0049602

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 640353

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [x] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	M. J. Kupfer, LMHC, H5-49 376-6631	[] Yes [X] No	8/8/97
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-AW-101	NA	NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	WHC-SD-WM-ER-470, Rev. 0	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

Add Appendix H, Evaluation to Establish Best-Basis Inventory for Double-Shell Tank 241-AW-101.

14a. Justification (mark one)

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

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for double-shell tank 241-AW-101 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

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

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	R. T. Winward	H5-49
File	H5-49	C. J. Benar	R2-12
T. E. Jones	H5-49		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

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A-7900-013-1

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. M. J. Kupfer	M J Kupfer	8-14-97	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	8-14-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other C. J. Benar	C. J. Benar	8-14-97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Double-Shell Tank 241-AW-101

T. E. Jones (Meier Associates), R. T. Winward (Meier Associates), and M. J. Kupfer
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for double-shell tank 241-AW-101 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-470	Page 1

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AW-101

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 7/26/95 on EDT 612170.	M. J. Kupfer	K. M. Hodgson
0A RS	Incorporate per ECN-640353.	M. J. Kupfer	K. M. Hodgson
		MJ Kupfer 8-14-97	K.M. Hodgson 8/14/97

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APPENDIX H

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AW-101

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APPENDIX H

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AW-101

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for double-shell tank (DST) 241-AW-101 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

H1.0 CHEMICAL INFORMATION SOURCES

Available waste (chemical) information for tank 241-AW-101 includes the following:

- The information included in Sections 2.0, 3.0, 4.0 and 5.0 of this Tank Characterization Report (TCR) for DST 241-AW-101 on tank history, sampling, analyses, and data evaluation.
- Analytical data on supernatant samples obtained in June 1990 (Welsh 1991).
- Analytical data on sludge core samples obtained in July 1987 (Weiss 1987)
- Analytical data on Privatization Contractor Sample Waste Envelope A (Esch 1996)
- Analytical data from *242-A Evaporator/Crystallizer Fiscal Year 1986 Campaign Run 86-5 Post-Run Document* (Starr 1987)
- Inventory estimates for this tank generated from the Hanford Defined Waste (HDW) model (Agnew et al. 1997).

H2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Tank 241-AW-101 is categorized as containing double-shell slurry feed (DSSF) and is essentially full. The waste in this tank is separated into a crust layer, supernatant layer and a solids layer on the bottom of the tank. The solids layer on the bottom of the tank can be divided into two components according to the origins of the wastes - one dating back to wastes added to the tank before 1986 and the other solids that have accumulated since the tank was filled with DSSF in 1986.

The supernatant was extensively characterized in 1990 (Welsh 1991). Limited analytical data are available from sludge core sampling in 1987 and an auger sample of the crust in 1995. However, these data sources do not provide inventory estimates for all three phases of the waste in this tank. The tank inventory estimates reported in Agnew et al. (1997) are listed in Table H2-1 for the nonradionuclides and Table H2-2 for radionuclides. The chemical species are reported without charge designation per the best-basis inventory convention.

Table H2-1. Hanford Defined Waste Model Predicted Inventory Estimates for Nonradioactive Components in Tank 241-AW-101.

Analyte	HDW inventory estimate[a] (kg)	Analyte	HDW inventory estimate[a] (kg)
Al	180,000	Ni	4,080
Bi	973	NO_2	383,000
Ca	14,800	NO_3	1.50 E+06
Cl	39,000	OH	712,000
Cr	25,500	Pb	1,080
F	24,300	PO_4	94,300
Fe	28,300	Si	9,390
Hg	16.0	SO_4	104,000
K	50,500	CO_3	221,000
Mn	3,640	TOC	77,700
Na	1.52 E+06	U_{TOTAL}	22,500
NH_3	60,900	Zr	1,230
H_2O (Wt%)	28.3	Density (g/mL)	1.65

HDW = Hanford Defined Waste
[a] Agnew et al. (1997).

