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ENGINEERING CHANGE NOTICE

Page 1 of 2

ECN 649891

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [x] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	M. J. Kupfer, LMHC, H5-49, 376-6631	[] Yes [X] No	9/9/98
	6. Project Title/No./Work Order No. Tank 241-SX-103	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-662, Rev. 0	10. Related ECN No(s). NA	11. Related PO No. NA

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	NA	NA Design Authority/Cog. Engineer Signature & Date	NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change 13b. Design Baseline Document? [] Yes [X] No

This ECN compiles all reconciliation changes made to the Best-Basis Inventory in FY 1998 and should replace Appendix D, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-SX-103, of the Tank Characterization Report. The reconciliation process involved correction of errata, reassessment of data outlyers, verification of uranium isotopic distribution and other alpha isotope distribution, and removal of "less than" values, etc. Changes were made to both text and tables. The inventory estimates of several waste components were revised.

14a. Justification (mark one)

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

14b. Justification Details

Tank waste inventory estimates are being provided as standard source term for the various waste management activities. FY 1997 evaluation of available information for all 177 underground storage tanks was performed and published in TCRs, preliminary TCRs, or revisions to existing TCRs. In FY 1998, a reconciliation process is being performed to update the best-basis inventories. This process ensures that the latest inventory estimates are available as a consistent source-term to support the activities of TWRS disposal and other users.

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

Central Files	B1-07	K. M. Hodgson	R2-11
DIMC	R1-41 ~~H6-15~~	M. J. Kupfer	R3-75
DOE Reading Room	H2-53	M. D. LeClair (3)	R3-75
TCSRC	R1-10	J. M. Conner	R2-11
K. M. Hall	R2-12		

RELEASE STAMP

DATE SEP 28 1998 HANFORD RELEASE

STA: 4 ID: 58

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A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1)
649891

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

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

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

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

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

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. M. J. Kupfer	M J Kupfer	9-9-98	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	~~9-18-98~~ 15	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J. M. Conner R2-11	J M Conner	9-14-98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

5

Preliminary Tank Characterization Report for Single-Shell Tank 241-SX-103: Best-Basis Inventory

D. W. Hendrickson
COGEMA Engineering Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN:	649891	UC:	721
Org Code:	7A110	Charge Code:	N4G3A
B&R Code:	EW3120074	Total Pages:	25

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

Abstract: The best-basis inventory provides waste inventory estimates that serve as standard characterization source terms for the various waste management activities. To establish a best-basis inventory for single-shell tank 241-SX-103, an evaluation of available information was performed. This work follows the methodology established in *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A (Kupfer et al. 1997).

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Release Approval — 9/28/98 (Date) — Release Stamp

Approved for Public Release

RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-662	Page 1

(2) Title

Preliminary Tank Characterization Report for Single-Shell Tank 241-SX-103: Best-Basis Inventory

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 08/28/97 on EDT 622681	M.J. Kupfer	K.M. Hodgson
0A RS	Incorporate per ECN-649891	M.J. Kupfer	K.M. Hodgson
		M.J. Kupfer 9-9-98	K.M. Hodgson 9-15-98

A-7320-005 (08/91) WEF168

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-SX-103

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-SX-103

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-SX-103 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.

D1.0 CHEMICAL INFORMATION SOURCES

There is no previous sample data for single-shell tank 241-SX-103. Available waste (chemical) information for tank 241-SX-103 includes the following:

- Analytical data from other S and U Tank Farm tanks with similar Supernatant Mixing Model Sludge (SMMS1) salt cake and Reduction and Oxidation (REDOX) Plant (R1) high-level (HLW) sludge waste types

- The Hanford Defined Waste (HDW) model document (Agnew et al. 1997) provides tank content estimates.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The HDW model inventories (Agnew et al. 1997), are shown in Tables D2-1 and D2-2. No samples have been taken from tank 241-SX-103 that can be used to estimate a tank inventory for comparison with the HDW model estimate. The tank volume used to generate this inventory is 2,465 kL (652 kgal) waste which is partitioned into 424 kL (112 kgal) sludge and 2,044 kL (540 kgal) salt cake from the HDW model (Agnew et al. 1997), which differs from the 2,468 kL (652 kgal) waste that is partitioned into 435 kL (115 kgal) sludge, 2,029 kL (536 kgal) salt cake, and 3.78 kL (1 kgal) supernatant reported by (Hanlon 1996). It should be noted that the 3.78 kL (1 kgal) of supernatant reported by Hanlon was not included in these calculations. The amount that may be in the supernatant is a small amount and will cause only a small error in determining this comparison. (The chemical species are reported without charge designation per the best-basis inventory convention.)

