Al	21,100	20,800	20,900	8,660
Bi	<153	<54.1	<104	<1,920
Ca	225	347	286	<1,920
Cl	4,400	5,380	4,890	1,330
TIC as CO_3	73,600	62,200	67,900	73,600
Cr	1,710	2,020	1,870	<199
F	838	1,430	1,130	20,300
Fe	97.0	68.4	82.9	<961
Hg	NR	NR	NR	NR
K	3,720	3,190	3,460	NR
La	<76.8	<22.2	<49.5	<961
Mn	18.3	16.3	17.3	<192
Na	236,000	168,000	202,000	194,000
Ni	66.6	36.0	51.3	NR
NO_2	62,700	66,600	64,700	30,900
NO_3	112,000	113,000	113,000	121,000
OH	111,000	23,500	67,300	NR
Pb	42.1	<43.8	<42.9	<1,920
PO_4	4,210	6,620	5,420	9,490
Si	608	169	388	<1,020
SO_4	11,200	6,620	8,900	15,500
Sr	<15.3	<6.88	<11.1	<192
TOC	4,640	5,300	4,970	5,500
U_{TOTAL}	<768	85.7	<427	<9,610
Zr	17.9	10.3	14.1	<193

Table D3-3. Comparison of Solids Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Nonradioactive Components. (2 Sheets)

Analyte	241-AN-104 Solids Conc.[1] (μg/g)	241-AN-105 Solids Conc.[2] (μg/g)	Average Solids Conc.[3] (μg/g)	241-AP-105 Solids Conc.[4] (μg/g)
Wt% water	45.6	44.7	45.2	44.0
Density (g/mL)	1.51	1.59	1.55	1.58

Notes:

NR = not reported

[1]Hu et al. (1997)
[2]Jo et al. (1997)
[3]Average of data from tanks 241-AN-104 and 241-AN-105 only.
[4]From Appendix B. Values reported in this column are the REML means for species detected above the method detection limit and simple means for the less-than values.

Based upon Table D3-3, Table D3-4 presents an estimated solids inventory for the solids in tank 241-AP-105. In generating the estimate for each constituent, the following logic was used:

- If available, sample-based results for the tank 241-AP-105 solids were used.
- If no tank 241-AP-105 sample-based result was available, the average value for the AN tank solids was adopted.
- For those tank 241-AP-105 results with less-than values, if the tank 241-AP-105 result was less than the average value for the AN tank solids, then the tank 241-AP-105 result was adopted. Otherwise the average AN tank solids value was used.
- All less-than values retained their less-than signs.

Table D3-4. Inventory Estimate for Tank 241-AP-105 Solids: Nonradioactive Components. (2 Sheets)

Analyte	241-AP-105 Solids Conc.[1] (μg/g)	Average Solids Conc.[2] (μg/g)	Estimated 241-AP-105 Solids Conc. (μg/g)	Estimated 241-AP-105 Solids Inventory[3] (kg)
Al	8,660	20,900	8,660	4,610
Bi	<1,920	<104	<104	<55
Ca	<1,920	286	286	152
Cl	1,330	4,890	1,330	710
TIC as CO_3	73,600	67,900	73,600	39,200
Cr	<199	1,870	<199	<106
F	20,300	1,130	20,300	10,800
Fe	<961	82.9	82.9	44
Hg	NR	NR	NR	NR
K	NR	3,460	3,460	1,840
La	<961	<49.5	<49.5	<26
Mn	<192	17.3	17.3	9
Na	194,000	202,000	194,000	103,000
Ni	NR	51.3	51.3	27
NO_2	30,900	64,700	30,900	16,400
NO_3	121,000	113,000	121,000	64,200
OH	NR	67,300	67,300	35,800
Pb	<1,920	<42.9	<42.9	<23
PO_4	9,490	5,420	9,490	5,050
Si	<1,020	388	388	207
SO_4	15,500	8,900	15,500	8,240
Sr	<192	<11.1	<11.1	<6
TOC	5,500	4,970	5,500	2,930
U_{TOTAL}	<9,610	<427	<427	<227
Zr	<193	14.1	14.1	8

Table D3-4. Inventory Estimate for Tank 241-AP-105 Solids: Nonradioactive Components. (2 Sheets)

Analyte	241-AP-105 Solids Conc.[1] (μg/g)	Average Solids Conc.[2] (μg/g)	Estimated 241-AP-105 Solids Conc. (μg/g)	Estimated 241-AP-105 Solids Inventory[3] (kg)
Wt% water	44.0	45.2	44.0	234,000
Density (g/mL)	1.58	1.55	1.58	NA

Notes:

NA = not applicable
NR = not reported

[1]Values reported in this column are the REML means for species detected above the method detection limit and simple means for the less-than values.

[2]Average solids concentration for tanks 241-AN-104 and 241-AN-105 (see Table D3-3)

[3]Based on a solids volume of 337 kL (89 kgal) and a solids density of 1.58 g/mL.

The validity of the assumptions may be checked by performing a mass and charge balance using the data in the final column of Table D3-4. Summing the masses in the last column (ignoring for the moment the less-than signs and assuming that silicon and TOC exist as SiO_3^- and acetate) generates a total mass of 540,000 kg. The mass of the solids may also be estimated from the assumed volume (337 kL [89 kgal]) and density (1.58 g/mL) for the solids:

$$\text{total solids mass (kg)} = 337 \text{ kL} \times 1.58 \text{ g/mL} \times 1{,}000 \text{ mL/L}$$

The resulting computation yields 532,000 kg for the solids mass. Considering the uncertainties inherent in the assumptions for the volume and composition of the solids, the two estimates give quite similar values with an RPD of 1.4 percent.