Table H2-2. Hanford Defined Waste Model Predicted Inventory Estimates for Radioactive Components in Tank 241-AW-101.

Analyte	HDW inventory estimate[a] (Ci)	Analyte	HDW inventory estimate[a] (Ci)
^{90}Sr	476,000	^{137}Cs	907,000
^{239}Pu	817		

HDW = Hanford Defined Waste
[a] Agnew et al. (1997).

H3.0 COMPONENT INVENTORY EVALUATION

The following evaluation was conducted to assess various estimates of tank contents.

H3.1 WASTE HISTORY TANK 241-AW-101

The double-shell tank 241-AW-101 went into service in 1980. From 1980 through the third quarter of 1985, this tank was filled and emptied a number of times. During this time period the tank received Plutonium-Uranium Extraction (PUREX) process miscellaneous wastes, dilute noncomplexed waste, water, complex concentrate, dilute phosphate waste from the 100 N Reactor, and double-shell slurry from the 242-A Evaporator.

In 1986, the tank was emptied down to approximately 200 kL (approximately 50 kgal) in preparation to receive DSSF from the 242-A Evaporator. In 1986, the tank received approximately 4,000 kL (approximately 1,000 kgal) of DSSF produced during Evaporator run 86-5. The tank has not received any waste transfers since 1986. For a more complete history of the waste in this tank refer to the Waste Status and Transaction Record Summary (Agnew et al. 1995) and Section 2.3 of this TCR.

H3.2 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

Both Agnew et al. (1997) and Hanlon (1997) list very similar total waste volumes for 241-AW-101. Agnew et al. lists 4,319 kL (1,141 kgal) and Hanlon lists 4,262 kL (1,126 kgal). Agnew et al. identifies the waste in the tank as 4,088 kL (1,080 kgal) of supernatant mixing model (SMM) Composite and 231 kL (61 kgal) of Tank Layer Model (TLM) Solids Composite. The SMM Composite includes 87.1 kL (23 kgal) of SMMA2 salt cake, and 4,000 kL (1,057 kgal) of supernatant liquids. SMMA2 is a concentrated supernatant from the 242-A Evaporator that, upon cooling, precipitates as a salt cake. The TLM Solids Composite is identified as PUREX low-level waste sludge.

Hanlon (1997) lists the tank as containing 3,950 kL (1,044 kgal) of supernatant liquids and 318 kL (84 kgal) of sludge. However, an internal memo (Stauffer 1997) recommends changing the solids value listed in Hanlon to 1,160 kL (306 kgal). The new 1,160 kL (306 kgal) solids value does not include the floating crust.

H3.3 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

The general approach in this engineering assessment is to utilize all available information to formulate the best-basis estimate of the tank's contents. The sources of information may include analytical data from samples taken from the tank of interest, analytical data from other tanks believed to contain waste types similar to those believed to be in the tank of interest, and data from models utilizing historical process records. The confidence level assigned to the best-basis inventory values then depends on the level of agreement among the various information sources.

H3.3.1 PRELIMINARY ASSESSMENT OF AVAILABLE INFORMATION

Tank 241-AW-101 is essentially full. A preliminary assessment identified several sources of information that could potentially be useful in developing the best-basis inventory estimate. However, no single source provided analytical characterization of the three layers known to be present in the tank - a floating crust, a liquid layer, and a sludge layer.

Almost all of the waste in this tank came from a single evaporator run and this DSSF was well characterized during production (Starr 1987). The DSSF characterization data coupled with HDW model inventory estimates (Agnew et al. 1997) for the sludge heel present in the tank when the DSSF was added, provide one basis for developing a best-basis inventory estimate.

