0050242 S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 640684

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	9/11/98
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-BX-101	NA	NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	WHC-SD-WM-ER-408, Rev. 0C	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

This ECN compiles all reconciliation changes made to the Best-Basis Inventory in FY 1998 and should replace Appendix C, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-BX-101, 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. H. Rasmussen	R2-12
K. M. Hall	R2-12		

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DATE: SEP 30 1998 HANFORD RELEASE

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A-7900-013-2 (05/96) GEF095

FEB 1999 RECEIVED EDMC

A-7900-013-1

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1. ECN (use no. from pg. 1): 640684

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	9-14-98	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	9-21-98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J. H. Rasmussen R2-12	J Rasmussen	9/18/98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-BX-101

S. L. Lambert
COGEMA Engineering Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 640684 UC: 721
Org Code: 7A110 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 92

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-BX-101, 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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SEP 30 1998
DATE:
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STA: 30
ID: 25

9/30/98
Release Approval Date

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-408	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-BX-101

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 07/20/95 on EDT-611428.	N.J. Milliken	J.G. Kristofzski
0-A RS	Incorporate per ECN-623841.	L.M. Sasaki L.M. Sasaki	J.G. Kristofzski 8/31/96
0-B RS	Incorporate per ECN-625691.	S.E. Kelly S.E. Kelly	J.G. Kristofzski JK 9/18/96
0C RS	Incorporate per ECN-640357	M.J. Kupfer M.J. Kupfer 8-18-97	K.M. Hodgson K.M. Hodgson 8-18-97
0D RS	Incorporate per ECN-640684	M.J. Kupfer M.J. Kupfer 9-14-98	K.M. Hodgson K.M. Hodgson 9-21-98

A-7320-003 (08/91) WEF168

APPENDIX C

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BX-101

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APPENDIX C

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BX-101

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

C1.0 CHEMICAL INFORMATION SOURCES

Available waste (chemical) information for tank 241-BX-101 includes:

- Data from two auger mode samples taken in 1994 for safety screening which consists of only limited analytical results. The data consists only of total alpha, differential scanning calorimetry (DSC) and percent water (see Section 4.0).
- Data from Tank Characterization Reports (TCRs) from other tanks in the BX Tank Farm, Tank 241-BX-104 (Hu and Stephens 1996), tank 241-BX-105 (Hall and Tran 1995) and tank 241-BX-106 (Sasaki et al. 1996)
- An inventory estimate for this tank (Agnew et al. 1997b).

C2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The 1995 Safety Screening Sampling produced no best-basis analyte analytical results. The HDW model inventories are listed in Tables C2-1 and C2-2. Table C2-1 lists nonradioactive components on a kilogram (kg) basis and Table C2-2 lists the radioactive components on a curie (Ci) basis. The HDW model estimates the total waste volume to be 162.8 kL (43 kgal) with a density of 1.66 g/mL. (The chemical species, in this appendix, are reported without charge designation per the best-basis inventory convention.)

Table C2-1. Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-BX-101.

Analyte[a]	HDW[b] inventory estimate (kg)	Analyte	HDW[b] inventory estimate (kg)
Al	4,180	NO_3	996
Bi	0.688	OH	36,700
Ca	772	oxalate	8.66E-04
Cl	94.9	Pb	0.942
Cr	18.3	PO_4	4,230
F	3.89	Si	3,300
Fe	6,790	SO_4	1,160
Hg	0.0057	Sr	0
K	24.4	TIC as CO_3	13,600
La	0.00104	TOC	225
Mn	0.654	U_{TOTAL}	45,800
Na	21,300	Zr	0.0114
NH_3	78	H_2O (wt%)	46.6
Ni	3,490	Density g/mL	1.66
NO_2	1,650		

HDW = Hanford Defined Waste
[a] No sample-based data
[b] Agnew et al. (1997b).

Table C2-2. Hanford Defined Waste Predicted Inventory Estimates for Radioactive Components in Tank 241-BX-101.

Analyte[a]	HDW[b] inventory estimate (Ci)	Analyte	HDW[b] inventory estimate (Ci)
^{90}Sr	366,000	^{239}Pu	218
^{137}Cs	595		

HDW = Hanford Defined Waste
[a] No sample-based data
[b] Agnew et al. (1997b), decayed to January 1, 1994.