A simple charge balance was performed using all the masses in Table D3-4 including the less-than values. The ratio of cation-to-anion charge is 0.85; the ideal ratio is one. Overestimating the hydroxide value and/or underestimating the potassium value may be causing the low charge-ratio value. Assumed for the charge balance was that all the metals carried a positive oxidation state (assuming Cr^{3+}, Mn^{2+}, and U^{6+}), and that silicon and TOC contributed to the negative charge in the form of SiO_3^- and acetate. The charge balance result, coupled with the mass balance results, provides support that the assumptions used in determining the tank 241-AP-105 solids compositions are reasonable.

The only sample-based radiochemical information for the solids layer is a total alpha activity result of <0.0101 μCi/g. Therefore, the radionuclide composition of the solids layer must be inferred from models and engineering estimates. As a starting point, radiochemical data for the solids in double-shell tanks 241-AN-104 and 241-AN-105 were tabulated and averaged; Table D3-5 shows these results. Additional estimates for ^{14}C, the uranium isotopes, and the plutonium isotopes are discussed in Section D3.3.1.

Table D3-5. Comparison of Solids Composition for Two Double-Shell Tanks Containing Double-Shell Slurry Feed: Radioactive Components (Decayed to January 1, 1994).

Analyte	241-AN-104 Solids Conc.[1] (μCi/g)	241-AN-105 Solids Conc.[2] (μCi/g)	Average Solids Conc. (μCi/g)
^{3}H	0.0167	NR	0.0167
^{60}Co	<0.0366	0.0456	<0.0411
^{90}Sr	35.8	12.3	24.1
^{90}Y	35.8	12.3	24.1
^{99}Tc	0.132	0.174	0.153
^{129}I	<0.00272	0.00379	<0.00325
^{137}Cs	364	307	336
^{137m}Ba	346	292	319
^{154}Eu	<0.122	<0.116	<0.119
^{155}Eu	<0.970	<0.522	<0.746
^{237}Np	<0.0118	<0.0110	<0.0114
^{238}U	<2.58E-04	2.88E-05	<1.43E-04
$^{239/240}Pu$	0.00358	0.00233	0.00295
^{241}Am	0.0189	0.00367	0.0113
^{243}Cm	<1.84E-04	NR	<1.84E-04
$^{243/244}Cm$	<0.00444	<0.00153	<0.00299

Notes:

NR = not reported

[1]Hu et al. (1997)
[2]Jo et al. (1997)

D3.2 EVALUATION OF LIQUID LAYER IN TANK 241-AP-105

D3.2.1 Liquid Layer: Contributing Waste Types

Between August 27 and August 29, 1995, 2,500 kL (660 kgal) of DSSF was transferred from tank 241-AP-105, leaving 594 kL (157 kgal) of liquid and solid waste in the tank. On August 16, 1996, the tank received 3,660 kL (967 kgal) of dilute noncomplexed waste from tank 241-AN-101. In February and March 1997, 3,622 kL (957 kgal) of dilute noncomplexed waste was transferred out of the tank, leaving approximately 291 kL (77 kgal) of dilute noncomplexed waste in the tank.

D3.2.2 Liquid Layer: Analytical Results

The tank was push-mode core sampled in July 1997. Appendix B shows the analytical results from these core samples. Subsequent to this sampling, 2,298 kL (607 kgal) of DSSF was transferred from tank 241-AW-106 to tank 241-AP-105 in August 1997. In May 1997, before the transfer, three grab samples of the DSSF in tank 241-AW-106 were taken, composited, and analyzed; Appendix B also presents the results from the composite sample of tank 241-AW-106.

The results from the May 1997 sampling of the DSSF in tank 241-AW-106 and the push-mode core sampling of the waste in tank 241-AP-105 in July 1997 provide a sample-based inventory for the liquid in tank 241-AP-105. The May 1997 sample is assumed to represent 2,298 kL (607 kgal) of the supernatant volume in tank 241-AP-105. This is the amount of supernatant transferred from tank 241-AW-106 in August 1997. The July 1997 push-mode samples are assumed to represent 291 kL (77 kgal) of the dilute noncomplexed supernatant. This volume is based on a total tank volume of 628 kL (Hanlon 1997), less a predicted solids inventory of 337 kL. The final supernatant volume of 2,582 kL (682 kgal) estimated for tank 241-AP-105 as of October 31, 1997, is equal to the sum of the dilute noncomplexed supernatant volume (291 kL) plus the DSSF volume (2,298 kL) minus 6 kL (1.6 kgal) caused by evaporation.

Tables D3-6 and D3-7 present the calculated composition and sample-based inventory for the supernatant in tank 241-AP-105. In computing the calculated supernatant composition, three assumptions were made:

- The assumed contribution from tank 241-AP-105 was 291 kL (11 volume percent) and the assumed contribution from tank 241-AW-106 was 2,298 kL (89 volume percent); the assumed final volume of mixture was 2,582 kL and allows for a 6 kL water loss by evaporation.

- For those analytes with no reported results for the tank 241-AP-105 drainable liquid, the analyte concentration was assumed to be equal to that of the tank 241-AW-106 supernatant.

- Less-than signs of the calculated composition and sample-based inventory were assigned to follow those of the tank 241-AW-106 supernatant results.

Analyte inventories were computed by multiplying the AP-105 drainable liquid composition by 0.11 and the AW-106 sample composition by 0.89, and summing the results to produce the AP-105 average supernate composition. This was converted to the total supernate inventory based on a total volume of 2,582 kL.

