0049962 S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 649438

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	8/31/98
	6. Project Title/No./Work Order No. Tank 241-BY-107	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-637, Rev. 0A	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

This ECN compiles all reconciliation changes made to the Best-Basis Inventory in FY 1998 and should replace Section 3.0 and Appendix D, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-BY-107, 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	D. J. McCain	R2-12
K. M. Hall	R2-12		

RELEASE STAMP

DATE STA: 4 HANFORD RELEASE ID: 58

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 649438

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. N. J. Kupfer	N. J. Kupfer	9-2-98	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	9-10-98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other D. J. McCain	R2-12 Jerrie J. McCain	9-3-98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-BY-107

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

EDT/ECN: 649438 UC: 721
Org Code: 7A110 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages:

Key Words: TCR, best-basis inventory, standard inventory

Abstract: The best-basis inventory provides waste inventory estimates that serve as standard characterization source terms for the various waste management activities. To establish a best-basis inventory for single-shell tank 241-BY-107, 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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Release Approval Date

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STA: 4
SEP 15 1998
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Approved for Public Release

RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-637	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-BY-107

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 04/09/97 on EDT-617591.	D.J. McCain	K.M. Hall
0-A RS	Incorporate per ECN-635509.	D.J. McCain	K.M. Hall
		[signature]	[signature] 8/27/97
0-B RS	Incorporate per ECN-649438.	M.J. Kupfer	K.M. Hodgson
		[signature] 9-2-98	9-10-98 [signature]

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 results of sample analyses, 2) component inventories are estimated 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. Not surprisingly, the information derived from these different approaches is often inconsistent.

An effort is underway to provide 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-BY-107 was performed, including the following:

- Data from two push mode 1996 core samples (see Appendix B)
- An inventory estimate generated by the HDW model (Agnew et al. 1997)
- Comparing the summation of individual waste types and total waste concentrations with similar BY tanks.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-107. For the following reasons, the sample-based inventory was selected as the best basis for analytes for which sample-based analytical values were available:

- The sampling-based inventory analytical concentrations compared favorably to those of other BY tanks.
- No methodology is available to fully predict BY saltcake or PFeCN from process flowsheet or historical records.
- Waste transfer records are not always complete and accurate.
- The engineering assessment supports the assumption that sample-based data appear reasonable and substituted additional information only for analytes for which high "less than" values were reported by the sample-based data.

- For analytes having no available values from the sample-based inventory or the engineering assessment-based inventory, the HDW model values were used. A note was made that they were of lower reliability (as were the engineering assessment-based values).

The best-basis inventory for tank 241-BY-107 is presented in Tables 3-1 and 3-2. 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. Appendix D contains the complete narrative regarding the derivation of the inventory estimates shown in Tables 3-1 and 3-2.

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, have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be a model result, a sample, or an engineering assessment-based result, if available. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-107 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	72,200	S	
Bi	81	E	Sample reported < 3,500
Ca	3,470	E	Based on engineering assessment. Sample reported < 6,000
Cl	4,970	S	
TIC as CO_3	82,000	S	
Cr	6,540	S	
F	7,380	S	
Fe	9,400	S	
Hg	7.65	E	Simpson (1998)
K	6,680	S	
La	0.0	E	Did not receive 224 waste
Mn	119	E	Sample reported <458
Na	473,000	S	
Ni	7,500	S	
NO_2	80,500	S	
NO_3	416,000	S	
OH_{TOTAL}	274,000	C	Calculated by mass balance difference
Pb	628	E	M reported 663
PO_4	47,500	S	Determined by ICP. Corrected waste volume.
Si	2,360	S	
SO_4	31,300	S	Determined by IC. Corrected waste volume.
Sr	2,690	S	

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-107 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment
TOC	8,400	S	
U_{TOTAL}	8,540	S	
Zr	94.9	E	S reported < 350

Note:

[1]S = sample-based, M = HDW model-based, or E = engineering assessment-based.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-107, Decayed January 1, 1994 (Effective January 31, 1997). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	74.6	M	
^{14}C	19.3	M	
^{59}Ni	3.07	M	
^{60}Co	18	M	
^{63}Ni	296	M	
^{79}Se	1.64	M	
^{90}Sr	33,600	S	
^{90}Y	33,600	S	Based on ^{90}Sr
^{93}Zr	7.90	M	
^{93m}Nb	5.73	M	
^{99}Tc	108	M	
^{106}Ru	0.00358	M	
^{113m}Cd	41.5	M	
^{125}Sb	80.4	M	
^{126}Sn	2.45	M	
^{129}I	0.209	M	
^{134}Cs	0.882	M	
^{137}Cs	241,000	S	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-107, Decayed January 1, 1994 (Effective January 31, 1997). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{137m}Ba	228,000	S	Based on ^{137}Cs
^{151}Sm	5680	M	
^{152}Eu	2.74	M	
^{154}Eu	303	M	
^{155}Eu	170	M	
^{226}Ra	8.54E-05	M	Added model value.
^{227}Ac	0.00114	M	
^{228}Ra	0.959	M	
^{229}Th	0.0221	M	
^{231}Pa	0.00573	M	
^{232}Th	0.0354	M	
^{232}U	5.91	S/M	Based on total U: used HDW isotopic ratios.
^{233}U	22.7	S/M	Based on total U: used HDW isotopic ratios.
^{234}U	3.1	S/M	Based on total U: used HDW isotopic ratios.
^{235}U	0.125	S/M	Based on total U: used HDW isotopic ratios.
^{236}U	0.0686	S/M	Based on total U: used HDW isotopic ratios.
^{237}Np	0.364	M	
^{238}Pu	0.924	S/M	Based on total alpha: used HDW isotopic ratios.
^{238}U	2.85	S/M	Based on total U: used HDW isotopic ratios.
^{239}Pu	35.8	S/M	Based on total alpha: used HDW isotopic ratios.
^{240}Pu	5.85	S/M	Based on total alpha: used HDW isotopic ratios.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-107, Decayed January 1, 1994 (Effective January 31, 1997). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{241}Am	15.9	S/M	Based on total alpha: used HDW isotopic ratios. Sample reported < 458
^{241}Pu	65.7	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Cm	2.75E-03	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Pu	3.16E-04	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Am	5.44E-04	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Cm	5.64E-05	S/M	Based on total alpha: used HDW isotopic ratios.
^{244}Cm	1.02E-04	S/M	Based on total alpha: used HDW isotopic ratios.

