0049749

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 644451

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	[] Yes [X] No	08/23/97
	6. Project Title/No./Work Order No. Tank 241-BY-108	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-533, 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

Add Appendix E, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-BY-108.

OCT 1997 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-BY-108 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	J. H. Baldwin	R2-12
File	H5-49		
R. T. Winward	H5-49		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

RELEASE STAMP
DATE: AUG 27 1997
HANFORD RELEASE
STA: 4
ID: 2

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 644451

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	Kathleen M. Hellfor	8/27/97	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	8-25-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J. H. Baldwin	John Baldwin	8/26/97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-BY-108

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

EDT/ECN: 644451 UC: 712
Org Code: 74640 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 260

Key Words: TCR, best-basis inventory

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-BY-108 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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Release Approval 8/27/97 Date

DATE: HANFORD RELEASE ID: 2.
STA: 4
AUG 27 1997
Release Stamp

Approved for Public Release

RECORD OF REVISION

(1) Document Number: WHC-SD-WM-ER-533

(2) Title: Tank Characterization Report for Single-Shell Tank 241-BY-108

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	EDT-615354.		
Rev. 0A RS	(7) These pages have been corrected as per ECN 629920: ES-3, ES-8, 2-5, 4-4, 5-3, 5-5, 5-6, 5-9, A-103	2/18/96	3/1/96
0B RS	Incorporate per ECN-644451	M.J. Kupfer 8/27/97	K.M. Hodgson 8/28/97

A-7320-005 (08/91) WEF168

APPENDIX E

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-108

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APPENDIX E

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-108

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-BY-108 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.

E1.0 CHEMICAL INFORMATION SOURCES

Available waste (chemical) information for tank 241-BY-108 included the following:

- Data from three core samples that were collected in 1995. Two cores were taken from the same riser and one was sent to a different laboratory for analysis. See Appendix A of this Tank Characterization Report (TCR).
- Data from two auger samples of the top 50.8 cm (20 in.) of waste taken in August 1994.
- The inventory estimate for this tank (Agnew et al. 1996) generated from the Hanford Defined Waste model (HDW), which is also referred to as the Los Alamos National Laboratory (LANL) model and as the Historical Tank Content Estimate (HTCE). The HDW model term will be used in this appendix.
- The TCRs from other tanks with the same BYSltCk waste type in the BY Tank Farm.

E2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Sample-based inventories (see Section 4.1.1 and Appendix A), derived from the analytical concentration data from the core samples and the HDW model inventories, generated by HDW model, are compared in Tables E2-1 and E2-2. Table E2-1 compares nonradioactive components on a kilogram (kg) basis, and Table E2-2 compares the radioactive components on a curie basis. The tank volume used to generate the engineering assessment and sample-based inventories is 863 kL (228 kgal) which consists of 583 kL

(154 kgal) sludge layer, 280 kL (74 kgal) salt cake, and no supernatant (Hanlon 1996). The HDW inventories were calculated based on a slightly different mix of sludge and salt cake volumes. Agnew et al. (1996) reports 624.5 kL (165 kgal) of PFeCN sludge, and 238.5 kL (63 kgal) of salt cake. The mean sludge density, that includes interstitial liquid, used to calculate the sample-based component inventories is 1.51 g/mL (Appendix A), and the HDW model density for the total solid waste is estimated to be 1.44 g/mL. Sample-based and engineering assessment inventories were calculated by multiplying the mean analyte concentration value by the current tank volume and by the sample-based density of the waste. Comparing Tables E2-1 and E2-2, the significant differences between the sample-based values for tank 241-BY-108, and the HDW model inventories of this tank for some of the bulk components, e.g., Al, Bi, Ca, Cr, F, Fe, K, Mn, Na, Ni, oxalate, Pb, PO_4, SO_4, Si, Sr, TIC, and percent water can been seen. The chemical species in this appendix are reported without charge designation per the best-basis inventory convention.

