0049693

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 640678

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 [ ]	D. W. Hendrickson, SESC, B4-51	[] Yes [X] No	7/8/97
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-AX-102	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-472, Rev. 0B	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 I, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-AX-102.

SEP 1998 RECEIVED EDMC

14a. Justification (mark one)

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

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-AX-102 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	D. L. Herting	T6-07
DOE Reading Room	H2-53	K. E. Bell	R2-12
TCSRC	R1-10	K. M. Hodgson	R2-11
File	H5-49	K. M. Hall	R2-12
D. W. Hendrickson	B4-51	L. M. Sasaki	R2-12
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

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A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 640678

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	7-8-97	PE		
Cog. Mgr. K. M. Hodgson	K.M. Hodgson	7-15-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other K. E. Bell	Kevin E. Bell	7-17-97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-AX-102

D. W. Hendrickson and D. L. Herting (NHC)
SGN Eurisys Services Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-AX-102 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-472	Page A

(2) Title
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(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
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APPENDIX I

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-AX-102

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APPENDIX I

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-AX-102

An effort is underway to provide waste inventory estimates that will serve as the standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996 and Kupfer et al. 1997). As part of this effort an evaluation was made of available information for single-shell tank 241-AX-102 including the following:

- Inventory estimates generated by Hanford Defined Waste (HDW) model (Agnew et al. 1997)
- Inventory estimates generated by a tank-specific assessment process utilizing chemical process flowsheets and a detailed historical tank waste transaction data base.

The results from this evaluation support using a predicted inventory based primarily on results from the tank-specific assessment process supplemented, in a few instances, by predictions of the HDW model.

The following sections establish a best-basis inventory estimate for chemical and radionuclide components in tank 241-AX-102. A complete list of data sources used in inventory evaluations is provided at the end of this appendix.

I1.0 CHEMICAL INFORMATION SOURCES

Tank 241-AX-102 has undergone seven sampling and analysis events. One sludge sample was taken in 1974, as the tank was being prepared for sluicing (Appendix G). The tank then contained 189,000 L (50 kgal) of sludge derived primarily from B Plant waste. The sample was analyzed for percent water, density, radionuclides, and a few metals. After sluicing (1976/1977), the tank contained a heel of approximately 26,000 L (7 kgal) of sludge. Six samples of the remaining sludge were analyzed for radionuclide content only (Appendix E).

After sluicing was completed, the tank was used as both a feed and slurry storage tank for the 242-A evaporator-crystallizer (1977 to 1980). The evaporator was processing complexed waste during that time. Analytical results for two liquid grab samples taken in early 1980 show the composition of the evaporator feed solution in the tank at that time

(Appendix C). These results provide no quantitative estimates of the solids deposited on top of the sludge heel, but they do indicate the type of waste that was being stored in the tank.

In 1988 the tank was declared a leaker, and a liquid grab sample was taken to establish the composition of the liquid to be pumped out of the tank by salt well pumping (Appendix B). This sample contained no solids, but analysis of the liquid firmly identifies the waste as concentrated complexed (CC) waste (waste having a total organic carbon concentration over 10 g/L at the aluminate phase boundary). The composition of the solids deposited during the evaporator operations (approximately 98,000 L) can be assumed to be similar in composition to the solids deposited by CC wastes in double-shell tanks 241-AN-107 and 241-AN-102, where the solids have been analyzed (Herting 1994a and 1996).

Two auger samples were taken from the surface of the waste in February 1995 to support the safety assessment of the tank. Limited analyses were obtained from these samples (see Section 4.0).

The Hanford Defined Waste (HDW) model report (Agnew et al. 1997) provides tank content estimates derived from process flowsheets and waste volume records.

I2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Hanlon (1996) estimates that tank 241-AX-102 contains 26,500 L (7 kgal) of sludge, 110,000 L (29 kgal) of saltcake, and 11,000 L (3 kgal) of supernatant liquid. These values are based on the surface level measurements and tank photographs taken at the time the tank was pumped in 1988. More recent photographs show that there is no supernatant liquid left in the tank.