Notes:

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

5.0 REFERENCES

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996a, *Waste Status and Transaction Record Summary for the Northwest Quadrant of the Hanford 200 East Area*, WHC-SD-WM-TI-669, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1996b, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 3*, LA-UR-96-858, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Baumeister, T., *Mechanical Engineer's Handbook,* 1958, (Sixth Edition), McGraw-Hill Book Company, New York, New York.

Brevick, C. H., R. L. Newell, and J. W. Funk, 1996, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas*, WHC-SD-WM-ER-349, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Carpenter, B. C., 1994, *Tank 241-BY-107 Tank Characterization Plan*, WHC-SD-WM-TP-274, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Cash, R. J., 1996a, *Cancellation of Ferrocyanide DQO Requirements*, (internal memorandum 79300-96-031 to S. J. Eberlein, July 22), Westinghouse Hanford Company, Richland, Washington.

Cash, R. J., 1996b, *Scope Increase of Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, Rev. 2, (internal memorandum 79300-96-029 to S. J. Eberlein, July 12), Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1996, *Recommendation 93-5 Implementation Plan*, DOE/RL-94-0001, Rev. 1, U.S. Department of Energy, Richland, Washington.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Fritts, L. L., 1996a, *Tank 241-BY-107, Cores 151 and 161, Analytical Results for the 45 Day Report*, WHC-SD-WM-DP-197, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Fritts, L. L., 1996b, *Tank 241-BY-107, Cores 151 and 161, Analytical Results for the Final Report*, WHC-SD-WM-DP-197, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending September 30, 1996*, WHC-EP-0182-102, Westinghouse Hanford Company, Richland, Washington.

Herting, D. L., 1996, *Polarized Light Microscopy Report on Tank BY-107 Sample*, Report, 8C510-96-107, December 23, Numatec Hanford Company, Richland, Washington.

Hodgson, K. M., and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wates Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Lockheed Martin Hanford Corp., Richland, Washington.

Homi, C. S., 1996a, *Tank 241-BY-107 Tank Characterization Plan*, WHC-SD-WM-TP-274, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Homi, C. S., 1996b, *Vapor Sampling and Analysis Plan*, WHC-SD-WM-TP-335, Rev. 2E, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., and D. R. Bratzel, 1995, *Tank 241-BY-107 Headspace Gas and Vapor Characterization Results for Samples Collected in March 1994 and October 1994*, WHC-SD-WM-ER-421, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., J. A. Glissmeyer, and D.S. Sklarew, 1997, *Screening for Organic Solvents in Hanford Waste Tanks Using Non-methane Organic Compound Vapor Concentrations*, PNNL-11490, Pacific Northwest National Laboratory, Richland, Washington.

Kummerer, M., 1995, *Topical Report on Heat Removal Characteristics of Waste Storage Tanks*, WHC-SD-WM-SARR-010, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, R. A. Watrous, S. L. Lambert, D. E. Place, R. M. Orme, G. L. Borsheim, N. G. Colton, M. D. LeClair, R. T. Winward, and W. W. Schulz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes* HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corporation for Fluor Daniel, Inc., Richland, Washington.

Lane, T. A., 1979, *Tank 107-BY Analysis and Viscosity Versus Temperature Plots*, (internal memorandum to J. J. Kirk, July 16), Rockwell Hanford Operations, Richland Washington.

LMHC, 1998, *Best-Basis Inventory for Tank 241-BY-107*, Tank Characterization Database, Internet at http://twins.pnl.gov:8001/TCD/main.html.

McCain, D. J., 1996a, *Immediate Notification: Violation of Differential Scanning Calorimetry Limit for Subsample Within Tank 241-BY-107*, (internal memorandum 79400-96-164, to Distribution, August 29), Westinghouse Hanford Company, Richland, Washington.

McCain, D. J., 1996b, *Tank 241-BY-107 Tank Characterization Plan*, WHC-SD-WM-TP-274, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Osborne, J. W., J. L. Huckaby, T. P. Rudolph, E. R. Hewitt, D. D. Mahlum, J. Y. Young, C. M. Anderson, 1994, *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution*, WHC-SD-WM-DQO-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Public Law 101-510, 1990, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," Section 3137 of *National Defense Authorization Act for Fiscal Year 1991*.