Table E2-1. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-BY-108. (2 Sheets)

Analyte	Sampling[a] inventory estimate (kg)	HDW[b] inventory estimate (kg)	Analyte	Sampling[a] inventory estimate (kg)	HDW[b] inventory estimate (kg)
Al	51,700	13,800	NO_2	35,500	23,600
Ba	161	NR	NO_3	261,000	190,000
Bi	<644	33,300	OH	NR	69,400
Ca	4,380	7,500	Oxalate	9,750	0.058
Cl	2,000	2,790	Pb	571	280
Cr	332	725	P as PO_4	33,800	23,900
F	8,590	2,600	Si as SiO_3	1,990	1,610
Fe	9,350	31,800	S as SO_4	29,800	14,600
FeCN/CN	NR	21,000	Sr	4,150	0.075
Hg	NR	1.73	TIC as CO_3	34,700	17,400
K	3,450	763	TOC	5,820	7,300
La	<87.6	0.107	U_{TOTAL}	12,300	17,800
Mg	581	NR	Zn	109	NR
Mn	272	42.6	Zr	<45.1	6.45
Na	212,000	125,000	H_2O (wt%)	27.2	53.0
NH_4	NR	45.1	density (kg/L)	1.51	1.44

Table E2-1. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-BY-108. (2 Sheets)

Analyte	Sampling[a] inventory estimate (kg)	HDW[b] inventory estimate (kg)	Analyte	Sampling[a] inventory estimate (kg)	HDW[b] inventory estimate (kg)
Ni	3,260	5,160			

HDW = Hanford Defined Waste
NR = Not reported
[a] Appendix A of this Tank Characterization Report
[b] Agnew et al. (1996).

Table E2-2. Sample-Based and Hanford Defined Waste Model Predicted Inventory Estimates for Radioactive Components in Tank 241-BY-108.

Analyte	Sampling[a] inventory estimate (Ci)	HDW[b] inventory estimate (Ci)	Analyte	Sampling[a] inventory estimate (Ci)	HDW[b] inventory estimate (Ci)
^{90}Sr	185,000	33,000	$^{239/240}Pu$	8:57	43
^{137}Cs	335,000	60,000	^{241}Am	<243	NR
^{154}Eu	<59.2	NR	Total α	80.5	NR
^{129}I	NR	NR	Total β	714,000	NR

HDW = Hanford Defined Waste
NR = Not reported
[a] Appendix A of this Tank Characterization Report
[b] Agnew et al. (1996), decayed to January 1, 1994.

E3.0 COMPONENT INVENTORY EVALUATION

(Refer to Section 2.3 of this TCR for a detailed summary of the waste transfer history.)

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.

E3.1 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

Agnew et al. (1996): PFeCN, BYSltCk
Hill et al. (1995): TBP-F, EB-ITS, 1C, and CW

1C	=	$BiPO_4$ First decontamination cycle waste
CW	=	$BiPO_4$ First decontamination cladding waste (1C and CW were handled as waste together) so 1C = 1C/CW
PFeCN	=	Ferrocyanide scavenged UR (TBP) supernatants in plant
BYSltCk	=	A mixture of supernatants from other waste types that have been blended to create a new waste type through concentration as a salt cake
TBP-F	=	Tributyl phosphate-ferrocyanide scavenged UR (TBP) supernatants (Equivalent to PFeCN)
EB-ITS	=	Evaporator Bottoms (EB) - In Tank Solidification (ITS) (Equivalent in this tank to BYSltCk)

Agnew et al. (1996) provides estimated volumes for these waste types as does Hanlon (1996) and these are addressed in Section E2.0. The Hanlon estimates are being used in the assessment because they are what was used in the sample-based inventory and are not much different from the Agnew et al. volume estimates. Agnew et al. predicts a PFeCN sludge layer, whereas, Hill et al. (1995) predicts a sludge layer represented by TBP-F and/or 1C/CW. As in tanks 241-BY-102 and 241-BY-104, there seems to be a small unexplained top sludge layer. The sludge appears to be interspersed in some salt cake layers as well as being a more defined layer at the bottom of the tank. There is no developed flowsheet for TBP-F but it is assumed that the Agnew et al. and Hill et al. sludge layers are somewhat equivalent. The sludge is called the PFeCN waste type for this assessment but what is really compared is a similar sludge (called PFeCN for convenience) from some of the BY Tank Farm waste tanks.

E3.2 INVENTORY EVALUATION

The following evaluation provides an engineering assessment of tank 241-BY-108 contents. For this evaluation, the following assumptions and observations are made:

- Tank waste mass is calculated using the measured density and the tank volume listed in Hanlon (1996). While this volume may or may not be correct, the analytical-based and the engineering assessment inventories are derived using this volume, and the volume reported by Agnew is only slightly different. As a result, inventory comparisons are made on slightly different waste type volume bases.