Analytical data from a number of other sampling events provide additional information. The supernatant layer was extensively characterized in 1990 (Welsh 1991) and narrowly focused analyses were completed on the sludge layer in 1987 (Weiss 1987) and the floating crust layer in 1995 (Section 3-3, in this TCR). In 1996, supernatant was collected to support Tank Waste Remediation System (TWRS) Privatization efforts and was well characterized (Esch 1996).

H3.3.2 INVENTORY ESTIMATES BASED ON EVAPORATOR RUN 86-5 DOUBLE-SHELL SLURRY FEED ANALYSIS DATA

During the evaporator run 86-5, five DSSF samples were collected during the transfer of the slurry feed from the evaporator to tank 241-AW-101. These samples were characterized extensively at the request of the Hanford Grout Disposal Program. The data from chemical, physical, and radiochemical analyses on these samples are reported in the evaporator post run document (Starr 1987). Since the DSSF produced during the 242-A Evaporator run 86-5 is the origin of almost all the material in tank 241-AW-101 (i.e., except for the approximately 200 kL [approximately 50 kgal] heel remaining when the tank was almost emptied in 1986), the slurry feed analyses should provide a good prediction of the current tank inventory. Since the DSSF was transferred into tank 241-AW-101 in 1986, both the floating crust layer and additional solids in the tank bottom have formed.

The analytical data for the five slurry samples collected during evaporator run 86-5 are shown in Table H3-1. The tank inventory estimate based on these data are also shown in Table H3-1. According to the post run document (Starr 1987), 4,082 kL (1,078 kgal) of slurry were transferred to tank 241-AW-101. This slurry volume estimate was used in the tank inventory estimates shown in Table H3-1.

Table H3-1. Tank 241-AW-101 Slurry Composition from Evaporator Run 86-5.[a] (2 Sheets)

Analyte	Sample #R-9893 moles/L	Sample #R-9894 moles/L	Sample #R-9895 moles/L	Sample #R-9896 moles/L	Sample #R-9897 moles/L	Average concentration moles/L	Slurry based inventory estimate[b] (kg)
Al	0.63	0.97	1.03	1.05	0.75	0.886	97,577
OH	3.76	4.83	5.4	5.5	5.2	4.938	342,668
NO_2	1.46	1.9	2.03	2.03	1.36	1.756	329,728
NO_3	2.28	3.3	3.63	3.62	4.05	3.376	854,411
CO_3	0.21	0.34	0.4	0.39	0.5	0.368	90,130
PO_4	0.12	0.05	0.49	0.05	0.06	0.154	59,719
SO_4	0.01	<0.03	<0.03	0.02	0.04	0.023	9,143
F	0.09	0.14	0.02	0.21	0.16	0.124	9,617
Cl	0.11	0.22	0.19	0.16	0.13	0.162	23,476
NH_3	0.03	0.04	<0.02	0.01	<0.02	0.027	1,850
B	0.0022	0.00285	0.00317	0.00249	NR	0.00268	118
Ca	0.00237	0.00233	0.00239	0.00254	0.00129	0.00218	356
Cr	0.00247	0.00389	0.0051	0.00469	0.00274	0.00378	801
K	0.59	0.91	1.02	1.05	0.6	0.834	133,112
Mg	4.42 E-04	3.19 E-04	4.74 E-04	4.45 E-04	2.43 E-04	3.85 E-04	36
Si	0.00497	NR	0.00675	0.0054	0.003	0.00503	576
P	0.02	0.03	0.04	0.04	0.02	0.03	3,796
Na	7.65	10.55	11.65	11.8	10.78	10.5	984,488
TOC (g/L)	4.28	5.7	5.7	5.55	4.83	5.21	21,275

Table H3-1. Tank 241-AW-101 Slurry Composition from Evaporator Run 86-5.[a] (2 Sheets)