Simpson, B. C., and D. J. McCain, 1996, *Historical Model Evaluation Data Requirements*, WHC-SD-WM-DQO-018, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Simpson, B. C., R. D. Cromar, and R. D. Schreiber, 1996, *Tank Characterization Report for Single-Shell Tank 241-BY-110*, WHC-SD-WM-ER-591, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Simpson, B. C., 1998, *Best Basis Inventory Change Package for Reconciliation of Mercury Values, Change Package No. 7*, (internal memorandum 7A120-98-005 to J. W. Cammann, February 26), Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

Turner, D. A., H. Babad, L. L. Buckley, and J. E. Meacham, 1995, *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, WHC-SD-WM-DQO-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989*, HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel, Inc., Richland, Washington.

Winkelman, W. D., 1996, *Tank 241-BY-107 Tank Characterization Plan*, WHC-SD-WM-TP-274, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-107

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-107

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-BY-107 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Chemical waste information for tank 241-BY-107 included the following:

- Data from two push cores samples collected in 1996 (see Appendix B).
- Data from pre-1989 analyses evaluated only for information purposes.
- The chemical and radionuclide inventory estimates for this tank generated from the HDW model (Agnew et al. 1997).
- The analytical data from other tanks with the same saltcake and sludge waste types in the BY Tank Farm.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Sample-based inventories are derived from analytical concentration data from the 1996 core samples. The HDW model generates inventories based on waste transactions and historical process information. Tables D2-1 and D2-2 compare the sample-based and HDW model inventories. Table D2-1 compares nonradioactive components on a kilogram basis, and Table D2-2 compares the radioactive components on a total curie basis. The chemical species are reported without charge designation.

The tank volume used to generate inventory values was 1,007 kL (266 kgal). There are two interpretations on the assignment of the waste phases. The HDW model assigns 443 kL (117 kgal) to sludge, 564 kL (149 kgal) to saltcake, and it assumes no supernatant (Agnew et al. 1997). The sample-based inventory is the sum of solid fraction inventory and liquid fraction

inventory. The sample based inventory uses current surveillance data and assigns 1,007 kL (266 kgal) to the solids fraction, and 95 kL (25 kgal) to the liquid fraction (Hanlon 1996). The solids sample density used to calculate the solid fraction inventory is 1.76 g/mL and liquid sample density is 1.46 g/mL. The HDW model uses a density of 1.65 g/mL.

By comparing Tables D2-1 and D2-2, the differences are evident between the sample-based values and the HDW model inventories for tank 241-BY-107 for the following components: Al, Bi, Cr, F, Fe, K, Na, Ni, NO_3, NO_2, oxalate, PO_4, SO_4, Sr, TIC, U, and percent water. Because of differences in mass basis, an approximately 16 RPD occurs between the two estimates for analytes with the same concentration; the sample-based estimate is higher.

Table D2-1. Sample-Based and Hanford Defined Waste-Based Model Inventory Estimates for Nonradioactive Components in Tank 241-BY-107.

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
Al	72,200	33,200	NO_2	80,500	62,600
Bi	< 3,500	16,400	NO_3	416,000	469,000
Ca	< 5,990	6,050	OH	N/R	117,000
Cl	4,970	3,270	Oxalate	24,300	0.113
Cr	6,540	1,670	Pb	N/R	663
F[3]	7,380	1,470	P as PO_4	47,500	22,500
Fe	9,400	23,200	Si	2,360	2,120
FeCN/CN	NR	8,350	S as SO_4	31,300	14,100
Hg	NR	5.80	Sr	2,690	0.0
K	6,680	1,030	TIC as CO_3	82,000	24,100
La	< 1,750	0.160	TOC	8,400	6,340
Mn	< 459	100	U_{TOTAL}	8,540	7,720
Na	473,000	283,000	Zr	< 350	3.78
Ni	7,500	2,620	H_2O (wt%)	37.7	35.1
NH_4	NR	1,650	Density (kg/L)	1.76	1.65

Notes:

NR = Not reported
[1]See Appendix B
[2]Agnew et al. (1997)
[3]Fluoride is based on water soluble portion only.

Table D2-2. Sample and Hanford Defined Waste Model Inventory Estimates for Radioactive Components in Tank 241-BY-107 (Decayed to January 1, 1994).

Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)
^{90}Sr	33,600	161,000
^{137}Cs	241,000	185.000
$^{239/240}Pu$	NR	66.7
Total alpha	93.2	NR
Total beta	269,000	NR

Notes:

NR = Not reported
[1]See Appendix B
[2]Agnew et al. (1997)

D3.0 COMPONENT INVENTORY EVALUATION

For a detailed summary of the waste transfer history, see Appendix A. An overview and summary of the most relevant transfer history follows (Agnew et al. 1995).

Tank 241-BY-107 is the first tank in a cascade that includes tanks 241-BY-108 and 241-BY-109. Tank 241-BY-107 began receiving first cycle bismuth phosphate process waste from B Plant in the third quarter of 1952. Transfers continued until the cascade was filled in the first quarter of 1951. The tank was almost emptied in the second quarter of 1952. Uranium recovery supernatant from tank 241-BX-109 was transferred to tank 241-BY-107 in the first quarter of 1953. By the third quarter of 1954, tank 241-BY-107 was pumped to prepare it for receiving ferrocyanide scavenged uranium recovery process waste. From 1954 to 1957, waste from the CR vault was sent to tanks in the BY Tank Farm for settling during the ferrocyanide scavenging campaign. Tank 241-BY-107 was a principal settling tank.