Table D2-1. Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-SX-103.

Analyte	HDW[a] inventory estimate (kg)	Analyte	HDW[a] inventory estimate (kg)
Al	144,000	NO_3	865,000
Bi	739	OH	523,000
Ca	4,810	oxalate	15.3
Cl	22,300	Pb	521
Cr	33,500	P as PO_4	21,800
F	3,310	S as SO_4	59,400
Fe	3,990	Sr	0
Hg	4.67	TIC	67,600
K	6,650	TOC	31,700
La	18.4	U_{TOTAL}	6,870
Mn	495	Zr	60.3
Na	886,000	H_2O (wt%)	28.5
Ni	1,370	density (kg/L)	1.69
NO_2	292,000		

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

Table D2-2. Predicted Inventory Estimates for Radioactive Components in Tank 241-SX-103.

Analyte	HDW[a] inventory estimate (Ci)	Analyte	HDW[a] inventory estimate (Ci)
^{90}Sr	424,000	^{239}Pu	169
^{137}Cs	781,000	^{240}Pu	28.2

HDW = Hanford Defined Waste
[a] Agnew et al. (1997), Decayed to January 1, 1997.

Tank 241-SX-103 was filled with waste from the REDOX facility from the second quarter of 1954 until the first quarter of 1971. Of the REDOX (R1) HLW (1952 to 1957) received during this time, 70 percent came from tank 241-SX-102 in a cascade. From 1971 until 1974 the tank was inactive. In 1975 tank 241-SX-103 sent and received salt cake waste from the evaporator until 1976. As late as 1992 tank 241-SX-103 was sending waste to tanks 241-SY-102, 241-SX-106, and 241-AW-102. The tank was labeled inactive in 1978 and was removed from service in 1980. It was partially isolated in June 1985.

D3.2 CONTRIBUTING WASTE TYPES

The HDW model (Agnew et al. 1997) predicts that the tank contains a total of 2,464 kL (652 kgal) of waste which consists of R1 process high-level waste (38 kL [10 kgal] R1), RsltCk (386 kL [102 kgal]), and 2,044 kL (540 kgal) of salt cake (SMMS1) predicted from the supernatant mixing model.

The Sort on Radioactive Waste Type (SORWT) model (Hill et al. 1995) lists R1 (REDOX HLW process waste), and evaporator bottoms (EB) as the primary and secondary waste types, respectively. The SORWT definition for EB waste is the salt cake that is equivalent to the SMM waste type. Hill et al. also lists Plutonium-Uranium Extraction (PUREX) cladding waste (CW) and PUREX organic wash waste (OWW) as tertiary and other waste types respectively.

Hanlon (1996) indicates 2,468 kL (652 kgal) of waste which consists of 435 kL (115 kgal) of sludge, 2,029 kL (536 kgal) of salt cake, and 3.8 kL (1.0 kgal) of supernatant. No description of the source of the sludge and salt cake are given.

D3.3 INVENTORY EVALUATION

The following evaluation provides an engineering assessment of tank 241-SX-103 contents. For this evaluation, the following assumptions and observations are made:

- Tank volume listed in Hanlon (1996) is 2,468 kL (652 kgal). This volume differs from Agnew et al. (1997), the total waste volume differs by less than 1 percent. The Hanlon volumes for salt cake and sludge will be used.
- Only the SMMS1 and R1 process waste streams contributed to solids formation.

D3.4 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

Table D3-1 shows the engineering evaluation approaches used on tank 241-SX-103.

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Table D3-1 shows the engineering evaluation approaches used on tank 241-SX-103.

Table D3-1. Engineering Evaluation Approaches Used On Tank 241-SX-103.