A 1993 report on waste level discrepancies (Swaney 1993) indicated that 30.5 cm (12 in.) or 125 kL (33 kgal) of waste exists in tank 241-AX-102 and that the surface reading used for the Hanlon volume estimates (36 cm [14.17 in.]) was probably high by 5.5 cm (2.17 in.) because the manual tape appeared to contact a small pipe protruding from the waste. No adjustment was made to the Hanlon inventory.

Current waste level readings of 24 cm (9.5 in.[1]) or 98.4 kL (26 kgal) are fairly consistent with Swaney (1993). The drop in the surface level from 30.5 cm (12 in.) in 1993 (Swaney 1993) to 24 cm (9.5 in.) in 1997 is probably due to evaporation of water, which is consistent with the photographic evidence of the disappearance of supernatant liquid. The bulk of the analytical data apply to the composition of the waste before the recent drying trend, so the earlier surface level reading of 30.5 cm (12 in.) (Swaney 1993) was used for the best-basis inventory evaluation.

According to the HDW model, tank 241-AX-102 contains 23,000 L (6 kgal) of sludge, 125,000 L (33 kgal) of saltcake, and no supernatant liquid.

Table I2-1 shows a summary of the volume data available, and the data chosen for the best-basis inventory evaluation. (The chemical species are reported without charge designation per the best-basis inventory convention.)

[1]Per telecon with K. D. Fowler, the current waste level manual tape reading for tank 241-AX-102 is 9.5 in. as recorded in PC-SACS data system July 15, 1997.

Table I2-1. Volume Data for Tank 241-AX-102 Sludge and Saltcake.[a]

	Hanlon (1996)		Swaney (1993)		Agnew et al. (1997)		Best-basis	
	kgal	kL	kgal	kL	kgal	kL	kgal	kL
Sludge	7	26.5	--	--	6	23	7	26.5[b]
Saltcake	29	110	--	--	33	125	26	98.4[c]
Supernate	3	11	--	--	0	0	0	0
Total	39	148	33	125	39	148	33	125

[a]The terms "sludge" and "saltcake" both include the interstitial liquid associated with the solids, which are predominantly water-insoluble metal oxides/hydroxides in the sludge and water-soluble sodium salt crystals in the saltcake.

[b]Hanlon (1996) value selected as the best-basis sludge volume

[c]Hanlon (1996) supernate volume was adjusted to zero as supported by photographic evidence of supernate evaporation. The saltcake volume was also adjusted to yield the tank 241-AX-102 total volume as reported by Swaney (1993).

Tables I2-2 and I2-3 list the predictions of the HDW model for the inventories of various analytes in tank 241-AX-102 waste.

Table I2-2. Hanford Defined Waste Inventory Estimates for Nonradioactive Components in Tank 241-AX-102.

Analyte	HDW model (kg)[a]	Analyte	HDW model (kg)[a]
Density (g/mL)	1.51	OH	18,300
Heat load (kW)	4.15	Pb	30.1
Al	5,950	P as PO_4	1,070
Bi	30.9	Si	916
Ca	380	S as SO_4	3,150
Cl	897	Sr	0.097
TIC as CO_3	3,870	U_{TOTAL}	2,390
Cr	331	Zr	7.93
F	167	EDTA	987
Fe	1,720	NH_3	140
Hg	0.23	Pu	6.94
K	271	Volume (kL)	148
La	0.46		
Mn	29.0		
Na	33,700		
Ni	109		
NO_2	13,600		
NO_3	35,300		

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

Table I2-3. Hanford Defined Waste Model Inventory Estimate for Radioactive Components in Tank 241-AX-102 Decayed to January 1, 1994.

Analyte	HDW model (Ci)[a]	Analyte	HDW model (Ci)[a]
^{3}H	32.4	^{226}Ra	2.34 E-04
^{14}C	5.1	^{227}Ac	0.00114
^{59}Ni	1.57	^{228}Ra	0.0379
^{60}Co	6.61	^{229}Th	8.82 E-04
^{63}Ni	161	^{231}Pa	5.91 E-04
^{79}Se	5.29	^{232}Th	0.00386
^{90}Sr	172,000	^{232}U	0.126
^{90}Y	172,000	^{233}U	0.482
^{93m}Nb	15.6	^{234}U	0.099
^{93}Zr	23.3	^{235}U	0.00396
^{99}Tc	37.7	^{236}U	0.00323
^{106}Ru	0.585	^{237}Np	0.133
^{113m}Cd	117	^{238}Pu	60.7
^{125}Sb	30.8	^{238}U	0.127
^{126}Sn	8.35	^{239}Pu	415
^{129}I	0.0728	^{240}Pu	148
^{134}Cs	0.504	^{241}Am	1,330
^{137m}Ba	35,200	^{241}Pu	4,200
^{137}Cs	37,300	^{242}Cm	1.79
^{151}Sm	15,500	^{242}Pu	0.0303
^{152}Eu	21.1	^{243}Am	0.148
^{154}Eu	1,660	^{243}Cm	0.218
^{155}Eu	1,030	^{244}Cm	8.96