Table D3-6. Calculated Composition and Inventory of Tank 241-AP-105 Supernatant: Physical Properties and Chemical Species. (3 Sheets)

Analyte	241-AP-105 Drainable Liquid (Mean)[1]	241-AW-106 Composite Sample[1]	241-AP-105 Average Supernatant[2,3]	Supernatant Inventory (kg)
Physical Properties/Miscellaneous Analytes				(kg)
Bulk density (g/mL)	1.32	1.34	1.34	NA
Percent water (wt%)	59.32	58.95	58.99	2,040,000
pH (unitless)	NR	13.17	13.17	NA
Ammonia (μg/mL)	97.8	6.83	17.1	44
Carbonate[4] (μg/mL)	NR	17,200	17,300	44,600
Hydroxide (μg/mL)	NR	41,800	41,900	108,000
TIC (μg C/mL)	NR	3,450	3,460	8,930
TOC (μg C/mL)	NR	2,010	2,020	5,200
Uranium[5] (μg/mL)	NR	24.0	24.1	62
ICP Metals (μg/mL)				(kg)
Aluminum	18,000	26,700	25,800	66,700
Antimony	<27.1	<24.1	<24.5	<63
Arsenic	<45.1	<40.1	<40.8	<105
Barium	<22.6	<20.1	<20.4	<53
Beryllium	<2.25	<2.00	<2.03	<5
Bismuth	<45.1	<40.1	<40.8	<105
Boron	<22.6	<20.1	<20.4	<53

Table D3-6. Calculated Composition and Inventory of Tank 241-AP-105 Supernatant: Physical Properties and Chemical Species. (3 Sheets)

Analyte	241-AP-105 Drainable Liquid (Mean)[1]	241-AW-106 Composite Sample[1]	241-AP-105 Average Supernatant[2,3]	Supernatant Inventory (kg)
ICP Metals (μg/mL) (cont'd)				(kg)
Cadmium	<2.30	<2.00	<2.04	<5
Calcium	<45.1	<40.1	<40.8	<105
Cerium	<45.1	<40.1	<40.8	<105
Chromium	256	346	337	870
Cobalt	<9.02	<8.02	<8.16	<21
Copper	<4.51	<4.01	<4.08	<11
Iron	<22.6	<20.1	<20.4	<53
Lanthanum	<22.6	<20.1	<20.4	<53
Lead	<45.2	54.4	53.5	138
Lithium	<4.51	<4.01	<4.08	<11
Magnesium	<45.1	<40.1	<40.8	<105
Manganese	<4.51	<4.01	<4.08	<11
Molybdenum	32.7	47.0	45.5	118
Neodymium	<45.1	<40.1	<40.8	<105
Nickel	<9.02	<8.02	<8.16	<21
Phosphorus	2,410	670	868	2,240
Potassium	30,800	11,400	13,600	35,200
Samarium	<45.1	<40.1	<40.8	<105
Selenium	<45.1	<40.1	<40.8	<105
Silicon	284	45.7	72.7	188
Silver	13.7	13.9	13.9	36
Sodium	185,000	185,000	186,000	479,000
Strontium	<4.51	<4.01	<4.08	<11
Sulfur	1,010	1,250	1,230	3,170
Thallium	<90.2	<80.2	<81.6	<211
Titanium	<4.51	<4.01	<4.08	<11
Uranium	<225	<200	<203	<525

Table D3-6. Calculated Composition and Inventory of Tank 241-AP-105 Supernatant: Physical Properties and Chemical Species. (3 Sheets)

Analyte	241-AP-105 Drainable Liquid (Mean)[1]	241-AW-106 Composite Sample[1]	241-AP-105 Average Supernatant[2,3]	Supernatant Inventory (kg)
ICP Metals (μg/mL) (cont'd)				(kg)
Vanadium	<22.6	<20.1	<20.4	<53
Zinc	10.5	12.7	12.5	32
Zirconium	<4.51	<4.01	<4.08	<11
IC Anions (μg/mL)				(kg)
Bromide	<549	<1,280	<1,200	<3,100
Chloride	3,080	7,360	6,900	17,800
Fluoride	1,160	3,440	3,190	8,240
Nitrate	185,000	296,000	284,000	734,000
Nitrite	59,900	136,000	128,000	330,000
Oxalate	594	1,720	1,600	4,130
Phosphate	916	2,590	2,410	6,220
Sulfate	1,910	5,970	5,530	14,300

Notes:

NR = not reported

[1]From Appendix B.

[2]Assumed contribution from tank 241-AP-105 is 291 kL (11 vol%); assumed contribution from tank 241-AW-106 is 2,298 kL (607 kgal) (89 vol%); assumed final volume of mixture is 2,582 kL (682 kgal) and allows for a 6 kL (1.6 kgal) water loss by evaporation.

[3]The concentrations of those analytes with no reported analytical data for the tank 241-AP-105 drainable liquid were assumed equal to the tank 241-AW-106 concentrations. For a given analyte, a less-than value was assigned to the calculated composition if the tank 241-AW-106 value had a less-than sign.

[4]Computed from the corresponding TIC value.

[5]Total uranium by kinetic phosphorescence.

Table D3-7. Calculated Composition and Inventory of Tank 241-AP-105 Supernatant: Radionuclides.

Analyte	241-AP-105 Drainable Liquid (Mean)[1] (μCi/mL)	241-AW-106 Composite Sample[1] (μCi/mL)	241-AP-105 Calculated Supernatant[2,3] (μCi/mL)	Supernatant Inventory[4] (Ci)
Alpha total	<0.00740	0.00696	0.00703	18.2
Beta total	NR	148	148	3.83E+05
^{3}H	NR	0.00325	0.00326	8.41
^{14}C	NR	4.80E-04	4.81E-04	1.24
^{60}Co	NR	<0.00936	<0.00939	<24.2
$^{89/90}Sr$	NR	0.272	0.273	704
^{94}Nb	NR	<0.0205	<0.0206	<53.1
^{99}Tc	NR	0.103	0.103	267
$^{106}Ru/^{106}Rh$	NR	<1.33	<1.33	<3,450
^{129}I	NR	1.28E-04	1.29E-04	0.331
^{134}Cs	NR	<0.0667	<0.0669	<173
^{137}Cs	NR	158	158	4.09E+05
$^{144}Ce/^{144}Pr$	NR	<0.850	<0.852	<2,200
^{154}Eu	NR	<0.0378	<0.0379	<97.9
^{155}Eu	NR	<0.237	<0.238	<614
^{226}Ra	NR	<1.68	<1.68	<4,340
^{237}Np	NR	2.81E-04	2.82E-04	0.728
^{238}Pu	NR	<3.50E-05	<3.51E-05	<0.0906
$^{239/240}Pu$	NR	7.53E-05	7.55E-05	0.195
^{241}Am	NR	<7.03E-05	<7.05E-05	<0.182
$^{243/244}Cm$	NR	<7.03E-05	<7.05E-05	<0.182

Notes:

[1]From Appendix B.