Analyte	Sample #R-9893 moles/L	Sample #R-9894 moles/L	Sample #R-9895 moles/L	Sample #R-9896 moles/L	Sample #R-9897 moles/L	Average concentration moles/L	Slurry based inventory estimate[b] (kg)
Radio-nuclides[c]	μCi/L	μCi/L	μCi/L	μCi/L	μCi/L	μCi/L	Ci
^{134}Cs	3,240	4,860	4,970	5,330	6,800	5,040	20,600
^{137}Cs	355,000	510,000	510,000	520,000	469,000	472,800	1.93 E+06
$^{89/90}Sr$	11,400	10,600	11,400	4,450	4,330	8,436	34,400
^{99}Tc	219	245	261	280	237	248.4	1,010
$\%H_2O$	56	49.7	47	46.2	51.5	50.1	
Density (g/mL)	1.36	1.5	1.57	1.53	1.49	1.49	

NR = Not reported

[a] Starr (1986)

[b] Slurry volume transferred = 4,082 kL (1,077 kgal)

[c] Radionuclides NOT decayed to January 1, 1994.

H3.3.3 TANK 241-AW-101 SUPERNATANT CHARACTERIZATION

The supernatant in tank 241-AW-101 was characterized extensively in 1990 to support the Hanford Grout Disposal Program. The samples were collected according to a statistically designed sampling plan. A statistical analysis of the analytical data was reported by Welsh (1991). The sampling, analyses, and data evaluation are reported in other sections of the TCR.

Supernatant samples from tank 241-AW-101 were characterized in 1996 as part of the TWRS privatization efforts. However, the 1996 sampling event was not designed to provide data that would be representative of the complete supernatant layer. The analytical data from the two supernatant sampling events are compared with the DSSF analysis and the SMM estimates reported by Agnew et al. (1997) in Table H3-2.

In general, there is very good agreement among the three sets of analytical data and significant differences with the HDW modeling results. There are some interesting differences between the DSSF analysis and 1990 supernatant analysis data. Most notable are decreases in radioactive strontium, phosphate, and TOC in the 1990 data as compared with the DSSF data. It is likely the radioactive strontium and phosphate were incorporated into the sludge layer. The major differences between the analytical data and the modeling results are in sodium, nitrate, and hydroxide.

Tank inventory estimates developed as part of the statistical analysis of the 1990 supernatant data are included in Table H3-3 for comparison purposes.

Table H3-2. Supernatant Analysis Data Summary for Tank 241-AW-101. (2 Sheets)

Analyte	Slurry feed based concentration[a] (moles/L)	1990 Supernatant sample-based concentration[b] (moles/L)	1996 Supernatant sample-based concentration[c] (moles/L)	SMM Composite concentration estimate[d] (moles/L)
Al	0.886	1.03	1.03	1.63
Ca	0.00218	8.26 E-04	0.00120	0.0647
Cl	0.162	0.146	0.159	0.269
Cr	0.00378	0.00310	0.00224	0.120
F	0.124	NR	0.0301	0.313
Fe	NR	0.00146	4.30 E-04	0.0166
K	0.834	1.07	1.04	0.316
Mn	NR	4.76 E-04	NR	0.0160
Na	10.5	10.0	10.2	16.2
NH_3	0.027	0.0145	NR	0.878
Ni	NR	NR	1.98 E-04	0.0107
NO_2	1.756	2.22	2.21	2.04
NO_3	3.376	3.45	3.31	5.93
OH	4.938	5.07	5.28	9.91
Pb	NR	NR	3.15 E-04	0.00127
PO_4	0.154	0.0222	0.0173	0.240
SO_4	0.023	0.0107	0.00713	0.265
CO_3	0.368	0.205	0.860	0.871
U_{TOTAL}	NR	9.41 E-04	1.43 E-04	0.020
TOC (g/L)	5.212	2.46	2.87	11.3
Density (g/mL)	1.49	1.56	1.48	1.68
H_2O (Wt%)	50.1	43.6	NR	26.4
Radionuclides (μCi/L) (decayed to January 1, 1994)				
^{134}Cs	342	398	415	65.1
^{137}Cs	340,000	474,000	440,000	222,000