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

I3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed to identify potential errors and/or missing information that would have an effect upon the HDW model component inventories.

I3.1 CONTRIBUTING WASTE TYPES

There is general agreement among various sources that tank 241-AX-102 contains two layers of waste, the bottom layer referred to as sludge and the top layer as saltcake. Each layer is discussed separately below.

I3.1.1 Sludge Layer

The HDW model (Agnew, 1996) predicts that the sludge layer is composed of 3.8 kL (1 kgal) of PUREX low level waste sludge (PL) and 19 kL (5 kgal) of B Plant waste (B) from strontium extraction operations. The overall composition of the sludge layer as predicted by the HDW model is shown in Table I3-1.

One grab sample of sludge was taken in 1974 in preparation for sluicing the sludge from the tank (Appendix G). Six more samples were taken after the sluicing was completed, but analyses were limited to a few radionuclides (Appendix E). The ^{137}Cs and ^{90}Sr activities reported for the before-sluicing sample were within the range of activities reported in the six post-sluicing samples, so the chemical analyses from the pre-sluicing sample are believed to be representative of the heel left after sluicing. These analyses are shown in Table I3-1, column 3.

Table I3-1. Comparison of Tank 241-AX-102 Hanford Defined Waste Model Sludge Layer Concentration Estimates with Sampling Data (Concentrations in $\mu g/g$, Except as Noted). (2 Sheets)

Analyte	HDW model composition estimate[a] ($\mu g/g$)	Sampling data composition estimate[b] ($\mu g/g$)	Adjusted HDW model estimate[c] ($\mu g/g$)
Al	19,500	NR	30,900
Bi	0	NR	0
Ca	7,300	5,070	11,600
Cl	469	NR	743
CO_3	10,900	NR	17,300
Cr	94	NR	149

Table I3-1. Comparison of Tank 241-AX-102 Hanford Defined Waste Model Sludge Layer Concentration Estimates with Sampling Data (Concentrations in μg/g, Except as Noted). (2 Sheets)

Analyte	HDW model composition estimate[a] (μg/g)	Sampling data composition estimate[b] (μg/g)	Adjusted HDW model estimate[c] (μg/g)
F	0	NR	0
Fe	52,200	90,600	82,700
Hg	0	NR	0
K	113	NR	179
La	0	NR	0
Mn	0	7,600	0
Na	47,800	NR	75,700
Ni	2,160	NR	3,420
NO_2	8,930	NR	14,100
NO_3	14,400	NR	22,800
Oxalate	0	NR	0
Pb	1.37	NR	2.16
PO_4	931	NR	1,470
Si	20,300	22,500	32,100
SO_4	1,320	NR	2,090
Sr	0	NR	0
Zr	0	NR	0
Cs (μCi/g)	167	803	264
Sr (μCi/g)	17,900	5,930	28,300
U_{TOTAL}	114.4	990[d]	102,000
Volume (gal)	6,000	NR	7,000
Volume (L)	22,600	NR	26,500
Density (g/mL)	1.41	1.57	1.57
Weight (kg)	31,900	NR	41,600
H_2O (wt%)	63.7	42.5	42.5

Table I3-1. Comparison of Tank 241-AX-102 Hanford Defined Waste Model Sludge Layer Concentration Estimates with Sampling Data (Concentrations in $\mu g/g$, Except as Noted). (2 Sheets)

Analyte	HDW model composition estimate[a] ($\mu g/g$)	Sampling data composition estimate[b] ($\mu g/g$)	Adjusted HDW model estimate[c] ($\mu g/g$)

HDW = Hanford Defined Waste
NR = Not reported
[a]Agnew et al. (1996)
[b]From pre-sluicing grab sample
[c]Based on adjustment for percent water as described in text
[d]Highest of five values from post-sluicing samples.