Tank 241-BY-107 became part of the in-tank solidification bottoms loop (ITS#2) in 1969. A heater was placed in tank 241-BY-112, and concentrated supernatants were circulated in a series of BY Tank Farm tanks. The tank was removed from service in 1975, and it was interim stabilized in 1979.

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

D3.1 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

Agnew et al. (1996) and Hill et al. (1995) have reported on the waste types in tank 241-BY-107. Agnew et al. provided HDW model-based predictions of current waste types and volumes as follows:

BY saltcake	564 kL (149 kgal)
1C2	91 kL (24 kgal)
UR	76 kL (20 kgal)
PFeCN1	114 kL (30 kgal)
PFeCN2	163 kL (43 kgal)

The following abbreviations were used to designate waste types:

BY saltcake	=	Saltcake resulting from in-tank solidification of supernatants (evaporation using in-tank heaters)
CW	=	$BiPO_4$ process aluminum cladding waste
1C2	=	First decontamination cycle $BiPO_4$ waste (also contains CW to neutralize the 1C2 waste). Occurred 1950 to 1956.
EB-ITS	=	Hill et al. (1995) designation for evaporator bottoms, comparable to BY saltcake
PFeCN1	=	Ferrocyanide sludge produced by in-plant scavenging of waste from uranium recovery process (0.005*M* ferrocyanide)
PFeCN2	=	Same as PFeCN1 with 0.0025*M* ferrocyanide.
UR	=	Waste from solvent extraction process used to remove uranium from waste sludges in the 1950s, sometimes called tributyl phosphate process

An examination of segment level data from core samples (see Appendix B, Section B2.4) indicates areas with high concentrations of Fe and Ni which indicate nickel ferrocyanide scavenged waste. These same areas also contain elevated concentrations of Ca, nonradioactive Sr, and PO_4 which probably indicates scavenging of ^{90}Sr by precipitation as $Sr_3(PO_4)_2$ and $Ca_3(PO_4)_2$. Based on segment level data, approximately 15 percent of the core profile consists of the nickel ferrocyanide scavenged waste. Assuming a total tank inventory of 1,010 kL (266 kgal), the volume of the sludge layer is estimated to be approximately 151 kL (40 kgal).

No other discernible sludge waste types were observed, for example, no areas with elevated bismuth concentrations were observed indicating that 1C2 waste solids are unlikely. An examination of segment level data indicated that the remaining waste (approximately 855 kL [226 kgal]) was probably BY saltcake.

The sample data indicated that the HDW model over predicts the volume of sludge in tank 241-BY-107 with the actual volume being closer to that predicted by Hanlon (1996). Based on the sample information, this assessment assumes 151 kL (40 kgal) ferrocyanide scavenged sludge and 855 kL (226 kgal) BY saltcake.

D3.2 ASSUMPTIONS

For this evaluation, the following assumptions and observations were made:

- Tank waste mass was calculated using sample-based densities and the total waste volumes listed in Hanlon (1996).
- Only the BY saltcake and the PFeCN waste streams contributed to solids formation. The 1C2/CW waste was not observed and was assumed absent.
- Based on evaluation of the segment level profile of components from the core samples of tank 241-BY-107, the assumed BY saltcake volume is 855 kL (226 kgal), and the assumed PFeCN sludge volume is 151 kL (40 kgal).
- No accurate and complete bulk component information exists for the ferrocyanide sludge layer from process flowsheet information for calculating the predicted engineering data set.
- No radiolysis of NO_3 to NO_2 and no additions of NO_2 to the waste for corrosion purposes are factored into this evaluation.

D3.3 BASIS FOR ASSESSING SALTCAKE INVENTORIES IN TANK 241-BY-107

The BY saltcake represents salt waste supernatants that are evaporated and concentrated using in-tank heaters. In-tank solidification (ITS) campaigns were performed in the BY Tank Farm from 1965 through 1976. Waste supernatants that were evaporated originated primarily from $BiPO_4$ process operations in B Plant. Heaters were placed in tanks 241-BY-101, 241-BY-102, and 241-BY-112. Certain BY Tank Farm tanks were designated as feed tanks. Concentrates from heated tanks were transferred to other tanks in the BY Tank Farm and some tanks in the BX Tank Farm where they cooled and crystallized (Agnew et al. 1995).

Agnew et al. (1997) provides a defined waste composition for BY saltcake. Because of the complicated waste supernatant transfer history of feed to the ITS campaign and the lack of flowsheet basis for the waste, it is difficult to perform an independent assessment to estimate a saltcake composition that can be compared to the model-based BYSltCk composition. However, samples that contain BY saltcake from BY Tank Farm tanks and from tank 241-BY-107 have been analyzed and reported. Table D3-1 summarizes the composition of saltcake layers from tanks 241-BY-105, 241-BY-106, and 241-BY-110 based on segment-level analysis reported, respectively, in Simpson et al. (1996a), Bell et al. (1996), and Simpson et al. (1996b). For comparison, the waste component concentrations for the BY saltcake layer for tank 241-BY-107 (see Appendix B) are shown. The BY saltcake defined waste composition from Agnew et al. (1997) is also shown. The mean analyte concentrations from the top three-and-one-half segments of the two four-segment core samples from tank 241-BY-107 (see Appendix B) were used as the BY saltcake basis for this tank.