Table H3-2. Supernatant Analysis Data Summary for Tank 241-AW-101. (2 Sheets)

Analyte	Slurry feed based concentration[a] (moles/L)	1990 Supernatant sample-based concentration[b] (moles/L)	1996 Supernatant sample-based concentration[c] (moles/L)	SMM Composite concentration estimate[d] (moles/L)
^{239}Pu	NR	NR	2.10	72.9
^{99}Tc	248	NR	146	226
^{90}Sr	6,970	991	1,190	117,000

NR = Not reported
SMM = Supernatant mixing model
[a] Starr (1987), double-shell slurry feed volume transferred = 4,082 kL (1,078 kgal)
[b] Welsh (1991), Inventory estimates for supernatant liquid only (3,937 kL [1,039 gal])
[c] Esch (1996)
[d] Agnew et al. (1997).

H3.3.4 SLUDGE AND CRUST INVENTORY ESTIMATES

The inventory estimate for solids in tank 241-AW-101 is problematic. Although the sludge layer in this tank was core sampled in 1987, the analyses were limited to selected radionuclides. Analytical data for the bottom 48-cm (19-in.) core sample are shown in Table H3-3. The bottom core would roughly correspond to the approximately 200 kL (approximately 50 kgal) heel left in the tank when it was almost emptied in 1986. The analytical data were used to develop radionuclide inventory estimates. These values are compared with the TLM composite model values reported by Agnew et al. (1997) in Table H3-3.

Table H3-3. 1987 Core Sample Analysis.[a] (2 sheets)

Analyte	Heel sample data (ηCi/g)	Heel inventory estimate (Ci)	TLM composite inventory estimate[b] (Ci)
$^{239/240}$Pu	92.1	34.0	677
^{141}Am	245.7	90.8	0
^{134}Cs	148	54.7	0
^{137}Cs	196,000	72,400	0

Table H3-3. 1987 Core Sample Analysis.[a] (2 sheets)

Analyte	Heel sample data (ηCi/g)	Heel inventory estimate (Ci)	TLM composite inventory estimate[b] (Ci)
U_{TOTAL}	0.4 μg/g	148 kg	3,080 kg

TLM = Tank layer model

[a] Radionuclides decayed to 1994, assumed sludge volume = 231 kL (61 kgal), and assumed density = 1.6

[b] Agnew et al. (1997).

In 1995, the crust layer in this tank was sampled using an auger technique (Section 3-3 of this TCR). The purpose of this sample was to address potential crust-burn safety issues. The analyses were limited to DSC, TGA, TOC, and TIC. The crust was reported to be approximately 1 percent inorganic carbon and approximately 1 percent organic carbon. Thus, there is little information from the crust sampling event to support the development of the tank inventory estimate.

H3.3.5 ENGINEERING ASSESSMENT INVENTORY ESTIMATE

The slurry feed that essentially filled tank 241-AW-101 in 1986 was well characterized because of the interest of the Hanford Grout Disposal Program. This program also requested the core sampling of the heel in 1987 and the supernatant liquid layer sampling and analysis in 1990. The floating crust layer was sampled in 1995 at the request of one of the tank safety programs. However, as previously discussed, taken collectively the analytical data fail to provide a complete picture of the tank inventory.

The major uncertainty involves the approximately 200 kL (approximately 53 kgal) heel that remained in the tank in 1986 when the tank was being prepared to receive the product from the 242-A Evaporator run 86-5. Except for the limited radioanalytical data from the 1987 core sampling, the HDW model is the only source of information for inventory estimates of the heel. There are obvious problems with the TLM solids composite inventory estimates reported by Agnew et al. (1997). The bulk density is listed as 1.20 g/mL with over 75 percent water. There is also very poor agreement between the limited radionuclide analytical data from the 1987 core sample and the values reported by the model. Never-the-less, these data were used in developing the best-basis estimate of the heel inventory listed in Table H3-4 given the absence of useful chemical analyses for the heel sample.