[2]Assumed contribution from tank 241-AP-105 is 291 kL (77 kgal) (11 vol%); assumed contribution from tank 241-AW-106 is 2,298 kL (607 kgal) (89 vol%); assumed final volume of mixture is 2,582 kL (682 kgal) and allows for a 6 kL (1.6 kgal) water loss by evaporation.

[3]The concentrations of those analytes with no reported analytical data for the tank 241-AP-105 drainable liquid were assumed equal to the tank 241-AW-106 concentrations.

[4]As of approximately May 1, 1997

D3.3 COMBINED SOLID AND LIQUID LAYERS IN TANK 241-AP-105

Table D3-4 gives inventory estimates for the chemical species in the solids layer; Table D3-5 provides a starting point for the radionuclide composition of the solids layer. Tables D3-6 and D3-7 respectively, provide estimates for the chemical and radiochemical content of the supernatant layer in tank 241-AP-105. However, both tables have either missing values or less-than values for several best-basis analytes. To complete the estimation of these analytes, a DSSF "waste type" was defined using the Agnew supernatant mixing model (SMM) estimates for several tanks that contain waste classified as DSSF (Agnew et al. 1997). Three tanks were identified as containing this waste type: 241-AN-104, 241-AN-105, and 241-AW-101 (Hanlon 1997). Besides containing DSSF waste, these tanks were selected because no significant transfers of waste to or from these tanks have occurred since the January 1, 1994 date for which the SMM estimates were generated.

Tables D3-8 and D3-9 compare the SMM chemical and radionuclide composition estimates for the three tanks. The last column for these tables contains an average estimate for each analyte based on the SMM estimates for the three tanks. The last columns constitute the DSSF "waste type" that was used to estimate the inventory for the remaining best-basis analytes.

Table D3-8. Comparison of Hanford Defined Waste Supernatant Mixing Model Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Nonradioactive Constituents.[1] (2 Sheets)

Analyte	241-AN-104 HDW SMM Conc. (μg/mL)	241-AN-105 HDW SMM Conc. (μg/mL)	241-AW-101 HDW SMM Conc. (μg/mL)	Average HDW SMM Conc. (μg/mL)
Al	34,000	63,500	44,200	47,200
Bi	197	391	239	276
Ca	1,280	2,240	2,600	2,040
Cl	6,700	12,800	9,560	9,690
TIC as CO_3	30,100	54,700	52,200	45,700
Cr	4,620	8,310	6,230	6,390
F	1,900	2,050	5,950	3,300
Fe	504	872	927	768
Hg	1.84	2.76	3.93	2.84
K	3,900	4,170	12,400	6,810
La	1.75	2.76	2.03	2.18
Mn	368	513	877	586
Na	254,000	472,000	373,000	366,000
Ni	334	622	630	529

Table D3-8. Comparison of Hanford Defined Waste Supernatant Mixing Model Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Nonradioactive Constituents.[1] (2 Sheets)

Analyte	241-AN-104 HDW SMM Conc. (μg/mL)	241-AN-105 HDW SMM Conc. (μg/mL)	241-AW-101 HDW SMM Conc. (μg/mL)	Average HDW SMM Conc. (μg/mL)
NO_2	78,600	143,000	93,900	105,000
NO_3	229,000	440,000	368,000	346,000
OH	125,000	233,000	168,000	175,000
Pb	196	359	264	273
PO_4	10,900	17,500	22,800	17,100
Si	629	1,170	850	884
SO_4	20,100	37,000	25,500	27,600
Sr	0.00	0.00	0.00	0.00
TOC	15,400	25,600	19,000	20,000
U_{TOTAL}	2,870	4,540	5,650	4,350
Zr	44.0	22.5	195	87.2
Wt% water	42.8	17.2	26.4	28.8
Density (g/mL)	1.47	1.88	1.68	1.68

Note:

[1]Derived from Agnew et al. (1997)

Table D3-9. Comparison of Hanford Defined Waste Supernatant Mixing Model Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Radioactive Constituents (Decayed to January 1, 1994).[1] (3 Sheets)

Analyte	241-AN-104 HDW SMM Conc. (μCi/mL)	241-AN-105 HDW SMM Conc. (μCi/mL)	241-AW-101 HDW SMM Conc. (μCi/mL)	Average HDW SMM Conc. (μCi/mL)
^{3}H	0.185	0.331	0.235	0.250
^{14}C	0.0259	0.0462	0.0302	0.0341
^{59}Ni	0.00140	0.00259	0.00176	0.0192
^{60}Co	0.0337	0.0592	0.0423	0.0451
^{63}Ni	0.138	0.256	0.173	0.189
^{79}Se	0.00282	0.00511	0.00363	0.0385
^{90}Sr	88.3	155	117	120
^{90}Y	88.5	155	117	120

Table D3-9. Comparison of Hanford Defined Waste Supernatant Mixing Model Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Radioactive Constituents (Decayed to January 1, 1994).[1] (3 Sheets)