The last column in Table I3-1 shows the composition as determined by adjusting the HDW model estimates to account for the apparent bias in percent water. The pre-sluicing sludge sample had a higher density and lower percent water than the HDW estimate. If the differences are assumed to have been caused by evaporation of water from the sludge, then both differences (density and percent water) are consistent.

The HDW concentrations were adjusted by algebraically calculating how much the concentrations would have changed when the water evaporated. The calculation is as follows, using Na as an example:

Assume 100 g of sludge at 63.7 percent H_2O and 4.78 percent Na before evaporation.

Let x = weight of water lost during evaporation
a = weight of sludge after evaporation = 100 - x
b = weight of water in sludge after evaporation = 63.7 - x
c = wt% water after evaporation = 42.5% (sample result)
d = wt% Na after evaporation

Find d.

Solution:

$c = 100b/a$, or $42.5 = 100(63.7-x)/(100-x)$; $x = 36.87$

$d = 100(4.78)/a = 478/(100-x) = 7.57\%$ Na

Concentrations derived from the adjusted HDW model predictions are in generally fair agreement with sampling data, but some exceptions are noteworthy. Manganese was predicted to be absent in the sludge, but analyses show a significant concentration. The HDW model predicted less ^{137}Cs and more ^{90}Sr than found in samples. The concentration of uranium in samples varied over a wide range (Appendix E) from 0.13 $\mu g/g$ (1.7×10^{-6} lb/gal) to 990 $\mu g/g$ (0.013 lb/gal), but all of the values were far less than the HDW model prediction.

I3.1.2 Saltcake Layer

The saltcake layer of waste in the tank was deposited during the years 1977 to 1980, when the tank was being used in conjunction with 242-A Evaporator-Crystallizer Operations. The HDW model uses the Supernate Mixing Model (SMM) subroutine to predict an inventory of 125 kL (33 kgal) of saltcake.

In 1988 the tank was declared a leaker, and a liquid grab sample was taken to establish the composition of the liquid to be pumped out of the tank by salt well pumping (Appendix B). This sample contained no solids, but analysis of the liquid firmly identifies the waste as CC waste (see Table I3-2). Specific "markers" for CC waste include the concentrations of carbonate, total organic carbon (TOC), ^{241}Am, and ^{90}Sr, all of which are much higher in CC waste than in other types of liquid Hanford waste.

Table I3-2. Comparison of 1988 Supernatant Liquid Sample from Tank 241-AX-102 with Supernatant Liquid Samples from Concentrated Complexed Waste Tanks 241-AN-102 and 241-AN-107 (Concentrations in Molarity Except as Noted).

Component	241-AX-102[a] (*M*)	241-AN-102[b] (*M*)	241-AN-107 (*M*)
NO_3	3.7	3.6	3.8
NO_2	1.4	1.8	1.1
CO_3	0.98	1.1	1.2
TOC (g/L)	36.8	26.3	42.9
Al	0.006	0.55	0.044
Ca	0.014	0.011	NR
Fe	0.033	NR	0.027
Na	7.32	11.2	8.6
^{241}Am (μCi/mL)	1.0	NR	0.63
$^{239/240}Pu$ (μCi/mL)	0.097	NR	0.034
^{137}Cs (μCi/mL)	350	382	253

Table I3-2. Comparison of 1988 Supernatant Liquid Sample from Tank 241-AX-102 with Supernatant Liquid Samples from Concentrated Complexed Waste Tanks 241-AN-102 and 241-AN-107 (Concentrations in Molarity Except as Noted).

Component	241-AX-102[a] (*M*)	241-AN-102[b] (*M*)	241-AN-107[c] (*M*)
^{90}Sr (μCi/mL)	175	74	93

NR = Not reported
[a]Appendix B
[b]Herting (1993)
[c]Herting (1994b).