Type of waste	How calculated	Check method
Supernatant	Assumed no supernatant	None, even though Hanlon (1996) indicates 3,785 L (1,000 gal) supernatant no method is available to calculate its contribution to the inventory.
Salt cake Volume = 2,029 kL (536 kgal) Density = 1.63 g/mL	Used sample-based concentrations from tanks with SMMS1 salt cake waste.	None, no sampling data available for this tank.
Sludge Volume = 435 kL (115 kgal) Density = 1.77 g/mL	Used the average analyte concentration from tank 241-S-102, 241-S-104, and 241-S-107. All have sample data and R1 waste. Only the segments that are believed to have R1 waste were used to calculate the concentration from each tank.	None, no sampling data available for this tank.

R1 = REDOX high-level waste generated between 1952 to 1957

SMMS1 = Supernatant Mixing Model 242-S Evaporator salt cake generated from 1973 until 1976

D3.4.1 Basis for Salt Cake Calculations Used in this Engineering Evaluation

For this evaluation the methodology developed for SMMS1 salt cake was used. This is based on comparing concentrations from S and U Tank Farm sample data shown in Table D3-2. Tanks 241-S-101 (Kruger et al. 1996), 241-S-102 (Egger et al. 1996), 241-U-106 (Brown et al. 1997), and 241-U-109 (Baldwin and Stephens 1996) were used to produce the average salt cake analyte concentrations for SMMS1 salt cake that were used in this comparison. To calculate the average SMMS1 concentration the waste volumes and predicted location from Agnew et al. (1997) for SMMS1 layers in each tank was determined. The TCR sample data were reviewed and, using segments that were located within the predicted location from Agnew et al. (1997), an average concentration was calculated. The concentrations from each tank and the segments used in the calculation are shown in Table D3-2. For comparison the SMM salt cake composition predicted by the HDW model for tank 241-SX-103 is also shown.

Table D3-2. SMMS1 Salt Cake Concentrations of Components in Tank 241-SX-103. (2 Sheets)

Analyte	241-S-101 segments 2L-4U[a] (μg/g)	241-S-102 segments 7L-10U[b] (μg/g)	241-U-106 segments 2U-4L[c] (μg/g)	241-U-109 segments 5U-8L[d] (μg/g)	Average concentration[e] (μg/g)	HDW model SMM concentration for tank 241-SX-103[f] (μg/g)
Al	18,000	15,085	13,620	13,625	15,100	29,400
Ag	12	17	16	NR	15	NR
B	110	75	80	NR	88	NR
Bi	71	76	<DL	<DL	73.5	214
Ca	273	237	336	<DL	282	953
Cl	4,500	4,099	2,926	NR	3,842	5,920
Cr	10,000	4,359	3,170	4,233	5,440	4,910
F	500	13,596	4,669	NR	6,255	958
Fe	508	1,298	3,096	<DL	1,630	427
K	1,109	898	1,309	NR	1,110	1,780
La	<DL	37	43	NR	40	5.34
Mn	266	597	1,189	<DL	684	143
Na	150,000	189,500	170,500	218,300	182,000	220,000
Ni	114	49	304	<DL	155	265
NO_2	91,000	40,100	56,000	42,900	57,500	74,300
NO_3	110,000	99,200	147,200	297,000	163,000	211,000
Pb	91	137	348	NR	192	147
PO_4	9,500	114,500	5,888	5,970	34,000	6,330
P	2,290	33,900	1,949	<DL	12,700	NR
S	5,940	2,683	3,878	NR	4,170	NR
Si	5,269	517	176	<DL	1,990	1,520
SO_4	20,700	12,500	10,774	11,100	13,800	16,800
Sr	7	<DL	<DL	NR	7	0
TOC	1,900	5,340	24,626	3,920	8,950	9,170
U	560	1,403	781	<DL	914	1,620
Zn	30	32	54	<DL	39	NR
Zr	14	39	88	NR	47	17.5
Oxalate	15,400	15,700	9,880	NR	13,700	4.43
Density g/mL	1.58	1.69	1.57	1.67	1.63	1.69

Table D3-2. SMMS1 Salt Cake Concentrations of Components in Tank 241-SX-103. (2 Sheets)

Analyte	241-S-101 segments 2L-4U[a] (μg/g)	241-S-102 segments 7L-10U[b] (μg/g)	241-U-106 segments 2U-4L[c] (μg/g)	241-U-109 segments 5U-8L[d] (μg/g)	Average concentration[e] (μg/g)	HDW model SMM concentration for tank 241-SX-103[f] (μg/g)
Radionuclides[g] (μCi/g)						
^{90}Sr	252	23	77	9	90	83.3
^{137}Cs	175	121	175	142	153	190