- Only the BYSltCk waste stream and the PFeCN waste stream contributed to solids formation.

- There is no accurate bulk component information for the sludge layer from process flowsheet information for calculating the predicted engineering data set. BY Tank Farm sludge concentration comparisons are available.

- 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.

E3.3 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

E3.3.1 Basis for Salt Cake Calculations Used in this Engineering Evaluation

After inspecting the analytical segment and core data for tank 241-BY-108, there was no reason to question the data. The very top portion of this salt cake shows a sludge like profile but no explanation as to what was deposited has been found. It appears likely to be a thin cladding waste layer. For this evaluation, the concentration table comparisons developed for BYSltCk were used. This is based on comparing six data sets from six BY Tank Farm TCRs and is shown in Table B3-2. Several analytes show differences for BYSltCk from tank-to-tank, and data for Cr concentration shows this tank to be a few times lower than the average of the other tanks. The other analytes seem to be within or near the spread of the values for the other tanks.

the average concentrations in Table E3-1 were calculated using data from tanks 241-BY-105, 241-BY-106, and 241-BY-110 (Bell et al. 1996, Simpson et al. 1996a, and 1996b). Tank 241-BY-102 was not included because it contained one of the ITS heaters and is not representative of the tanks that received ITS concentrated wastes. Tanks 241-BY-104 and 241-BY-108 were not included because it was not possible to separate the salt cake concentrations from the total waste concentrations.

Calculations for Table E3-1 are: (average concentration of analyte in μg/g) x (waste in kgal) x 3,785 L/kgal x 1,000 mL/L x (density in g/mL) x kg/(1 E+09) μg = total kg for this waste type in the tank.

Table E3-1. Tank 241-BY-108 Salt Cake Calculations.
Concentrations in $\mu g/g$, inventory in kg. (2 Sheets)

Element	241-BY-105[a] (SC)	241-BY-106[b] (SC)	241-BY-110[c] (SC)	Average conc.	HDW average conc.	(SC volume of 280 kL [74 kgal])
Al	18,400	20,400	14,100	17,633	35,783	8,385
Bi	55.6	NR	NR	55.6	116.2	26
B	NR	113	92.3	103	NR	49
Cd	6.54	8.25	21.1	12	NR	5.7
Ca	216	308	400	308	1,817.9	146
Cl	897	2,060	2,250	1,736	2,784.3	825
Cr	321	855	2,900	1,359	1,628.7	646
Co	8.75	NR	NR	8.75	NR	4.2
Cu	7.57	NR	NR	7.57	NR	3.6
F	4,100	5,130	5,420	4,883	699.5	2,322
Fe	476	215	924	538	554.4	256
Pb	50.3	64.5	130	82	726.1	39
Mn	54.8	9.57	52.8	39.1	110.4	19
Ni	75.9	47.9	193	106	489.7	50
NO_3	491,000	329,000	184,000	334,667	245,767	159,146
NO_2	9,410	32,100	30,600	24,037	49,532	11,430
Oxalate	11,300	8,990	13,600	11,297	0.15	5,372
PO_4	4,890	5,270	14,200	8,120	4,023.3	3,861
P	1,010	1,032	4,650	2,231	NR	1,061
K	712	2,470	1,930	1,704	910.8	810
Si	180	184	451	272	1,359.2	129
Ag	17.4	14.5	17.5	16.5	NR	7.8
Na	198,000	203,000	237,000	212,667	176,264	101,131
Sr	88.3	44.4	58.1	64	0.19	30
SO_4	10,600	11,300	18,400	13,433	11,357	6,388
S	3140	3280	5950	4123	NR	1,961
TIC	NR	7,359	31,800	19,580	3,720.6	9,311
TOC	3,250	2,500	5,920	3,890	NR	1,850
U	261	164.2	697	374	3793	178
Zn	36.8	18.4	32.8	29.3	NR	14

Table E3-1. Tank 241-BY-108 Salt Cake Calculations.
Concentrations in $\mu g/g$, inventory in kg. (2 Sheets)