Analyte	241-AN-104 HDW SMM Conc. (μCi/mL)	241-AN-105 HDW SMM Conc. (μCi/mL)	241-AW-101 HDW SMM Conc. (μCi/mL)	Average HDW SMM Conc. (μCi/mL)
^{93}Zr	0.0138	0.0248	0.0175	0.0187
^{93m}Nb	0.0100	0.0182	0.0129	0.0137
^{99}Tc	0.196	0.350	0.227	0.257
^{106}Ru	8.06E-06	1.31E-05	1.49E-05	1.20E-05
^{113m}Cd	0.0725	0.129	0.0889	0.0968
^{125}Sb	0.185	0.310	0.291	0.262
^{126}Sn	0.00429	0.00776	0.00553	0.00586
^{129}I	3.76E-04	6.75E-04	4.37E-04	4.96E-04
^{134}Cs	0.0307	0.0487	0.0652	0.0482
^{137}Cs	196	346	222	254
^{137m}Ba	185	327	210	241
^{151}Sm	9.97	18.1	12.8	13.6
^{152}Eu	0.00362	0.00630	0.00440	0.00477
^{154}Eu	0.532	0.940	0.659	0.710
^{155}Eu	0.225	0.387	0.281	0.298
^{226}Ra	1.16E-07	2.14E-07	1.56E-07	1.62E-07
^{227}Ac	7.13E-07	1.32E-06	9.86E-07	1.01E-06
^{228}Ra	2.57E-04	4.76E-04	3.21E-04	3.51E-04
^{229}Th	5.95E-06	7.26E-06	7.46E-06	6.89E-06
^{231}Pa	3.19E-06	5.83E-06	4.20E-06	4.41E-06
^{232}Th	2.18E-05	4.96E-05	3.11E-05	3.42E-05
^{232}U	7.91E-04	0.00148	0.00111	0.00113
^{233}U	0.00303	0.00566	0.00427	0.00432
^{234}U	8.95E-04	0.00129	0.00212	0.00143
^{235}U	3.50E-05	5.06E-05	8.16E-05	5.57E-05
^{236}U	4.81E-05	5.83E-05	1.41E-04	8.26E-05
^{237}Np	6.89E-04	0.00124	8.11E-04	9.12E-04
^{238}U	9.63E-04	0.00153	0.00190	0.00146

Table D3-9. Comparison of Hanford Defined Waste Supernatant Mixing Model Composition for Three Double-Shell Tanks Containing Double-Shell Slurry Feed: Radioactive Constituents (Decayed to January 1, 1994).[1] (3 Sheets)

Analyte	241-AN-104 HDW SMM Conc. (μCi/mL)	241-AN-105 HDW SMM Conc. (μCi/mL)	241-AW-101 HDW SMM Conc. (μCi/mL)	Average HDW SMM Conc. (μCi/mL)
^{238}Pu	0.00198	0.00276	0.00475	0.00317
^{239}Pu	0.0428	0.0705	0.0729	0.0621
$^{239/240}Pu$	0.0512	0.0838	0.0893	0.0748
^{240}Pu	0.00842	0.0133	0.0164	0.0127
^{241}Pu	0.166	0.216	0.437	0.273
^{241}Am	0.0557	0.100	0.0951	0.0837
^{242}Pu	7.64E-07	6.92E-07	1.83E-06	1.10E-06
^{242}Cm	1.31E-04	2.31E-04	1.71E-04	1.78E-04
^{243}Am	3.09E-06	4.40E-06	7.64E-06	5.04E-06
^{243}Cm	1.28E-05	2.29E-05	1.75E-05	1.77E-05
$^{243/244}Cm$	1.43E-04	2.37E-04	2.63E-04	2.14E-04
^{244}Cm	1.30E-04	2.14E-04	2.45E-04	1.97E-04

Note:

[1]Derived from Agnew et al. (1997)

To arrive at a final best-basis estimate for the best-basis analytes, the estimates for the waste composition in tank 241-AP-105 in Tables D3-4 (solids nonradioactive), D3-6 (liquids nonradioactive), and D3-8 (SMM nonradioactive) are combined in Table D3-10 to generate a total tank estimate for the nonradioactive inventory in tank 241-AP-105. Similarly, the data in Tables D3-5, D3-7, and D3-9 are combined in Table D3-11 to generate a total tank estimate for the radionuclide inventory in tank 241-AP-105. Before determining the best-basis radiochemical inventory for tank 241-AP-105, the May 1997 tank 241-AW-106 grab sample-based radiochemical data were decay corrected from May 1, 1997, to January 1, 1994.

The best-basis estimates shown in the last columns of Tables D3-10 and D3-11 were generated using the following assumptions and logic:

- The "241-AP-105 Total Inventory" column was generated by summing the solids inventory (first column) and supernatant inventory (second column) values.

- The "Estimate from Average HDW SMM" column was generated using the entire estimated waste volume of 2,926 kL (773 kgal). This treatment assumes that the SMM values represent the entire tank waste contents. This assumption is based on the fact that SMM does not differentiate between the liquid and solids fractions of the waste. SMM values were used to generate best-basis estimates for Hg, La, and a number of minor radionuclides where sample-based values were not available.

- If the value in the "241-AP-105 Total Inventory" column is available, this value was selected as the best-basis value in the "Best-Basis Inventory" column. Less than values are identified as upper bounding in the final best-basis tables if those analytes are based on the measured solids composition in tank 241-AP-105.

- If the value in the "241-AP-105 Total Inventory" column was *not reported*, then the "Estimate from Average HDW SMM" value was automatically adopted as the best-basis estimate and was carried to the "241-AP-105 Best-Basis Inventory" column.

- If the value in the "241-AP-105 Total Inventory" column was a less-than value, and its value was *less than* that shown in the "Estimate from Average HDW SMM" column, then the 241-AP-105 total inventory value was carried to the "241-AP-105 Best-Basis Inventory" column without the less-than sign. The assumption here is that the SMM correctly predicts the presence of the specie in the waste, but that the actual amount of the specie is better represented by the 241-AP-105 total inventory value. This logic may generate inventory values that are biased high.

- If the value in the "241-AP-105 Total Inventory" column was a less-than value, and its value was *greater than* that shown in the "Estimate from Average HDW SMM" column, then the "Estimate from Average HDW SMM" value was carried to the "241-AP-105 Best-Basis Inventory" column. The assumption here is that the SMM better predicts the amount of the specie in the waste, and that the "241-AP-105 Total Inventory" value is biased too high.

- Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997).

Table D3-10. Tank 241-AP-105 Projected Best-Basis Inventory: Nonradioactive Constituents. (2 Sheets)

Analyte	241-AP-105 Solids Inventory[1] (kg)	241-AP-105 Supernatant Inventory[2] (kg)	241-AP-105 Total Inventory[3] (kg)	Estimate from Average HDW SMM[4] (kg)	Projected 241-AP-105 Best-Basis Inventory (kg)
Al	4,610	66,700	71,300	138,000	71,300
Bi	<55	<105	<160	804	160
Ca	152	<105	<257	5,950	257
Cl	710	17,800	18,500	28,300	18,500
TIC as CO_3	39,200	44,600	83,800	133,000	83,800
Cr	<106	870	<976	18,600	976
F	10,800	8,240	19,100	9,620	19,100
Fe	<44	<53	<97	2,240	97
Hg	NR	NR	NR	8	8
K	1,840	35,200	37,000	19,900	37,000
La	<26	<53	<79	6	6
Mn	9	<11	<20	1,710	20
Na	103,000	479,000	583,000	1,070,000	583,000
Ni	27	<21	<48	1,540	48
NO_2	16,400	330,000	346,000	307,000	346,000
NO_3	64,200	734,000	798,000	1,010,000	798,000
OH_{Total}	35,800	108,000	144,000	512,000	137,000[5]
Pb	<23	138	<161	796	161
PO_4	5,050	6,220	11,300	49,800	11,300
Si	207	188	394	2,580	394
SO_4	8,240	14,300	22,500	80,500	22,500
Sr	<6	<11	<16	0	0
TOC	2,930	5,200	8,130	58,400	8,130
U_{TOTAL}	<227	62	<289	12,700	289

Table D3-10. Tank 241-AP-105 Projected Best-Basis Inventory: Nonradioactive Constituents. (2 Sheets)

Analyte	241-AP-105 Solids Inventory[1] (kg)	241-AP-105 Supernatant Inventory[2] (kg)	241-AP-105 Total Inventory[3] (kg)	Estimate from Average HDW SMM[4] (kg)	Projected 241-AP-105 Best-Basis Inventory (kg)
Zr	8	<11	<18	255	18
Water	234,000	2,040,000	2,280,000	1,150,000	2,280,000

Notes:

[1]From Table D3-4

[2]From Table D3-6

[3]Sum of solids (second column) and supernatant (third column) values. Calculations were performed with more precision than shown in the table; rounding error may cause the totals to be slightly different from the simple sum of columns two and three.

[4]From Table D3-8 and calculated with a volume of 2,582 kL (682 kgal)

[5]Total hydroxide value determined from charge balance and includes metal oxides as hydroxides; CO_3^{2-}, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, and SiO_3^{2-} are considered as separate species in the charge balance equation.

Table D3-11. Tank 241-AP-105 Projected Best-Basis Inventory: Radioactive Constituents (Decayed to January 1, 1994). (3 Sheets)

Analyte	Average-Based Solids Inventory[1] (Ci)	241-AP-105 Supernatant Inventory[2] (Ci)	241-AP-105 Total[3] (Ci)	Estimate from Average HDW SMM[4] (Ci)	Projected 241-AP-105 Best-Basis Total (Ci)
^{3}H	8.88	10.2	19.1	731	19.1
^{14}C	0.955	1.24	2.20	99.6	2.20
^{59}Ni	NR	NR	NR	5.60	5.60
^{60}Co	<21.9	<30.5	<52.4	132	52.4
^{63}Ni	NR	NR	NR	551	551
^{79}Se	NR	NR	NR	11.3	11.3
^{90}Sr	12,800	764	13,600	3.51E+05	13,600
^{90}Y	12,800	764	13,600	3.51E+05	13,600

Table D3-11. Tank 241-AP-105 Projected Best-Basis Inventory: Radioactive Constituents (Decayed to January 1, 1994). (3 Sheets)

Analyte	Average-Based Solids Inventory[1] (Ci)	241-AP-105 Supernatant Inventory[2] (Ci)	241-AP-105 Total[3] (Ci)	Estimate from Average HDW SMM[4] (Ci)	Projected 241-AP-105 Best-Basis Total (Ci)
^{93}Zr	NR	NR	NR	54.6	54.6
^{93m}Nb	NR	NR	NR	39.9	39.9
^{99}Tc	81.6	267	348	751	348
^{106}Ru	NR	<3.58E+04	NR	0.0351	0.0351
^{113m}Cd	NR	NR	NR	283	283
^{125}Sb	NR	NR	NR	765	765
^{126}Sn	NR	NR	NR	17.1	17.1
^{129}I	<1.73	0.331	<2.06	1.45	1.45
^{134}Cs	NR	<542	NR	141	141
^{137}Cs	1.79E+05	4.43E+05	6.21E+05	7.42E+05	6.21E+05
^{137m}Ba	1.70E+05	4.20E+05	5.90E+05	7.03E+05	5.90E+05
^{151}Sm	NR	NR	NR	39,800	39,800
^{152}Eu	NR	NR	NR	13.9	13.9
^{154}Eu	<63.2	<129	<192	2,070	192
^{155}Eu	<397	<987	<1,380	869	869
^{226}Ra	NR	<4,340	NR	4.73E-04	4.73E-04
^{227}Ac	NR	NR	NR	0.00294	0.00294
^{228}Ra	NR	NR	NR	1.03	1.03
^{229}Th	NR	NR	NR	0.0201	0.0201
^{231}Pa	NR	NR	NR	0.0129	0.0129
^{232}Th	NR	NR	NR	0.0997	0.0997
^{232}U	NR	NR	0.0379	3.29	0.0379
^{233}U	NR	NR	0.145	12.6	0.145
^{234}U	NR	NR	0.133	4.18	0.133
^{235}U	NR	NR	5.09 E-03	0.163	0.005
^{236}U	NR	NR	9.69 E-03	0.241	0.00969
^{237}Np	<6.06	0.728	<6.79	2.66	2.66
^{238}U	<0.0763	0.0209	0.0963	4.27	0.0963