<DL = Less than the detectable limit
HDW = Hanford Defined Waste
NR = Not reported
SMMS1 = Supernatant Mixing Model 242-S Evaporator salt cake generated from 1973 until 1976
[a] Kruger et al. (1996)
[b] Eggers et al. (1996)
[c] Brown et al. (1997)
[d] Baldwin and Stephens (1996)
[e] Average of tank 241-S-101, 241-S-102, 241-U-106, and 241-U-109 concentrations
[f] Agnew et al. (1997), Radionuclides decayed to January 1, 1994
[g] Radionuclides are reported as of the date of sample analysis.

D3.4.2 Basis for Sludge Calculations used In This Engineering Evaluation

Data from tanks 241-S-102 (Kruger et al. 1996), 241-S-104 (DiCenso et al. 1994), and 241-S-107 (Simpson et al. 1996) were used to produce average analyte concentrations for R1 sludge waste. To calculate the average concentration, the volumes and predicted location of the sludge were taken from Agnew et al. (1997) for the tanks R1 waste. The TCR sample data were then reviewed, and only the segments that were located within the predicted sludge location from Agnew et al. (1997) were used in deriving an average concentration. The average concentration from each tank and the segments used in the calculation is shown below in Table D3-3. For comparison the average sludge layer composition predicted by the HDW model for tank 241-SX-103 is also shown.

Table D3-3. R1 Sludge Concentration Estimate of Components in Tank 241-SX-103. (2 Sheets)

Analyte	241-S-101 segments 7U-8L[a] (μg/g)	241-S-104 (total sludge concentration)[b] (μg/g)	241-S-107 segments[c] (μg/g)	Average Concentration[d] (μg/g)	HDW Model Sludge Values for 241-SX-103[e] (μg/g)
Al	127,000	117,000	56,400	100,000	58,400
Bi	<38.8	<45.7	NR	<42.2	0.762
Ca	322	247	234	268	2,090
Cl	2,050	3,200	1,860	2,370	2,600
Cr	2,230	2,350	1,180	1,920	22,800
F	<65.7	145	150	<120	3.57
Fe	1,960	1,720	1,160	1,613	3,460
Hg	NR	<0.126	NR	<0.126	0.115
K	539	300	457	432	687
La	<19.5	<2.07	NR	<10.8	1.25 E-06
Mn	2,750	1,150	83	1,330	1.46
Na	112,000	121,000	60,400	97,800	174,000
Ni	90.7	56	206	118	625
NO_2	31,100	25,900	34,300	30,433	49,200
NO_3	119,000	191,000	57,600	122,500	190,000
Pb	37	29.6	33	33.2	18.8
PO_4	1,360	<2,190	1,630	<1,730	22.4
Si	1,360	1,330	1,060	1,250	1,950
SO_4	897	2,270	1,300	1,489	2,110
Sr	456	424	378	420	0
TIC as CO_3	NR	4,140	NR	4,140	3,290
TOC	NR	1,730	NR	1,730	47.7
U	7,684	6,690	8,685	7,690	1,760
Zr	36	33.6	131	66.9	0.0332

Table D3-3. R1 Sludge Concentration Estimate of Components in Tank 241-SX-103. (2 Sheets)

Analyte	241-S-101 segments 7U-8L[a] (μg/g)	241-S-104 (total sludge concentration)[b] (μg/g)	241-S-107 segments [c] (μg/g)	Average Concentration[d] (μg/g)	HDW Model Sludge Values for 241-SX-103[e] (μg/g)
Radionuclides[f] (μCi/g)					
^{90}Sr	NR	301	276	288	188
^{137}Cs	98	60.5	74	77.6	175
density (g/mL)	1.77	1.64	1.90	1.77	1.72

NR = Not Reported.
HDW = Hanford Defined Waste.
[a] Kruger et al. (1996)
[b] DiCenso et al. (1994)
[c] Statistically determined median R1 sludge concentrations for tank 241-S-107 contained in the attachment to Simpson et al. (1996)
[d] Average of analyte concentrations for tank 241-S-101, 241-S-104, and 241-S-107
[e] Agnew et al. (1997)
[f] Radionuclides decayed to January 1, 1994.