Element	241-BY-105[a] (SC)	241-BY-106[b] (SC)	241-BY-110[c] (SC)	Average conc.	HDW average conc.	(SC volume of 280 kL [74 kgal])
Zr	5.23	6.28	14.4	8.64	16.7	4.1
Density (g/mL)	NR	1.71	NR	1.71	1.62	NR
wt% H_2O	16.1	25.5	23.2	21.6	37.4	NR
Radio-nuclides[d]	μCi/g	μCi/g	μCi/g	μCi/g	μCi/g	kCi
^{137}Cs	NR	106	60	83	133.2	39.5
^{90}Sr	NR	<4.26	22.5	22.5	80.3	10.7
$^{239/240}Pu$	NR	NR	0.0192	0.0192	0.107	0.0091
Total Alpha	0.0168	<0.00945	0.0434	0.0301	NR	0.014
Total Beta	NR	<80.2	NR	NR	NR	NR

HDW = Hanford Defined Waste (displayed for comparison only)
NR = Not reported
SC = Salt cake
[a] Simpson et al. (1996a)
[b] Bell et al. (1996)
[c] Simpson et al. (1996b)
[d] Radionuclides are reported as of the date of sample analysis.

E3.3.2 Basis for Sludge Calculations used In This Engineering Evaluation

The sludge in tank 241-BY-108 appears on top, some in the middle, and more at the bottom. It is not possible to isolate and calculate the sludge layers in this tank. Tank 241-BY-108 is compared to five other tanks in the BY Tank Farm in Table E3-2 for both salt cake and sludge. It can be directly compared to tank 241-BY-104 since both inventories are for the total contents. Several analyte concentrations flip flop as being higher in one tank or the other but a general type agreement is obvious. This leads to conclusion that the sample-based data is fairly representative of this type of waste.

Table E3-2. BY Tank Farm Average Concentrations. (2 Sheets)

Element	241-BY-102[a] (SC) (µg/g)	241-BY-104[b] (total) (µg/g)	241-BY-105[c] (SC) (µg/g)	241-BY-106[d] (SC) (µg/g)	241-BY-110[e] (SC) (µg/g)	241-BY-108[f] (total) (µg/g	241-BY-106 (SL)[d] (µg/g)	241-BY-110 (SL) (µg/g)
Al	14,600	30,100	18,400	20,400	14,100	39,800	30,800	28,300
As	<2,030	<62.4	NR	NR	NR	<116	NR	NR
Sb	<1,220	<37.5	NR	NR	NR	<186	NR	NR
Ba	<1,010	<69.1	NR	NR	NR	124	NR	NR
Be	<101	<3.16	NR	NR	NR	<6.73	NR	NR
Bi	<2,030	<285	55.6	NR	NR	<495	NR	NR
B	<101	<45	NR	113	92.3	250	NR	39.8
Br	<854	NR	NR	NR	NR	NR	NR	NR
Cd	<101	16.1	6.54	8.25	21.1	<16.3	NR	7.4
Ca	<2,110	1,240	216	308	400	3,370	8,150	14,200
Ce	<2,030	<62.4	NR	NR	NR	<123	NR	NR
Cl	1,220	2,320	897	2,060	2,250	1,540	NR	3,570
Cr	1,870	4,580	321	855	2,900	255	1,120	2,220
Co	<406	<15.2	8.75	NR	NR	34.2	NR	NR
Cu	<210	<8.25	7.57	NR	NR	<45.9	NR	NR
F	18,000	4,630	4,100	5,130	5,420	6,610	NR	4,220
Fe	1,860	4,090	476	215	924	7,190	33,000	20,000
La	<1,010	<36.8	NR	NR	NR	<67.4	NR	NR
Pb	<2,030	190	50.3	64.5	130	439	NR	1,880
Li	<203	NR	NR	NR	NR	NR	NR	NR
Mg	<2,030	<165	NR	NR	NR	447	NR	NR
Mn	372	77.1	54.8	9.57	52.8	209	NR	228
Mo	<1,010	36.5	NR	NR	NR	<54.1	NR	NR
Nd	<2,030	<71.2	NR	NR	NR	<119	NR	NR
Ni	4,820	1,160	75.9	47.9	193	2,510	6,960	6,670
NO_3	95,000	261,000	491,000	329,000	184,000	201,000	NR	111,000
NO_2	13,900	34,900	9,410	32,100	30,600	27,300	NR	43,200
Oxalate	19,300	13,100	11,300	8,990	13,600	7,500	NR	5,870
PO_4	27,000	11,200	4,890	5,270	14,200	26,000	NR	32,100
P	9,500	3,560	1,010	1,032	4,650	10,100	20,500	10,500
K	NR	3,390	712	2,470	1,930	2,650	NR	2,930
Sm	<2,030	<62.4	NR	NR	NR	<131	NR	NR
Se	<2,030	<62.8	NR	NR	NR	<135	NR	NR
Si	4,350	434	180	184	451	1,530	NR	1,190
Ag	<203	16.9	17.4	14.5	17.5	<49.9	NR	10.2
Na	267,000	220,000	198,000	203,000	237,000	163,000	130,000	161,000