As indicated in Table D3-1, the average concentrations of most major components for the three BY Tank Farm saltcake samples compare within approximately a factor of two to the tank 241-BY-107 saltcake components. Exceptions include Al, Fe, Ni, and Cr which are significantly more concentrated in the BY saltcake of tank 241-BY-107. A possible explanation is that the core sample segments used as the basis for the tank 241-BY-107 saltcake composition contained some sludge mixed with saltcake.

The average BY saltcake compositions based on sample analyses compared well to the predicted BY saltcake HDW model compositions for most major components (see Table D3-1). Note, however, that the sample fluoride concentrations were consistently about six to seven times higher than the HDW model concentrations.

Table D3-1. Concentrations of Components in BY Tank Farm Saltcake Samples ($\mu g/g$). (2 Sheets)

Analyte	Tank 241-BY-105	Tank 241-BY-106	Tank 241-BY-110	Average Concentration	Tank 241-BY-107	HDW BY Saltcake Concentration
Al	18,400	20,400	14,100	17,633	33,400	34,973
Bi	55.6	NR	NR	55.6	NR	114.9
Ca	216	308	400	308	< 2,900	1,791
Chloride	897	2,060	2,250	1,736	2,400	2,859
Cr	321	855	2,900	1,359	3,850	1,754
Fluoride	4,100	5,130	5,420	4,883	4,432	649
Fe	476	215	924	538	1,450	749
Pb	50.3	64.5	130	82	< 2,000	721
Mn	54.8	9.57	52.8	39.1	< 244	109
Ni	75.9	47.9	193	106	2,220	487
NO_3	491,000	329,000	184,000	334,667	245,000	248,782
NO_2	9,410	32,100	30,600	24,037	37,000	47,143
Oxalate	11,300	8,990	13,600	11,297	14,200	0.15
PO_4	4,890	5,270	14,200	8,120	12,600	3,998
P	1,010	1,032	4,650	2,231	< 6,600	NR
K	712	2,470	1,930	1,704	3,770	956
Si	180	184	451	272	< 1,100	1,319
Ag	17.4	14.5	17.5	16.5	< 200	NR
Na	198,000	203,000	237,000	212,667	258,000	184,674

Table D3-1. Concentrations of Components in BY Tank Farm Saltcake Samples (μg/g). (2 Sheets)

Analyte	Tank 241-BY-105	Tank 241-BY-106	Tank 241-BY-110	Average Concentration	Tank 241-BY-107	HDW BY Saltcake Concentration
Sr	88.3	44.4	58.1	64	< 415	0.0
SO_4	10,600	11,300	18,400	13,433	16,800	11,373
S	3,140	3,280	5,950	4,123	5,770	NR
TIC	NR	7,359	31,800	19,580	9,620	4,198
TOC	3,250	2,500	5,920	3,890	4,080	4,465
U	261	164.2	697	374	755	3,930
Zr	5.23	6.28	14.4	8.64	< 200	1.30
Density (g/mL)	NR	1.71	NR	1.71	1.56[1]	1.63
wt% H_2O	16.1	25.5	23.2	21.6	36.6	36.3
Radionuclides	**(μCi/g)**					
^{137}Cs	NR	106	60	83.0	128	92.2
^{90}Sr	NR	< 4.26	22.5	22.5	17.9	78
$^{239/240}Pu$	NR	NR	0.0192	0.0192	NR	0.0572
Total alpha	0.0168	< 0.00945	0.0434	0.0301	.018	NR

Note:

NR = Not reported.

[1]Includes solids and drainable liquid (see Appendix B).

D3.4 BASIS FOR ASSESSING SLUDGE INVENTORIES IN TANK 241-BY-107

A defined waste composition for PFeCN1 and PFeCN2 is provided in the HDW model (Agnew et al. 1997). The HDW model defined waste reflects the addition of potassium ferrocyanide, sodium ferrocyanide, and nickel sulfate to remove ^{137}Cs from supernatants in uranium recovery wastes. The ^{137}Cs was coprecipitated with the $Na_2NiFe(CN)_6$ precipitate. If the waste supernatants contained high concentrations of ^{90}Sr, nonradioactive strontium nitrate and/or calcium nitrate was added to coprecipitate the ^{90}Sr as the insoluble phosphate. Scavenging of U Plant waste was performed from 1954 to 1957 with the ferrocyanide sludges settling primarily in tanks 241-BY-106, 241-BY-107, 241-BY-108, or 241-BY-110. The accumulated sludges in these tanks were periodically transferred to tank 241-BY-104 or 241-BY-105.

Tanks other than tank 241-BY-107, which contain ferrocyanide scavenged uranium recovery process sludges, have been sampled and analyzed (tanks 241-BY-104, 241-BY-105, 241-BY-106, 241-BY-108, and 241-BY-110). In particular, segment-level evaluation of analyses from tanks 241-BY-106 and 241-BY-110 have provided clear evidence of solids compositions consistent with the defined waste basis for PFeCN. This assessment compares the average analyte concentrations for the ferrocyanide sludge component of tanks 241-BY-106 and 241-BY-110 to the analyte concentrations for the ferrocyanide components of tank 241-BY-107 (see Table D3-2). The average component concentrations for the bottom half segment of the two (four-segment) tank 241-BY-107 core samples were used because they appeared to represent the expected flowsheet basis for the ferrocyanide waste (see Appendix B).