D3.5 ESTIMATED COMPONENT INVENTORIES

The chemical inventory of tank 241-SX-103 is estimated from the assumed salt cake and sludge volumes (Table D3-1). The resulting inventories are provided in Table D3-4. The inventories estimated by the HDW model are included for comparison.

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-SX-103. (2 Sheets)

Component	This evaluation (kg) sludge	This evaluation (kg) salt cake	This evaluation total inventory (kg)	HDW estimated (kg)
Bi	<32.5	243	259	739
K	333	3,670	4,000	6,650
La	<8.32	132	132	18.4
NO_3	94,400	539,000	633,000	865,000
Mn	1,020	2,260	3,280	495

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-SX-103. (2 Sheets)

Component	This evaluation (kg) sludge	This evaluation (kg) salt cake	This evaluation total inventory (kg)	HDW estimated (kg)
SO_4	1,150	45,600	46,800	59,480
Ca	206	933	1,140	4,810
Ni	91	513	604	1,370
Cr	1,480	18,000	19,500	33,500
PO_4	<1,330	112,000	113,000	21,800
F	<92.5	15,800	15,900	3,310
Al	77,000	49,900	127,000	144,000
Fe	1,240	5,400	6,640	3,990
TOC	1,330	29,600	30,900	31,700
Oxalate	NR	45,300	45,300	15.3
Na	75,300	602,000	677,000	886,000
H_2O (percent)	NR	30.6	30.6	28.5

HDW = Hanford Defined Waste (Agnew et al. 1997)
NR = Not reported.

Since no post-1989 analytical data were available from this tank, the reliability of these estimates (in either this engineering assessment or the HDW model inventory estimates) are suspect. Although these uncertainties cannot be resolved at this point, some trends can be discussed.

Manganese. Potassium permanganate was used in the REDOX process until 1959, thus manganese is expected to be found in tanks containing waste from that process. It is most likely present as highly insoluble manganese dioxide in the alkaline waste materials and would be expected to be in the sludge. The R1 Sludge composition estimate developed in this engineering assessment for manganese was 1,330 μg/g. Interestingly, the SMMS1 salt cake composition estimate for manganese was 684 μg/g--much higher than would be expected based on solubility considerations. It should be noted that there are large ranges in both the SMMS1 and R1 data sets for manganese.

The HDW model predicts essentially zero manganese in the sludge (1.06 kg) in tank 241-SX-103 and 148 μg/g in the salt cake layer. The HDW model inventory estimate for manganese is 495 kg. Based on the discussion above, the 3,280 kg inventory estimate developed in this engineering assessment is likely to be closer to the true value.

Phosphate. There is a large difference between the engineering assessment tank inventory estimate (113,000 kg) and the HDW model estimate (21,800 kg). The engineering assessment value is biased high because of one extremely high phosphate value in the data set used to develop the SMMS1 salt cake composition estimate (see Table D3-2). If the phosphate data from tank 241-S-102 are eliminated from the SMMS1 composition estimate then the engineering assessment and the HDW estimate would be in reasonable agreement. However, since the HDW model failed to predict the high phosphate value for 241-S-102, it should not be taken as a reliable indicator for phosphate in tank 241-SX-103.

Fluoride. The fluoride ion inventory estimate is 4.8 times the engineering assessment (15,900) than in the HDW model (3,310). Without analytical data from tank 241-SX-103, it is difficult to defend the choice of one value over the other.

Iron. The iron inventory estimate in the engineering assessment is about five thirds the HDW model inventory. The iron value determined in the engineering assessment for the salt cake is approximately 4 times the HDW salt cake model value. As shown in Table D3-2, the data set used to estimate iron in the SMMS1 salt cake varies from 3,096 μg/g to less than detection limit. Without analytical data from tank 241-SX-103 it is difficult to defend the choice of one value over the other.

Nickel. The nickel inventory from the engineering assessment is approximately half the HDW model inventory. The HDW model predicts more nickel in the sludge than the engineering assessment (455 kg to 91 kg respectively). The salt cake engineering assessment value and the SMM modeling from the HDW estimate are in closer agreement with each other, 884 kg and 914 kg for the HDW model and engineering assessment respectively.

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

D4.0 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.