C3.0 COMPONENT INVENTORY EVALUATION

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

See Section 2.3 of this TCR for a detailed waste transfer history of tank 241-BX-101.

A brief summary of the waste transfer history follows, based on Section 2.3:

- Received metal waste (MW), 1948 through 1951
- MW waste was sluiced from the tank and the tank was declared empty in June 1954
- Received secondary tri-butyl phosphate (TBP or UR) supernatant waste in 1956 and secondary plutonium-uranium extraction (PUREX) coating waste in 1962
- Received cesium recovery waste (CSR) from 1970 through 1972
- Received evaporator bottoms (EB), 1967 through 1968
- Received and transferred miscellaneous waste such as B Plant Low-Level (BL), ion exchange (IX), organic solvent wash waste (OWW), CWP, Thoria high-level waste (HLW) or cladding waste (TH), Thoria low-level waste (THL) from 1969 through 1976.

In the fourth quarter of 1977, a salt well was installed in the tank. The tank was deactivated in 1978.

C3.1 CONTRIBUTING WASTE TYPES

The following are reported waste types in tank 241-BX-101

Agnew et al. (1997a and 1997b): MW, BL
Hill et al. (1995): TBP (UR), CWP, BL, IX

Abbreviations:

CWP	=	PUREX cladding waste (aluminum clad fuel)
MW	=	Metal waste
TBP (UR)	=	Tri-Butyl Phosphate (Uranium Recovery)
CSR	=	Cesium recovery waste
BL	=	B Plant low-level waste
IX	=	ion exchange waste
R	=	Redox waste
DE	=	Diatomaceous Earth

The tank volume used to generate the HDW inventory is 162.8 kL (43 kgal) total waste (Agnew et al. 1997b). Hanlon (1997) reports a sludge layer of 159 kL (42 kgal), no salt cake, and 3.8 kL (1 kgal) of supernatant. Agnew et al. reports 109.8 kL (29 kgal) of MW, 49.2 kL (13 kgal) of BL, and 3.8 kL (1 kgal) supernatant. The HDW density used in the model to calculate the inventory was 1.66 g/mL.

Rodenhizer (1987) indicates that MW was sluiced from tank 241-BX-101 from January to June 1954. Tank 241-BX-101 was declared empty by the end of the June 1954. Little or no MW remained in tank 241-BX-101. Several wastes were transferred to the tank after that time. The wastes that appear most likely to be the main sources of solids in tank 241-BX-101 are CSR, TBP and CWP. Other sources may have contributed to the waste in this tank such as BL and IX but production and transfer records are not adequate to predict exactly which waste types and amounts were contributors. Ion exchange waste (IX) includes waste not only from cesium recovery operations (CSR), but also wastes from strontium recovery.

Production records reviewed by Anderson (1990), Agnew et al. (1997a), and Hill et al. (1995) show a lot of similarity between tanks 241-BX-101 and 241-BX-104 as to the waste histories associated with the tanks. Tanks 241-BX-101 and 241-BX-104 received mostly B Plant MW, CSR waste and secondary TBP waste and PUREX coating waste. Tanks 241-BX-101 through 241-BX-103 formed a first cascade in the BX Tank Farms and tanks 241-BX-104 through 241-BX-106 formed a second cascade. Several transfers occurred both ways between tanks of the two cascades. The assignment as to what was left in these tanks is very different between Agnew at al. and Hill et al.

Agnew et al. (1997a) lists MW as the major waste in tanks 241-BX-101 and 241-BX-104. Rodenhizer (1987) lists these tanks to have been emptied of MW. Tanks 241-BX-104 and 241-BX-105 have been sampled and, based on these results, the Agnew et al. assumption of large quantities of MW is judged incorrect. Hill et al. (1995), Agnew et al. (1997a), and Anderson (1990) all show large quantities of CSR and secondary TBP and CWP wastes entering each of these tanks. Lesser quantities of other waste such as BL, IX, EB, R, and OWW entered some of the tanks in both cascades. Hill et al. (1995) lists the primary waste in each of these tanks as being TBP and CWP (excluding the predominate DE in tank 241-BX-102).