The average concentrations for most major components in the two BY Tank Farm PFeCN sludge samples compare within approximately a factor of two to the component concentrations in tank 241-BY-107. The component concentrations also compare within an approximate factor of two to those of the HDW model PFeCN defined waste. A major exception is Ni which is approximately three-fold higher in the tank 241-BY-107 sludge layer than in the two comparison tank PFeCN samples or the HDW model PFeCN waste. An additional exception is that the HDW model predicts a much higher nitrate concentration for the PFeCN waste than found in the tank samples.

Table D3-2. Concentration of Components in BY Tank Farm Sludge Samples (μg/g). (2 Sheets)

Element	Tank 241-BY-106	Tank 241-BY-110	Average Sludge Concentration	Tank 241-BY-107	Average[1] HDW PFeCN Concentration
Al	30,800	28,300	29,550	46,750	NR
Ca	8,150	14,200	11,175	14,180	6,483
Chloride	NR	3,570	3,570	2,580	818
Cr	1,120	2,220	1,670	2,075	53.6
Fluoride	NR	4,220	4,220	1,705	1,284
Fe	33,000	20,000	26,500	33,300	29,559
Pb	NR	1,880	1,880	< 2,000	NR
Mn	NR	228	228	725	NR
Ni	6,960	6,670	6,815	18,275	4,469
NO_3	NR	111,000	111,000	95,500	360,520
NO_2	NR	43,200	43,200	40,700	36,000
Oxalate	NR	5,870	5,870	9,110	NR
PO_4	NR	32,100	32,100	14,100	18,440
P	20,500	10,500	15,500	25,600	NR
K	NR	2,930	2,930	3,700	208
Si	NR	1,190	1,190	2,920	373
Na	130,000	161,000	145,500	222,000	163,669
Sr	NR	6,840	6,840	10,300	NR
SO_4	NR	18,400	18,400	18,640	5,656
S	NR	5,360	5,360	3,000	NR
TIC	5,580	6,430	6,005	2,130	1,942
TOC	20,400	11,100	15,750	8,270	4,415
U	NR	20,900	20,900	32,600	117
Zr	589	19.7	304.35	< 192	NR
Density (g/mL)		1.76	1.76	1.79	1.75
wt% H_2O	37.3	30.5	33.9	37.6	28.4

Table D3-2. Concentration of Components in BY Tank Farm Sludge Samples (μg/g). (2 Sheets)

Element	Tank 241-BY-106	Tank 241-BY-110	Average Sludge Concentration	Tank 241-BY-107	Average[1] HDW PFeCN Concentration
Radionuclides	μCi/g				
^{137}Cs	508	140	324	NR	206.2
^{90}Sr	763	348	555.5	NR	183.5
$^{239/240}Pu$	0.0997	0.061	0.08035	NR	0.0021
Total alpha	0.253	NR	0.253	0.176	NR

Note:

NR = Not reported.

[1]The average of PFeCN1 and PFeCN2 is shown for comparison.

D3.5 COMPARISON OF INVENTORY ESTIMATES

Table D3-3 summarizes the estimated chemical inventories for tank 241-BY-107. The sample-based inventory for tank 241-BY-107, the predicted engineering assessment inventory, and the HDW model estimated inventory are shown. The engineering assessment inventory is based on the average analytical concentrations for the three BY Tank Farm saltcake comparison tanks and the two BY Tank Farm PFeCN comparison tanks. The calculated inventories for the saltcake and sludge components were added together to provide the total tank inventory estimate in Table D3-3.

The engineering assessment assumed the average density of 1.71 g/mL for the three BY Tank Farm saltcake comparison tanks and an average sludge density of 1.79 g/mL for the two BY Tank Farm PFeCN comparison tanks. As noted earlier, the assumed saltcake volume was 855 kL (226 kgal), and the assumed sludge volume was 151 kL (40 kgal).

The following is an example calculation for the Na inventory shown in Table D3-3 for the engineering assessment:

Kg Na: 212,667 μg/g x 1.0E-06 g/μg x 1.71 kg/L x 855 $kL_{SALTCAKE}$ x 1,000 L/kL + 145,500 μg/g x 1.0E-06 g/μg x 1.79 kg/L x 151 kL_{SLUDGE} x 1,000 L/kL = 350,000 kg

Comments and observations about the inventories of selected components shown in Table D3-3 are provided in the following text.

Aluminum. The Al inventory based on the tank 241-BY-107 sample analyses was approximately twice that of the engineering assessment and the HDW model. Tank 241-BY-107 analytical data were considered the best basis because high Al concentrations were consistently found in the sludge and saltcake portions for both core samples.

Bismuth. The Bi inventory predicted by the HDW model is significantly higher than the sample-based inventory. The major contribution of Bi from the HDW model is from 1C2 waste. This assessment assumed that 1C2 waste was not present in the tank because no areas with elevated Bi concentrations were found when examining tank 241-BY-107 segment-level data.