The composition of the solids deposited during the evaporator operations (approximately 98.4 kL) can be assumed to be similar in composition to the solids deposited by CC wastes in double-shell tanks 241-AN-102 and 241-AN-107, where the solids have been analyzed. Table I3-3 shows a comparison of the compositions of the saltcake as predicted by the SMM subroutine and as determined by analysis in tanks 241-AN-102 and 241-AN-107.

Table I3-3. Composition of Saltcake Layer in Tank 241-AX-102 as Predicted by Supernate Mixing Model Subroutine and in Tanks 241-AN-102 and 241-AN-107 as Determined by Analysis (Values in μg/g, Except as Noted).

Component	241-AX-102[a]	241-AN-102[b]	241-AN-102[c]	241-AN-107[d]	Average[e]
Density (g/mL)	1.53	1.53	1.50	1.47	1.50
Wt% H_2O	39.3	41.0	40.3	45.6	42.3
Na	169,000	177,000	234,000	140,500	184,000
Al	27,900	12,000	12,200	16,000	13,400
Fe	236	1,200	1,500	3,900	2,200
Cr	1,720	1,300	1,370	450	1,040
Pb	157	200	< 270	330	265
Ni	208	260	420	330	337
Mn	152	250	480	510	413
Ca	767	450	810	440	567
K	1,400	1,500	< 1,700	1,100	1,300
NO_3	183,000	136,000	112,000	142,000	130,000
NO_2	69,900	55,000	39,300	42,000	45,400
CO_3	92,000	80,000	61,500	49,000	63,500
PO_4	5,420	4,400	3,030	4,050	3,830
SO_4	16,300	20,000	25,900	8,400	18,100
F	873	1,250	< 890	1,150	1,200
Cl	4,620	2,600	2,060	1,350	2,000
TOC	11,800	23,000	16,300	27,000	22,100
$^{239/240}Pu$ (μCi/g)	0.05	NR	NR	0.085	0.085
^{137}Cs (μCi/g)	184	215	285	300	267
^{90}Sr (μCi/g)	72	105	169	115	130

NR = Not reported
[a]Agnew et al. (1996)
[b]Based on grab samples taken in 1994 and 1995 (Herting 1996)
[c]Based on core sample taken in 1990 (Douglas et al. 1996)
[d]Based on grab samples taken in 1994 (Herting 1994b)
[e]Average of analytical data in columns 3-5.

Agreement between the SMM subroutine predictions and the analytical data are generally good, but the subroutine appears to have a tendency to underestimate the concentrations of sparingly soluble components (Fe, Pb, Ni, Mn) and overestimate concentrations of very soluble components (NO_3, NO_2, CO_3).

Two auger samples were taken from the surface of the 241-AX-102 waste in February 1995 to support the safety assessment of the tank. Limited analyses were obtained from these samples (see Section 4.0). The moisture content of the auger samples (30.5 percent) was less than the SMM prediction (39.3 percent) and the 241-AN tank samples (average 42.3 percent). The lower moisture content is consistent with the drying trend in the tank that has caused the surface level to drop from 30.5 cm (12 in.) in 1988 to the current 24.1 cm (9.5 in.).

The nitrate concentration in the auger samples (172,000 μg/g) is slightly higher than in 241-AN samples and slightly lower than in the SMM prediction. The nitrite concentration in the auger samples (40,700 μg/g) is lower than both the prediction and 241-AN sample results. The TOC value for the auger samples (56,550 μg/g) is approximately double the value from the 241-AN samples and five times the SMM prediction. The analytical values for the auger samples were not used in developing the best-estimate inventory because the inventory was based on the analytical data that represent the sludge at the time when the waste level in the tank was 30.5 cm (12 in.), i.e., before the sludge dried out due to evaporation of water.

I3.2 ASSUMPTIONS FOR RECONCILING WASTE INVENTORIES

This section presents the results of this inventory evaluation for tank 241-AX-102 (as detailed in Section I3.1). A set of simplified assumptions forms the basis for the best-basis inventory. The following assumptions and observations are based upon best technical judgement pertaining to parameters that can significantly influence tank inventories:

1. The volume of sludge in the tank is 26.5 kL (7.0 kgal). The volume of saltcake is 98.4 kL (26.0 kgal). There is no supernatant liquid in the tank.