C3.2 ASSUMPTIONS

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

- Tank waste mass is calculated using the measured density estimated in the comparison TCR (1.73 g/mL). This density is slightly higher than the HDW model density (1.66 g/mL). The total tank volume used is listed in Hanlon (1997) as 162.8 kL (43 kgal) and is the same volume as reported by Agnew et al. (1997b)

- The average sludge concentrations for tank 241-BX-104 and supernate concentrations for tanks 241-BX-104, 241-BX-105 and 241-BX-106 can be used to estimate the average analyte concentrations in tank 241-BX-101. These values are assumed to be the closest indicators of the unknown analytical data for tank 241-BX-101.

- 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.

C3.3 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

Table C3-1. Engineering Evaluation Approaches Used On 241-BX-101. (2 Sheets)

Type of waste	How calculated	Check method
Supernatant Volume = 3.785 kL (1 kgal) Density not needed in calculations (concentration in terms of conc./mL)	BX Tank Farm Engineering Assessment - Used the average concentrations for the supernatants from tanks 241-BX-104, 241-BX-105 and 241-BX-106. This is done to demonstrate that this amount of supernatant is not of significance in the total inventory.	Not applicable.
Salt cake None expected	Not applicable	Not applicable
Sludge Total solids volume = 159 kL (42 kgal) Density = 1.73 g/mL	BX Tank Farm Engineering Assessment - Used the concentrations for the solids in tank 241-BX-104.	Not applicable.

Since tanks 241-BX-101 through 241-BX-103 have not been sampled, chemical inventory information is not available for this cascade. However Anderson (1990) and Hill et al. (1995) indicate tanks 241-BX-101 and 241-BX-104 share a common waste history with similar waste types (CSR and secondary TBP and CWP wastes). Secondary TBP and CWP wastes are wastes associated with the supernate from the primary receiver tanks.

Table C3-2 briefly summarizes the waste transaction histories for tanks 241-BX-101 and 241-BX-104.

Table C3-2. Comparison of Wastes Received By Tanks 241-BX-101 and 241-BX-104.

Waste Type	Tank 241-BX-101 (kL)	Tank 241-BX-104 (kL)
MW[a]	14,300	10,760
Secondary TBP	1,690	
CWP		45
Secondary CWP/OWW/IWW	17,800	3,550
CSR	50,681	32,960
BL	1,810	
Purex/Redox Supernate		19,500
Evaporator Bottoms (from BY-112)	950	
Secondary BL	9,795	

[a] Metal wastes (MW) were removed by sluicing in 1956 and 1957.

The sludge layers in tanks 241-BX-101 and 241-BX-104 may have formed in part from the radiolytic decomposition of the organic complexants in the CSR waste. Degraded organics from such decomposition would have been subsequently transferred to other tanks. A substantial amount of aluminum and other components also are thought to have precipitated from this waste due to the atmospheric absorption of CO_2. Based on this assessment, the sample-based estimates from tanks 241-BX-104, 241-BX-105 and 241-BX-106 will be used to derive the best-basis estimates for tank 241-BX-101. While a small amount of secondary TBP waste was added to this tank, the projected amount of TBP sludge should be less than 0.27 kL based on the relative amount of secondary TBP waste added to tank 241-TY-106. It thus appears that less than 0.17 percent of the sludge in this tank was derived from the TBP waste. The possible contribution from secondary CWP waste is more difficult to judge since the solubility of the most important species, sodium aluminate, is controlled by the pH of the supernate. The phosphate and TOC in this sludge may be due to the decomposition of the organic complexants added to the CSR waste (mostly the CSR derived from current acid waste). Another possible source would be monobutyl and dibutyl phosphates in the OWW. One should also note the high uranium inventory in this waste which is likely derived from the residual metal waste heel. Based on the comparative concentration profiles (38,400 micrograms per gram for BX-104 sludge compared to 250,000 micrograms per gram for MW), the inventory of residual metal waste appears to be about 24 kL, or less than 15 percent of the

total sludge volume. This MW inventory is equivalent to a MW layer 5.8 cm (2.3 in.) thick, which is not inconsistent with claim that this tank was declared empty of metal waste in June 1954.