Table D3-11. Tank 241-AP-105 Projected Best-Basis Inventory: Radioactive Constituents (Decayed to January 1, 1994). (3 Sheets)

Analyte	Average-Based Solids Inventory[1] (Ci)	241-AP-105 Supernatant Inventory[2] (Ci)	241-AP-105 Total[3] (Ci)	Estimate from Average HDW SMM[4] (Ci)	Projected 241-AP-105 Best-Basis Total (Ci)
^{238}Pu	NR	<0.0931	0.11	9.24	0.11
^{239}Pu	NR	NR	1.42	181	1.42
$^{239/240}$Pu	1.57	0.195	1.77	218	1.77
^{240}Pu	NR	NR	0.345	37.1	0.345
^{241}Pu	NR	NR	10.3	797	10.3
^{241}Am	6.02	<0.183	<6.20	244	<6.20
^{242}Pu	NR	NR	4.26 E-05	0.00320	4.26 E-05
^{242}Cm	NR	NR	9.9 E-03	0.519	9.9 E-03
^{243}Am	NR	NR	5.91 E-04	0.0147	5.91 E-04
^{243}Cm	<0.0979	NR	7.16 E-02	0.0518	7.16 E-02
$^{243/244}$Cm	<1.59	<0.198	<1.79	0.625	0.625
^{244}Cm	NR	NR	1.72	0.574	1.72

Notes:

[1]From Table D3-5 and calculated with a volume of 337 kL (89 kgal) and density of 1.58 g/mL

[2]From Table D3-7 and calculated with a volume of 2,582 kL (682 kgal)

[3]Sum of Solids (second column) and Supernatant (third column) values. Calculations were performed with more precision than shown in the table; rounding error may cause the totals to be slightly different from the simple sum of columns two and three. Uranium isotopes based on total uranium using the HDW isotopic ratios. Pu isotopes based on ^{239}Pu derived from $^{239/240}$Pu sample values. Other Pu isotopes based on HDW isotopic ratios. ^{243}Am and ^{242}Cm based on ^{241}Am using HDW isotopic ratios. ^{243}Cm and ^{244}Cm based on $^{243/244}$Cm sample values using HDW isotopic ratios.

[4]From Table D3-9 and calculated with a volume of 2,926 kL (773 kgal)

[5]See Section D3.3.1 for the calculation of ^{14}C, uranium isotopes, and plutonium isotopes.

The validity of the assumptions used to generate the best-basis estimates in Tables D3-10 and D3-11 may be checked by performing a mass and charge balance using the data in the final column of Table D3-10. Summing the masses in the last column (assuming that silicon and TOC exist as SiO_3^{2-} and acetate) generates a total mass of 4,420,000 kg. Approximately 51.6 percent of the total mass consists of water. This estimate is useful only for general

comparison purposes because it fails to account for the precipitated form of most species. The mass of the solids may also be estimated from the assumed solids volume (337 kL [89 kgal]) and density (1.58 g/mL) and the supernatant volume (2,582 kL [682 kgal]) and density (1.34 g/mL):

$$\text{total waste mass (kg)} = (337\ \text{kL} \times 1.58\ \text{g/mL} + 2{,}582\ \text{kL} \times 1.34\ \text{g/mL}) \times 1000\ \text{mL/L}.$$

The resulting computation yields 4,000,000 kg for the total waste mass, which generally agrees with the previous estimate.

The tank 241-AP-105 best-basis total hydroxide value of 137,000 kg was determined by charge balance. This value is similar to the value of 144,000 kg determined by summing the solids and supernatant contributions to the total hydroxide. Therefore, based on mass and charge balance considerations, the assumptions underlying the best-basis estimates appear to be internally consistent.

D3.3.1 Radionuclide Best-Basis Inventory: Additional Considerations

Table D3-11 includes some additional considerations that were used in estimating the radionuclide inventory for tank 241-AP-105. These are summarized as follows:

The ^{14}C concentrations in the waste were assumed to parallel the total carbon content of the waste. Therefore, the ^{14}C content of the solids was computed as:

$$\text{Solids } ^{14}C\ (\text{Ci}) = \text{Supernatant } ^{14}C \times (\text{solids total carbon/supernatant total carbon})$$

The inventory for Uranium isotopes was assumed equal to the total uranium inventory. The inventories of the uranium isotopes were calculated by using the HDW model isotopic ratios for tank 241-AP-105.

Plutonium isotope inventories were computed from the $^{239/240}Pu$ sample value, using HDW isotopic ratios for ^{239}Pu and ^{240}Pu. Other plutonium isotopes were derived from ^{239}Pu using HDW model isotopic ratios. Americium isotopes were computed from ^{241}Am by using the HDW model isotopic ratios for ^{241}Am and ^{243}Am. Curium 242 (^{242}Cm) was also estimated from the sample-based value for ^{241}Am using the HDW isotopic ratios. Finally, ^{243}Cm and ^{244}Cm were estimated from the $^{243/244}Cm$ sample value using the HDW isotopic ratios.

D4.0 DEFINE THE BEST BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These 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 them into a form that is suitable for long-term storage.

Chemical and radiological inventory information are generally derived using three approaches: 1) component inventories are estimated using the results of sample analyses; 2) component inventories are predicted using the HDW model based on process knowledge and historical information; or 3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data.

An effort is underway to provide best-basis waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-AP-105 was performed. The engineering assessment done in this evaluation should serve as the basis for the best estimate inventory for tank 241-AP-105 for the following reasons.