2. The best-basis inventory of the sludge layer is based on the analytical results for a grab sample of the sludge taken in 1974. For analytes that were not measured, the HDW model estimates are used after adjusting the values to account for evaporation, as described earlier. For TOC, the contribution of the sludge was assumed to be zero.

3. The best-basis inventory of the saltcake layer is based on the analytical results for samples from tanks 241-AN-102 and 241-AN-107. It is assumed that the compositions of solids in these three tanks are similar because the composition of the supernatant liquids in the three tanks are similar. Tanks 241-AN-102 and 241-AN-107 contain waste that was previously stored in 241-AX-102, though some additional blending of waste occurred. That is, the waste was transferred first to tank 241-AZ-102, where it was blended with CC waste from other single-shell tanks before being transferred to 241-AN-102 and 241-AN-107. Analytes not measured (Bi, Hg, La, Zr, OH, Si, Sr, U) are estimated as the SMM results from the HDW model (Agnew et al. 1997).

4. The overall best-basis inventory of the tank is the sum of the inventories for the sludge layer and the saltcake layer.

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I4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Key waste management 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. Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with these activities.

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, 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.

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

Tables I4-1 and I4-2 list the best-basis inventory of nonradioactive and radioactive components in tank 241-AX-102 as determined from consideration of both HDW model and independent assessment values and use of a 124.92 kL tank waste volume. The inventory values reported in Tables I4-1 and I4-2 are subject to change. Refer to the Tank Characterization Database (TCD) 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, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table I4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AX-102 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	3,260	M/E	
Bi	30.9	M	
Ca	300	S/E	
Cl	330	M/E	
TIC as CO_3	10,100	M/E	
Cr	160	M/E	
F	180	M/E	
Fe	4,090	S/E	
Hg	0.227	M	
K	200	M/E	
La	0.461	M	
Mn	380	S/E	
Na	30,290	M/E	
Ni	190	M/E	
NO_2	7,300	M/E	
NO_3	20,100	M/E	
OH_{TOTAL}	15,700	C	
Pb	39.5	M/E	
P as PO_4	630	M/E	
Si	660	S/E	
S as SO_4	2,760	M/E	
Sr	0.097	M/E	
TOC	3,290	S/E	
U_{TOTAL}	420	S/E	

Table I4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AX-102 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Zr	7.9	M	

[1]S = Sample Based
M = Hanford Defined Waste model (Agnew, 1996)
E = Engineering Assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table I4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AX-102 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	32.4	M	
^{14}C	5.1	M	
^{59}Ni	1.57	M	
^{60}Co	6.61	M	
^{63}Ni	161	M	
^{79}Se	5.29	M	
^{90}Sr	268,000	S/E	
^{90}Y	268,000	S/E	Referenced to ^{90}Sr
^{93m}Nb	15.6	M	
^{93}Zr	23.3	M	
^{99}Tc	37.7	M	
^{106}Ru	0.585	M	
^{113m}Cd	117	M	
^{125}Sb	30.8	M	
^{126}Sn	8.35	M	
^{129}I	0.0728	M	
^{134}Cs	0.504	M	
^{137m}Ba	49,200	S/E	Referenced to ^{137}Cs
^{137}Cs	52,000	S/E	
^{151}Sm	15,500	M	
^{152}Eu	21.1	M	
^{154}Eu	1,660	M	
^{155}Eu	1,030	M	
^{226}Ra	2.34 E-04	M	
^{227}Ac	0.00114	M	
^{228}Ra	0.0379	M	
^{229}Th	8.82 E-04	M	
^{231}Pa	5.91 E-04	M	
^{232}Th	0.00386	M	
^{232}U	0.126	M	
^{233}U	0.482	M	

Table I4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AX-102 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{234}U	0.099	M	
^{235}U	0.00396	M	
^{236}U	0.00323	M	
^{237}Np	0.133	M	
^{238}Pu	60.7	M	
^{238}U	0.127	M	
^{239}Pu	415	M	
^{240}Pu	148	M	
^{241}Am	1,330	M	
^{241}Pu	4,200	M	
^{242}Cm	1.79	M	
^{242}Pu	0.0303	M	
^{243}Am	0.148	M	
^{243}Cm	0.218	M	
^{244}Cm	8.96	M	

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

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I5.0 APPENDIX I REFERENCES

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