This engineering assessment used the analytical solids concentration from tank 241-BX-104 to estimate the solids inventory in tank 241-BX-101. Table C3-3 shows the analytical concentrations for each analyte in the reference tank. Also shown is the HDW model estimate for tank 241-BX-101 and the total inventory reported in kg for each analyte in tank 241-BX-101. The HDW concentration values are shown for comparison. A solids volume of 159 kL (42 kgal) and average density of 1.73 g/mL were used to calculate the inventory reported in kg.

Table C3-3. BX Farm Engineering Assessment Tank 241-BX-101 Solids Inventory. (2 Sheets)

Analyte	241-BX-104[a] (μg/g)	HDW 241-BX-101[c] (μg/g)	241-BX-101 Total (kg)
Al	115,000	15,300	31,600
Bi	551	0	150
Ca	1,900	2,920	520
Cl	1,040	294	285
Cr	6,330	29.5	1,740
F	<882	0	<240
Fe	6,400	25,700	1,760
K	1,060[b]	70.5	290
La	<138	0	<38
Mn	1,540	0	423
Na	72,700	78,300	20,000
Ni	155[b]	13,200	43
NO_2	24,200	5,160	6,660
NO_3	47,800	1,900	13,150
Pb	946	0	260
PO_4	8,490	15,900	2,335
P	2,340	NR	643
Si	1,880	12,500	520
SO_4	1,750	4,130	480
Sr	51.1	0	14

Table C3-3. BX Farm Engineering Assessment Tank 241-BX-101 Solids Inventory. (2 Sheets)

Analyte	241-BX-104[a] (μg/g)	HDW 241-BX-101[c] (μg/g)	241-BX-101 Total (kg)
TIC as CO_3	24,200	51,200	6,660
TOC	5,210	733	1,430
U	38,400	173,000	10,560
Zr	1,260[b]	0	346
Physical Properties			
Density (g/mL)	1.73	1.66	1.73
wt% H_2O	29.5	46.6	29.5
Radionuclides[d]	μCi/g	μCi/g	kCi
^{14}C	4.91E-04[b]	1.61 E-03	0.135
^{60}Co	0.0261[b]	9.09 E-04	7.18
^{90}Sr	220[b]	1380	60,500
^{99}Tc	0.0329[b]	4.89 E-03	9.05
^{129}I	4.35E-05[b]	9.41 E-06	0.012
^{137}Cs	76.7	0.935	21,100
$^{239/240}Pu$	0.366[b]	1.00	100
^{241}Am	0.629[b]	0.745	173

NR = Not reported (NRs and < (less than) not included in the average unless < is the only value)

[a] Hu and Stephens (1996), 1996 sample, except as noted

[b] 1986 core sample from tank 241-BX-104, Hu and Stephens (1996)

[c] Agnew et al. (1997b), radionuclides decayed to January 1, 1994

[d] Sample radionuclide concentrations and inventories reported as January 1, 1994.

Average supernatant concentrations from tanks 241-BX-104, 241-BX-105, and 241-BX-106 were used to estimate the supernatant inventory in tank 241-BX-101. Table C3-4 provides the average analytical concentrations for each analyte, HDW model estimates for tank 241-BX-101 and the supernatant inventory reported in kg. The HDW values are shown only for comparison. Table C3-5 provides the total analyte inventory for the engineering assessment. The supernatant volume assumed in these calculations is 3.785 kL (1 kgal).