An overall tank inventory estimate was developed by combining the heel inventory estimate with the estimates calculated from the analytical data on the DSSF produced during evaporator run 86-5. The overall tank estimates are listed in Table H3-4 as the "Engineering Inventory Estimate." The inventory estimate based on 1990 supernatant analytical data

(Welsh 1991) and the HDW inventory estimates (Agnew et al. 1997) are also included in Table H3-4 for comparison.

Table H3-4. Inventory Estimates for Tank 241-AW-101. (2 Sheets)

Analyte	Supernatant based inventory estimate[a] (kg)	Slurry based inventory estimate[b] (kg)	Pre-1986 heel estimate[c] (kg)	Engineering inventory estimate (kg)	HDW inventory estimate[d] (kg)
Al	110,000	97,600	0	97,600	180,000
Bi	NR	NR	0	NR	973
Ca	130	357	4,250	4,610	14,800
Cl	20,400	23,500	28.5	23,500	39,000
Cr	632	802	85.5	888	25,500
F	<300	9,620	0	9,620	24,300
Fe	321	NR	24,500	NR	28,300
Hg	NR	NR	0	NR	16
K	164,000	133,000	55	133,000	50,500
Mn	103	NR	67.7	NR	3,640
Na	906,000	984,000	3,030	987,000	1.52 E+06
NH_3	971	1,850	0	1850	60,900
Ni	NR	NR	1,520	NR	4,080
NO_2	401,000	330,000	94.5	330,000	383,000
NO_3	844,000	854,000	3,270	857,000	1.50 E+06
OH	340,000	343,000	24,600	368,000	712,000
Pb	<1190	NR	1.85	NR	1,080
PO_4	8,300	59,700	1,360	61,100	94,300
Si	1,040	577	0	577	9,390
SO_4	4,060	9,140	79.8	9,220	104,000
CO_3	48,500	90,100	7,630	97,700	221,000
TOC	9,690	21,300	101	21,400	77,700
U_{TOTAL}	880	NR	148	1,028	22,500
Zr	NR	NR	0	NR	1,230
Density (g/mL)	1.5	1.49	1.20	NA	1.65

Table H3-4. Inventory Estimates for Tank 241-AW-101. (2 Sheets)

Analyte	Supernatant based inventory estimate[a] (kg)	Slurry based inventory estimate[b] (kg)	Pre-1986 heel estimate[c] (kg)	Engineering inventory estimate (kg)	HDW inventory estimate[d] (kg)
H_2O (Wt%)	43.6	50.1	73.5	NA	28.3
Radionuclides (Ci) (decayed to January 1, 1994)					
^{134}Cs	1,570	1,400	54.7	1,450	265
^{137}Cs	1.87 E+06	1.76 E+06	72,400	1.83 E+06	907,000
^{239}Pu	4.71	NR	34.0	NR	817
^{99}Tc	NR	1,010	0	1,010	922
^{90}Sr	3,880	31,300	0	31,300	476,000

HDW = Hanford Defined Waste

NR = Not reported

[a] Welsh (1991), Inventory estimates for supernatant liquid only (3,937 kL [1,039 kgal])

[b] Starr (1987), Double-shell slurry feed volume transferred = 4,082 kL (1,078 kgal)

[c] All radionuclide data from Weiss (1987)except for ^{90}Sr. The ^{90}Sr and chemical data from Agnew et al. (1997), assumed sludge volume = 231 kL (61 kgal)

[d] Agnew et al. (1997).

H4.0 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 assessments 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/disposal.

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. The information derived from these different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-AW-101 was performed. An assessment of available chemical information for tank 241-AW-101 was performed, including the following:

- Review of analytical data from 242-A Evaporator post-run documents
- Analytical results from a solids samples collected in 1987 and 1995
- Analytical results from supernatant samples collected in 1990 and 1996.