Potassium. The sample-based K inventory is significantly higher than predicted by the HDW model. High concentrations of K were found in sludge and saltcake samples from the BY Tank Farm tanks. The HDW model assumes that ferrocyanide scavenging of ^{137}Cs was performed by the addition of $Na_4Fe(CN)_6$ rather than $K_4Fe(CN)_6$. Records show, however, that significant quantities of $K_4Fe(CN)_6$ were also used.

Nickel. The major source of Ni in tank 241-BY-107 is from the Ni ferrocyanide scavenging of uranium recovery waste to precipitate ^{137}Cs. The profiles from both core samples from tank 241-BY-107 showed a very high concentration of Ni in segment 4 (see Appendix B) which indicates the PFeCN sludge layer. The Ni concentrations for this layer were significantly higher than for other tanks containing the same PFeCN waste type. The reason for the higher Ni concentrations cannot be explained at this time.

Sodium. The sample-based Na inventory is approximately twice that predicted by the HDW model because this assessment assumes a much higher contribution of saltcake to the tank inventory (855 kL [226 kgal]) than the HDW model (564 kL [149 kgal]). In addition, the Na concentrations in BY saltcake samples are consistently higher than the predicted Na concentration for the HDW model BY saltcake.

Nitrate. The sample-based NO_3 inventory is approximately the same as that predicted by the HDW model.

Phosphate. The PO_4 inventory for the BY Tank Farm comparison tanks (engineering assessment) and the HDW model inventory are comparable. However, the PO_4 inventory based on sample analysis of tank 241-BY-107 is approximately double the engineering assessment and HDW inventory. Because the contribution of PO_4 in the saltcake and sludge components for tank 241-BY-107 core samples is consistently high, the sample-based inventory was selected as the best-basis inventory.

Fluoride. The sample-based fluoride inventory is approximately four times higher than the HDW model inventory. The sample analyses for the three BY saltcake comparison tanks and tank 241-BY-107 consistently show five to six times higher fluoride concentrations than predicted for the HDW model BY saltcake.

Iron. The HDW inventory is two- to three-fold higher than the sample-based inventories. The HDW model assumes a much higher sludge content in this tank (538 kL [142 kgal] versus 151 kL [40 kgal]) which provides the majority of the Fe contribution.

Oxalate. The sample-based oxalate inventory is much higher than predicted by the HDW model. The analytical data show oxalate as a major organic degradation product, but the HDW model assumes that organic components are degraded to higher molecular weight species.

Strontium. The sample-based Sr inventories are much higher than the HDW model predicted inventory. The HDW model does not assume that nonradioactive Sr was added to scavenge ^{90}Sr as $Sr_3(PO_4)_2$ during the ferrocyanide scavenging campaigns. Sample analyses and process history records provide substantial evidence that calcium and strontium were used for scavenging ^{90}Sr from certain tank supernatants.

Total Hydroxide. 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 D3-3. Comparison of Selected Component Inventory Estimates for Tank 241-BY-107 Waste. (2 Sheets)

Component	Engineering Assessment-Based (kg)	Sample-based (kg)	HDW Estimated (kg)
Bi	81	<3,550	16,400
K	3,280	6,670	1,030
Ca	3,470	<5,990	6,050
NO_3	519,000	416,000	469,000
NO_2	46,800	80,500	62,600
Ni	2,000	7,500	2,620
SO_4	24,600	31,300	14,100
Cr	24,400	6,540	1,670
PO_4	20,500	47,500	22,500
F	8,280	7,380	1,470

Table D3-3. Comparison of Selected Component Inventory Estimates for Tank 241-BY-107 Waste. (2 Sheets)

Component	Engineering Assessment-Based (kg)	Sample-based (kg)	HDW Estimated (kg)
Al	33,800	72,200	33,200
Fe	7,950	9,400	23,200
Sr	1,940	2,690	0.0
TIC	30,300	16,400	4,820
TOC	9,940	8,400	6,340
Oxalate	18,100	24,300	0.113
U	6,200	8,540	7,720
Na	350,000	473,000	283,000
H_2O (percent)	23.5	37.7	35.1

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 results of sample analyses, 2) component inventories are estimated 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. Not surprisingly, the information derived from these different approaches is often inconsistent.

An effort is underway to provide 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-BY-107 was performed, including the following:

- Data from two push mode 1996 core samples (see Appendix B)
- An inventory estimate generated by the HDW model (Agnew et al. 1997)
- Comparing the summation of individual waste types and total waste concentrations with similar BY tanks.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-107. For the following reasons, the sample-based inventory was selected as the best basis for analytes for which sample-based analytical values were available:

- The sampling-based inventory analytical concentrations compared favorably to those of other BY tanks.
- No methodology is available to fully predict BY saltcake or PFeCN from process flowsheet or historical records.
- Waste transfer records are not always complete and accurate.
- The engineering assessment supports the assumption that sample-based data appear reasonable and substituted additional information only for analytes for which high "less than" values were reported by the sample-based data.
- For analytes having no available values from the sample-based inventory or the engineering assessment-based inventory, the HDW model values were used. A note was made that they were of lower reliability (as were the engineering assessment-based values).

The best-basis inventory for tank 241-BY-107 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) (LMHC 1998) for the most current inventory values.