Table E3-2. BY Tank Farm Average Concentrations. (2 Sheets)

Element	241-BY-102[a] (SC) (μg/g)	241-BY-104[b] (total) (μg/g)	241-BY-105[c] (SC) (μg/g)	241-BY-106[d] (SC) (μg/g)	241-BY-110[e] (SC) (μg/g)	241-BY-108[f] (total) (μg/g)	241-BY-106 (SL)[h] (μg/g)	241-BY-110 (SL) (μg/g)
Sr	<203	2,330	88.3	44.4	58.1	3,190	NR	6,840
SO_4	57,700	17,300	10,600	11,300	18,400	22,900	NR	18,400
S	17,300	4,420	3,140	3,280	5,950	6,960	NR	5,360
Tl	<4,060	<125	NR	NR	NR	<479	NR	NR
Ti	<203	<12.1	NR	NR	NR	74.9	NR	NR
TIC	27,800	14,800	NR	7,359	31,800	5,340	5,580	6,440
TOC	4,360	6,810	3,250	2,500	5,920	4,480	20,400	11,100
U	<10,100	3,270	261	164.2	697	9,470	NR	20,900
V	<1,010	<31.2	NR	NR	NR	<47.3	NR	NR
Zn	396	41	36.8	18.4	32.8	83.5	194	91.6
Zr	<203	13.2	5.23	6.28	14.4	<34.7	589	19.
Density (g/mL)	1.5	1.75	NR	1.71	NR	NR	NR	NR
wt% H_2O	NR	25.6	16.1	25.5	23.2	27.2	37.3	30.5
Radionuclides[i] (μCi/g)								
^{137}Cs	NR	97	NR	106	60	258	508	140
^{60}Co	NR	<0.0149	NR	NR	NR	<0.00911	NR	NR
^{90}Sr	NR	391	NR	<4.26	22.5	143	763	348
$^{239/240}Pu$	NR	NR	NR	NR	0.0192	0.0459	0.0997	0.061
Total Alpha	0.089	0.179	0.0168	<0.00945	0.0434	0.0619	0.253	NR
Total Beta	NR	837	NR	<80.2	NR	549	NR	NR

SC = Salt cake

SL = Sludge

Total = A total inventory of all solids (salt cake and sludge) and interstitial liquids for the tank

[a] Sasaki et al. (1997)

[b] Benar et al. (1996)

[c] Simpson et al. (1996a)

[d] Bell et al. (1996)

[e] Simpson et al. (1996b)

[f] This Tank Characterization Report

[g] This tank had an in-tank heater to concentrate waste

[h] Sludge readings for tank 241-BY-106 were called suspect in the Tank Characterization Report and should be used with caution. Only one of three cores was retrieved in the sludge layer

[i] Radionuclides reported as of the sample analysis date.

Sample concentrations from other tanks with PFeCN sludge were used for comparison. The sludge analyte concentrations were used to calculate the predicted sludge inventories (Table E3-3). Calculations for Table E3-3 are: (average concentration of analyte in $\mu g/g$) x (waste in kgal) x 3,785 L/kgal x 1,000 mL/L x (density in g/mL) x kg/(1 E+09) μg = total kg for this waste type in the tank.