Based on this engineering assessment, a best-basis inventory was developed for tank 241-AW-101 using the available analytical data and the HDW model tank inventory estimates reported by Agnew et al. (1997).

All available information supports the conclusion that this tank contains approximately 4,280 kL (1,130 kgal) of waste - most of it DSSF. The DSSF originally added to the tank in 1986 has partitioned into three phases: (1) a floating crust layer, (2) a supernatant liquid layer, and (3) a solids layer on the bottom of the tank. Solids from the DSSF have added to an approximate 200 kL (approximate 50 kgal) heel that was in the tank when the DSSF was added. Current estimates are that approximately 1140 kL (306 kgal) of solids are in the bottom of this tank, not including the floating crust (Stauffer 1997). Although the overall tank inventory estimate can be predicted with available information, there is little specific information on the composition of the crust or bottom layer.

Best-basis tank inventory values were 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 were only reported for total beta, total alpha, ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium, while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., were infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.)

Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured nuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

The inventory values reported in Tables H4-1 and H4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with valences of other analytes. In some cases, this approach required that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. No adjustments were required in this best-basis estimate. This charge balance approach is consistent with that used by Agnew et al. (1997).

Table H4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AW-101 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	110,000	S	Engineering estimate = 97,600
Bi	973	M	
Ca	4,610	E	
Cl	23,500	E	
TIC as CO_3	97,700	E	
Cr	888	E	
F	9,620	E	

Table H4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AW-101 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Fe	28,300	M	
Hg	16	M	
K	164,000	S	Engineering estimate = 133,000
La	8.29	M	
Mn	3,640	M	
Na	987,000	E	
Ni	4,080	M	
NO_2	401,000	S	
NO_3	857,000	E	
OH_{TOTAL}	543,000	C	
Pb	1,080	M	
PO_4	61,100	E	
Si	1,040	S	
SO_4	9,220	E	
Sr	NR		
TOC	21,400	E	
U_{TOTAL}	1,028	E	
Zr	1,230	M	

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

Table H4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AW-101 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	958	M	
^{14}C	124	M	
^{59}Ni	7.18	M	
^{60}Co	173	M	
^{63}Ni	707	M	
^{79}Se	14.8	M	
^{90}Sr	31,300	E	
^{90}Y	31,300	E	Referenced to ^{90}Sr
^{93}Zr	71.5	M	
^{93m}Nb	52.4	M	
^{99}Tc	922	M	
^{106}Ru	0.0607	M	
^{113m}Cd	362	M	
^{125}Sb	1,180	M	
^{126}Sn	22.6	M	
^{129}I	1.78	M	
^{134}Cs	265	M	
^{137}Cs	1.83 E+06	E	
^{137m}Ba	1.73 E+06	E	Referenced to ^{137}Cs
^{151}Sm	52,400	M	
^{152}Eu	17.9	M	
^{154}Eu	2,690	M	
^{155}Eu	1,140	M	
^{226}Ra	6.38 E-04	M	
^{227}Ac	0.00402	M	
^{228}Ra	1.31	M	

Table H4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AW-101 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{229}Th	0.0304	M	
^{231}Pa	0.0171	M	
^{232}Th	0.127	M	
^{232}U	4.53	M	
^{233}U	17.4	M	
^{234}U	10.1	M	
^{235}U	0.390	M	
^{236}U	0.700	M	
^{237}Np	3.31	M	
^{238}Pu	83.4	M	
^{238}U	8.79	M	
^{239}Pu	817	M	
^{240}Pu	225	M	
^{241}Am	388	M	
^{241}Pu	8,330	M	
^{242}Cm	0.698	M	
^{242}Pu	0.0319	M	
^{243}Am	0.0311	M	
^{243}Cm	0.0712	M	
^{244}Cm	1.0	M	

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

H5.0 APPENDIX H REFERENCES

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