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, have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model

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

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-107 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	72,200	S	
Bi	81	E	Sample reported < 3,500
Ca	3,470	E	Based on engineering assessment. Sample reported < 6,000
Cl	4,970	S	
TIC as CO_3	82,000	S	
Cr	6,540	S	
F	7,380	S	
Fe	9,400	S	
Hg	7.65	E	Simpson (1998)
K	6,680	S	
La	0.0	E	Did not receive 224 waste
Mn	119	E	Sample reported <458
Na	473,000	S	
Ni	7,500	S	
NO_2	80,500	S	
NO_3	416,000	S	
OH_{TOTAL}	274,000	C	Calculated by mass balance difference
Pb	628	E	M reported 663
PO_4	47,500	S	Determined by ICP. Corrected waste volume.
Si	2,360	S	
SO_4	31,300	S	Determined by IC. Corrected waste volume.
Sr	2,690	S	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-107 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, or E)[1]	Comment
TOC	8,400	S	
U_{TOTAL}	8,540	S	
Zr	94.9	E	S reported < 350

Note:
[1]S = sample-based, M = HDW model-based, or E = engineering assessment-based.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-107, Decayed January 1, 1994 (Effective January 31, 1997). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	74.6	M	
^{14}C	19.3	M	
^{59}Ni	3.07	M	
^{60}Co	18	M	
^{63}Ni	296	M	
^{79}Se	1.64	M	
^{90}Sr	33,600	S	
^{90}Y	33,600	S	Based on ^{90}Sr
^{93}Zr	7.90	M	
^{93m}Nb	5.73	M	
^{99}Tc	108	M	
^{106}Ru	0.00358	M	
^{113m}Cd	41.5	M	
^{125}Sb	80.4	M	
^{126}Sn	2.45	M	
^{129}I	0.209	M	
^{134}Cs	0.882	M	
^{137}Cs	241,000	S	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-107, Decayed January 1, 1994 (Effective January 31, 1997). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{137m}Ba	228,000	S	Based on ^{137}Cs
^{151}Sm	5680	M	
^{152}Eu	2.74	M	
^{154}Eu	303	M	
^{155}Eu	170	M	
^{226}Ra	8.54E-05	M	Added model value.
^{227}Ac	0.00114	M	
^{228}Ra	0.959	M	
^{229}Th	0.0221	M	
^{231}Pa	0.00573	M	
^{232}Th	0.0354	M	
^{232}U	5.91	S/M	Based on total U: used HDW isotopic ratios.
^{233}U	22.7	S/M	Based on total U: used HDW isotopic ratios.
^{234}U	3.1	S/M	Based on total U: used HDW isotopic ratios.
^{235}U	0.125	S/M	Based on total U: used HDW isotopic ratios.
^{236}U	0.0686	S/M	Based on total U: used HDW isotopic ratios.
^{237}Np	0.364	M	
^{238}Pu	0.924	S/M	Based on total alpha: used HDW isotopic ratios.
^{238}U	2.85	S/M	Based on total U: used HDW isotopic ratios.
^{239}Pu	35.8	S/M	Based on total alpha: used HDW isotopic ratios.
^{240}Pu	5.85	S/M	Based on total alpha: used HDW isotopic ratios.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-107, Decayed January 1, 1994 (Effective January 31, 1997). (3 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{241}Am	15.9	S/M	Based on total alpha: used HDW isotopic ratios. Sample reported < 458
^{241}Pu	65.7	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Cm	2.75E-03	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Pu	3.16E-04	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Am	5.44E-04	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Cm	5.64E-05	S/M	Based on total alpha: used HDW isotopic ratios.
^{244}Cm	1.02E-04	S/M	Based on total alpha: used HDW isotopic ratios.

Notes:

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

D5.0 APPENDIX D REFERENCES

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1995, *Waste Status and Transaction Record Summary (WSTRS)*, WHC-SD-WM-TI-615, -614, -669, and -689, Rev. 2, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

Bell, K. E., J. L. Franklin, J. L. Stroup, J. L. Huckaby, 1996, *Tank Characterization Report for Single-Shell Tank 241-BY-106*, WHC-SD-WM-ER-616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1996, *Waste Tank Summary Report for Month Ending September 30, 1996*, WHC-EP-0182-102, Westinghouse Hanford Company, Richland, Washington.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

Hodgson, K. M, and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, R. A. Watrous, S. L. Lambert, D. E. Place, R. M. Orme, G. L. Borsheim, N. G. Colton, M. D. LeClair, R. T. Winward, and W. W. Schulz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes* HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corporation for Fluor Daniel, Inc., Richland, Washington.

LMHC, 1998, *Best-Basis Inventory for Tank 241-BY-107*, Tank Characterization Database, Internet at http://twins.pnl.gov:8001/TCD/main.html.

Simpson, B. C., J. G. Field, L. M. Sasaki, 1996a, *Tank Characterization Report for Single-Shell Tank 241-BY-105*, WHC-SD-WM-ER-598, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Simpson, B. C., R. D. Cromar, R. D. Schreiber, 1996b, *Tank 241-BY-110 Characterization Report*, WHC-SD-WM-ER-591, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Simpson, B. C., 1998, *Best Basis Inventory Change Package for Reconciliation of Mercury Values, Change Package No. 7*, (internal memorandum 7A120-98-005 to J. W. Cammann, February 26), Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989*, HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel, Inc., Richland, Washington.