Table E3-3. Tank 241-BY-108 PFeCN Sludge Calculations. (2 Sheets)

Element	241-BY-106[a] (SL) ($\mu g/g$)	241-BY-110[b] (SL) ($\mu g/g$)	Average sludge conc. ($\mu g/g$)	Average[c] HDW conc. ($\mu g/g$)	241-BY-108 SL (kg) (SL volume of 583 kL [154 kgal])
Al	30,800	28,300	29,550	NR	25,823
B	NR	39.8	39.8	NR	35
Cd	NR	7.4	7.4	NR	6
Ca	8,150	14,200	11,175	8,285	9,766
Cl	NR	3,570	3,570	1,994	3,120
Cr	1,120	2,220	1,670	112.9	1,459
F	NR	4,220	4,220	2,707	3,688
Fe	33,000	20,000	26,500	37,619	23,158
Pb	NR	1,880	1,880	NR	1,643
Mn	NR	228	228	NR	199
Ni	6,960	6,670	6,815	5,704	5,956
NO_3	NR	111,000	111,000	110,250	97,001
NO_2	NR	43,200	43,200	5,368	37,752
Oxalate	NR	5,870	5,870	NR	5,130
PO_4	NR	32,100	32,100	26,800	28,052
P	20,500	10,500	15,500	NR	13,545
K	NR	2,930	2,930	478	2,560
Si	NR	1,190	1,190	1,296	1,040
Ag	NR	10.2	10.2	NR	9
Na	130,000	161,000	145,500	65,111	127,150
Sr	NR	6,840	6,840	NR	5,977
SO_4	NR	18,400	18,400	11,926	16,079
S	NR	5,360	5,360	NR	4,684
TIC	5,580	6,440	6,010	2,481	5,248
TOC	20,400	11,100	15,750	559.7	13,764

Table E3-3. Tank 241-BY-108 PFeCN Sludge Calculations. (2 Sheets)

Element	241-BY-106[a] (SL) (μg/g)	241-BY-110[b] (SL) (μg/g)	Average sludge conc. (μg/g)	Average[c] HDW conc. (μg/g)	241-BY-108 SL (kg) (SL volume of 583 kL [154 kgal])
U	NR	20,900	20,900	19,900	18,264
Zn	194	91.6	142.8	NR	125
Zr	589	19.7	304.35	NR	266
wt% H_2O	37.3	30.5	33.9	59.6	30
Radio-nuclides[d]	μCi/g	μCi/g	μCi/g	μCi/g	kCi
^{137}Cs	508	140	324	10.46	283
^{90}Sr	763	348	556	2.34	485
$^{239/240}Pu$	0.0997	0.061	0.08035	0.0015	0.070
Total Alpha	0.253	NR	0.253	NR	0.221

HDW = Hanford Defined Waste
NR = Not reported
PFeCN = Ferrocyanide sludge produced by in-plant scavenging of waste from uranium recovery
[a] Bell et al. (1996)
[b] Simpson et al. (1996b)
[c] Average of PFeCN1 and PFeCN2, presented for comparison only
[d] Radionuclides reported as of the sample analysis date.

The engineering assessment inventory values, sample-based values and the HDW model values are compared in Table E3-4. No values are shown in the engineering assessment column because, no improvements to the sample-based values were determined for this tank. The engineering assessment compared tank 241-BY-108 to five other BY Tank Farm sample-based analyte mean concentrations and concluded that the data looked reasonable with Cr being the only analyte that showed a concentration much different than the average of other tank, it being between two to three times higher. Selected comparisons are as follows:

Table E3-4. Comparison of Selected Component Inventory Estimates for Tank 241-BY-108 Waste.

Component	Sample-based (kg)	HDW estimated (kg)
Bi	<644	33,300
K	3,450	763
La	<87.6	0.107
NO_3	261,000	190,000
Mn	272	42.6
SO_4	29,800	14,600
Cr	332	725
PO_4	33,800	23,900
F	8,590	2,600
Al	51,700	13,800
Fe	9,350	31,800
TIC	6,940	3,480
TOC	5,820	7,300
Oxalate	9,750	0.058
Na	212,000	125,000
H_2O (percent)	27.2	53

HDW = Hanford Defined Waste.

At this time, there is no way to accurately predict the salt cake analytical values through an engineering assessment, other than by comparing with the BYSltCk methodology developed by comparison of other TCRs on similar tanks. The majority of this tank's inventory is from BTSltCk salt cake and PFeCN sludge. The HDW model also used a slightly different waste volume and mixture. Best-basis evaluations dealing with different sludge waste types have shown that the solubilities of some analytes determined from flowsheet and sample data do not agree with the HDW model treatment of solubilities. The best-basis inventory analyses of tanks with 1C and 2C waste types discuss these disagreements in detail. Solubility assumptions affect salt cake predictions because flowsheet analytes not found in the sludge are placed by the HDW model in the salt cake and vice versa.