As part of this effort, an evaluation of available chemical information for tank 241-SX-103 was performed, including the following:

- The inventory estimate generated by the HDW model (Agnew et al. 1997)
- An engineering evaluation which produced a predicted SMMS1 salt cake inventory and R1 sludge inventory based on methodology developed by evaluation of similar tanks in the S and U Tank Farms.

Based on this evaluation, a best-basis inventory was developed for tank 241-SX-103 since sampling information is not available. The engineering evaluation inventory was chosen as the best basis for those analytes for which sample-based analytical values were available, from similar S and U Tank Farm tanks for the following reasons:

- The sample-based inventory analytical concentrations of the other S and U Tank Farm tanks containing SMMS1 compared favorably with each other for SMMS1 salt cake.
- No methodology is available to fully predict SMMS1 salt cake from process flowsheet or historical records.
- No methodology is available to fully predict R1 waste from process flowsheet or historical records for this tank. REDOX process first-cycle R1 waste changed composition during the process and accurate records of these changes are not available at this time. Also R1 waste was cascaded and transferred into and out of many S, SX, and U Tank Farm tanks between 1972 and 1978, which makes it hard to predict precipitation factors for analytes in the waste. Some tanks will show higher concentrations for certain analytes because of the length of time the waste was in the tank before being transferred out.

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

The best-basis inventory estimate for tank 241-SX-103 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) (LMHC 1998) for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, 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. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-SX-103 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	127,000	E	
Bi	259	E	
Ca	14,530	E	
Cl	14,300	E	
TIC as CO_3	67,600	M	
Cr	19,500	E	
F	15,900	E	
Fe	6,640	E	
Hg	0	E	Simpson (1998)
K	4,000	E	
La	132	E	
Mn	3,280	E	
Na	677,000	E	
Ni	604	E	
NO_2	214,000	E	
NO_3	633,000	E	
OH	376,000	C	
Pb	660	E	
P as PO_4	113,000	E	
Si	7,540	E	
S as SO_4	46,800	E	
Sr	347	E	
TOC	30,900	E	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-SX-103 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
U_{TOTAL}	8,950	E	
Zr	207	E	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997)
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 D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SX-103 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	672	M	
^{14}C	90.6	M	
^{59}Ni	8.76	M	
^{60}Co	101	M	
^{63}Ni	854	M	
^{79}Se	11.2	M	
^{90}Sr	519,400	E	
^{90}Y	519,400	E	Referenced to ^{90}Sr
^{93}Zr	54.7	M	
^{93m}Nb	40.8	M	
^{99}Tc	648	M	
^{106}Ru	0.0185	M	
^{113m}Cd	240	M	
^{125}Sb	432	M	
^{126}Sn	17.1	M	
^{129}I	1.25	M	
^{134}Cs	7.85	M	
^{137}Cs	566,000	E	
^{137m}Ba	535,000	E	Referenced to ^{137}Cs
^{151}Sm	39,700	M	
^{152}Eu	14	M	
^{154}Eu	1,670	M	
^{155}Eu	797	M	
^{226}Ra	5.86 E-04	M	
^{227}Ac	0.00355	M	
^{228}Ra	0.395	M	
^{229}Th	0.00926	M	
^{231}Pa	0.0146	M	
^{232}Th	0.0259	M	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-SX-103 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}U	2.62	E/M	Based on U_{TOTAL} and HDW model isotopic distribution
^{233}U	10.0	E/M	Based on U_{TOTAL} and HDW model isotopic distribution
^{234}U	3.33	E/M	Based on U_{TOTAL} and HDW model isotopic distribution
^{235}U	0.135	E/M	Based on U_{TOTAL} and HDW model isotopic distribution
^{236}U	0.111	E/M	Based on U_{TOTAL} and HDW model isotopic distribution
^{237}Np	2.37	M	
^{238}Pu	4.76	M	
^{238}U	2.99	E/M	Based on U_{TOTAL} and HDW model isotopic distribution
^{239}Pu	169	M	
^{240}Pu	28.2	M	
^{241}Am	192	M	
^{241}Pu	306	M	
^{242}Cm	0.4	M	
^{242}Pu	0.00166	M	
^{243}Am	0.00669	M	
^{243}Cm	0.0367	M	
^{244}Cm	0.356	M	

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

D5.0 APPENDIX D REFERENCES

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