- The July 1997 core sampling of tank 241-AP-105 and the May 1997 grab sampling of supernatant in tank 241-AW-106 are the most recent samplings events for the waste currently in tank 241-AP-105 (Supernatant from 241-AW-106 was transferred to 241-AP-105 in August 1997 which is subsequent to the core sample event).

- The HDW model estimate is outdated because of the large number of waste transfers that have occurred subsequent to the date that the HDW model estimate is valid for the inventory of tank 241-AP-105.

- The reported solids volume (Hanlon 1997) conflicts with the sludge level determinations from previous sampling events. The Hanlon-reported solids volume overstates the amount of solids in the tank.

Best-basis inventory estimates for tank 241-AP-105 are presented in Tables D4-1 and D4-2. Where sample data were not available, best-basis estimates for solids are based on an average of solids inventories in tanks 241-AN-104 and 241-AN-105 ratioed to 337 kL (89 kgal). Where sample data were not available for the supernatant, best-basis estimates are based on an average of supernatant inventories in tanks 241-AN-104, 241-AN-105, and 241-AW-101

ratioed to a supernatant volume of 2,582 kL (682 kgal). Additional modeling data were derived from an average of the HDW model estimates for tanks 241-AN-104, 241-AN-105, and 241-AW-101 ratioed to total volume of 2,920 kL (771 kgal). Because tank 241-AP-105 is an active tank, the inventory values reported in Tables D4-1 and D4-2 are subject to change.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-105 as of October 31, 1997. (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	71,300	S/E	
Bi	0	E	Bi is relatively insoluble in the supernate added to this tank
Ca	257	S/E	
Cl	18,500	S/E	
TIC as CO_3	83,800	S/E	
Cr	976	S/E	Upper bounding estimate
F	19,100	S/E	
Fe	97	S/E	Upper bounding estimate
Hg	0	E	Simpson 1998
K	37,000	S/E	
La	0	E	La is relatively insoluble in the supernate added to this tank
Mn	20	S/E	
Na	583,000	S/E	
Ni	48	S/E	Upper bounding estimate
NO_2	346,000	S/E	
NO_3	798,000	S/E	
OH	137,000	C	
Pb	161	S/E	
PO_4	11,300	S/E	IC analysis
Si	394	S/E	
SO_4	22,500	S/E	IC analysis
Sr	0.326	S/E	Estimated assuming 30% of Sr is ^{90}Sr
TOC	8,130	S/E	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-105 as of October 31, 1997. (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
U_{TOTAL}	289	S/E	
Zr	18	S/E	

Note:

[1]S = Sample-based, M = HDW model-based, E = Engineering assessment-based, C = Charge balance

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of October 31, 1997 (Decayed to January 1, 1994). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	19.1	S/E	
^{14}C	2.20	S/E	
^{59}Ni	5.60	M/E	
^{60}Co	52.4	S/E	Upper bounding estimate
^{63}Ni	551	M/E	
^{79}Se	11.3	M/E	
^{90}Sr	13,600	S/E	
^{90}Y	13,600	S/E	Referenced to ^{90}Sr
^{93}Zr	54.6	M/E	
^{93m}Nb	39.9	M/E	
^{99}Tc	348	S/E	
^{106}Ru	0.0351	M/E	
^{113m}Cd	283	M/E	
^{125}Sb	765	M/E	
^{126}Sn	17.1	M/E	
^{129}I	1.45	M/E	
^{134}Cs	141	M/E	
^{137}Cs	6.21E+05	S/E	
^{137m}Ba	5.90E+05	S/E	Referenced to ^{137}Cs
^{151}Sm	39,800	M/E	
^{152}Eu	13.9	M/E	
^{154}Eu	192	S/E	Upper bounding estimate
^{155}Eu	869	M/E	
^{226}Ra	4.73E-04	M/E	
^{227}Ac	0.00294	M/E	
^{228}Ra	1.03	M/E	
^{229}Th	0.0201	M/E	
^{231}Pa	0.0129	M/E	
^{232}Th	0.0997	M/E	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of October 31, 1997 (Decayed to January 1, 1994). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}U	0.0379	S/E/M	Based on total U: Used HDW isotopic ratios
^{233}U	0.145	S/E/M	Based on total U: Used HDW isotopic ratios
^{234}U	0.133	S/E/M	Based on total U: Used HDW isotopic ratios
^{235}U	0.00509	S/E/M	Based on total U: Used HDW isotopic ratios
^{236}U	0.00969	S/E/M	Based on total U: Used HDW isotopic ratios
^{237}Np	2.66	M/E	
^{238}U	0.0963	S/E/M	Based on total U: Used HDW isotopic ratios
^{238}Pu	0.109	S/E/M	Based on ^{239}Pu: Used HDW isotopic ratios
^{239}Pu	1.42	S/E/M	Based on $^{239/240}Pu$: Used HDW isotopic ratios
^{240}Pu	0.344	S/E/M	Based on $^{239/240}Pu$: Used HDW isotopic ratios
^{241}Pu	10.3	S/E/M	Based on ^{239}Pu: Used HDW isotopic ratios
^{241}Am	6.20	S/E	Upper bounding estimate
^{242}Pu	4.25E-05	S/E/M	Based on ^{239}Pu: Used HDW isotopic ratios
^{242}Cm	0.00995	S/E/M	Based on ^{241}Am: Used HDW isotopic ratios
^{243}Am	5.91E-04	S/E/M	Based on ^{241}Am: Used HDW isotopic ratios

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-105 as of October 31, 1997 (Decayed to January 1, 1994). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{243}Cm	0.0716	M/E	Based on $^{243/244}Cm$: Used HDW isotopic ratios
^{244}Cm	1.72	M/E	Based on $^{243/244}Cm$: Used HDW isotopic ratios

Note:

[1]S = Sample-based (based on 1996 core samples; see Appendix B), M = HDW model-based, 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 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. 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. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. (1997 Section 6.1.10).

D5.0 APPENDIX D REFERENCES

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