E4.0 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/disposal. 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.

As part of this effort, an evaluation of available chemical information for tank 241-BY-108 was performed, including the following:

- Data from 1995 core samples (Appendix A).
- An inventory estimate generated by the HDW model (Agnew et al. 1996).
- Data from two auger samples of the top 50.8 cm (20 in.) of waste taken in August 1994.
- Comparison with the BYSltCk methodology developed by evaluation of similar tanks in the BY Tank Farm.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-108 for which sampling information was available. The sample-based inventory was chosen as the best basis for those analytes for which sample-based analytical values were available for the following reasons:

- The sample-based inventory analytical concentrations compared favorably to those of five other BY Tank Farm tanks
- No methodology is available to fully predict BYSltCk or PFeCN from process flowsheet or historical records
- Waste transfer records are not complete and not always accurate
- The engineering assessment could confirm the sample-based data appear reasonable and could not substitute any additional information

- For those few analytes where no values were available from the sample-based inventory the HDW model values were used.

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, significant figures are retained. No such adjustments were necessary in this tank. This charge balance approach is consistent with that used by (Agnew et al. 1997).

The inventory values reported in Tables E4-1 and E4-2 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 HDW Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

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

The best-basis inventories for tank 241-BY-108 are presented in Tables E4-1 and E4-2.

Table E4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-108 (Effective January 31, 1997).

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	51,700	S	
Bi	<644	S	
Ca	4,380	S	
Cl	2,000	S	
TIC as CO_3	34,700	S	TIC = 6,940 kg
Cr	332	S	
F	8,590	S	
Fe	9,350	S	
Hg	1.73	M	
K	3,450	S	
La	<87.6	S	
Mn	272	S	
Na	212,000	S	
Ni	3,260	S	
NO_2	35,500	S	
NO_3	261,000	S	
OH_{TOTAL}	131,000	C	
Pb	571	S	
P as PO_4	33,800	S	
Si	1,990	S	
S as SO_4	29,800	S	
Sr	4,150	S	
TOC	5,820	S	
U_{TOTAL}	12,300	S	
Zr	<45.1	S	

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

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Table E4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-108 Decayed to January 1, 1994. (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	32.9	M	
^{14}C	8.35	M	
^{59}Ni	3.09	M	
^{60}Co	15.4	S	
^{63}Ni	287	M	
^{79}Se	0.733	M	
^{90}Sr	195,000	S	
^{90}Y	195,000	S	Referenced to ^{90}Sr
^{93}Zr	3.53	M	
^{93m}Nb	2.58	M	
^{99}Tc	46.9	M	
^{106}Ru	0.00151	M	
^{113m}Cd	18.0	M	
^{125}Sb	34.0	M	
^{126}Sn	1.10	M	
^{129}I	0.0907	M	
^{134}Cs	0.387	M	
^{137}Cs	351,000	S	
^{137m}Ba	332,000	S	Referenced to ^{137}Cs
^{151}Sm	2,550	M	
^{152}Eu	1.42	M	
^{154}Eu	69.6	S	
^{155}Eu	669	S	
^{226}Ra	4.71 E-05	M	
^{227}Ac	5.36 E-04	M	
^{228}Ra	0.405	M	
^{229}Th	0.00936	M	
^{231}Pa	0.00254	M	
^{232}Th	0.0150	M	
^{232}U	2.26	M	

Table E4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-108 Decayed to January 1, 1994. (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	8.66	M	
^{234}U	0.656	M	
^{235}U	0.0246	M	
^{236}U	0.0208	M	
^{237}Np	0.162	M	
^{238}Pu	8.7	S	
^{238}U	1.33	M	
^{239}Pu	59.7	S	
^{240}Pu	3.89	M	
^{241}Am	<244	S	
^{241}Pu	44.1	M	
^{242}Cm	0.00666	M	
^{242}Pu	2.12 E-04	M	
^{243}Am	3.71 E-04	M	
^{243}Cm	1.36 E-04	M	
^{244}Cm	1.28 E-04	M	

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

E5.0 APPENDIX E REFERENCES

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