Table C3-4. BX Tank Farm Engineering Assessment Tank 241-BX-101 Supernatant Inventory. (2 Sheets)

Analyte	241-BX-104[a] (μg/mL)	241-BX-105[b] (μg/mL)	241-BX-106[c] (μg/mL)	Average[d] (μg/mL)	HDW 241-BX-101[e] (μg/mL)	241-BX-101 (kg)
Al	2,840	5,930	6,720	5,163	24,100	20
Bi	6.90	<12.1	NR	7.0	135	0.0265
Ca	19.1	144	NR	82	201	0.31
Cl	2,800	NR	3,410	3,105	3,360	12
Cr	2,970	249	NR	1,610	2,060	6.1
F	300	NR	336	318	763	1.2
Fe	2.05	4.37	<20	<8.81	62.4	<0.0333
Pb	<16.3	51.4	NR	<33.9	185	<0.128
Mn	<1.63	<22.0	NR	<11.8	129	<0.0447
Ni	8.9	93.6	NR	51.3	59	0.19
NO_3	135,000	117,000	111,000	121,000	97,000	458
NO_2	63,800	NR	64,400	64,100	55,500	243
PO_4	4,780	5,210	NR	4,995	4,700	19
P	1,780	1,700	NR	1,740	NR	6.6
K	2,010	2,600	NR	2,305	1,120	8.7
Si	82.4	139	NR	111	533	0.42
Na	140,000	124,000	157,000	140,000	123,000	531
Sr	<0.488	1.8	NR	<1.14	0	0.0043
SO_4	3,930	NR	NR	3,930	13,400	15
TIC as CO_3	44,750	NR	61,500	53,100	12,400	201
TOC	3,190	9,440	2,360	5,000	5,250	19
U	<65.0	4.51	NR	<34.7	532	0.131
Zr	<1.63	<5.06	NR	<3.35	2.24	<0.0127

Table C3-4. BX Tank Farm Engineering Assessment Tank 241-BX-101 Supernatant Inventory. (2 Sheets)

Analyte	241-BX-104[a] (μg/mL)	241-BX-105[b] (μg/mL)	241-BX-106[c] (μg/mL)	Average[d] (μg/mL)	HDW 241-BX-101[e] (μg/mL)	241-BX-101 (kg)
Physical Properties						
Density (g/mL)	1.29	1.29	1.27	1.283	1.34	1.283
wt% H_2O	59.1	68.5	61.3	63	57.6	63
Radio-nuclides[e,f]	μCi/L	μCi/L	μCi/L	μCi/L	μCi/L	Ci
^{90}Sr	1950[g]	9,360	285	3,870	19	14.6
^{137}Cs	119,000[g]	147,000	170,800	146,000	68.4	552
$^{239/240}Pu$	18.4[g]	17.2	NR	17.8	0.00744	0.0674

HDW = Hanford Defined Waste
NR = Not Reported
[a] Hu and Stephens (1996), 1996 sample, except as noted
[b] Hall and Tran (1995)
[c] Sasaki et al. (1996)
[d] The average of tanks 241-BX-104, 241-BX-105, and 241-BX-106 only includes reported values, NR not included. Less than values are included if no reported values are available
[e] Agnew et al. (1997b), radionuclides decayed to January 1, 1994
[f] Sample radionuclide concentrations and inventories are reported as of January 1, 1994.
[g] Hu & Stevens (1996), 1986 sample

The BX Tank Farm Engineering Assessment Total Inventory including both solids and supernatant is shown in Table C3-5.

Table C3-5. BX Tank Farm Engineering Assessment Tank 241-BX-101 Engineering Assessment Total Inventory Calculations. (2 Sheets)

Analyte	241-BX-101 Supernatant (kg)	241-BX-101 Solids (kg)	241-BX-101 Tank Total (kg)
Al	20	31,600	31,620
Bi	0.0265	150	150
Ca	0.31	520	520
Cl	12	285	297
Cr	6.1	1,740	1,740
F	1.2	<240	<240
Fe	<0.0333	1,760	1,760
Pb	<0.128	260	260
Mn	<0.0447	423	423
Ni	0.19	43	43
NO_3	458	13,150	13,610
NO_2	243	6,660	6,900
PO_4	19	2,335	2,335
P	6.6	643	650
K	8.7	290	300
Si	0.42	520	520
Na	531	20,000	20,500
Sr	<0.0043	14	14
SO_4	15	480	495
TIC as CO_3	201	6,660	6,860
TOC	19	1,430	1,450
U	<0.131	10,560	10,560

Table C3-5. BX Tank Farm Engineering Assessment Tank 241-BX-101 Engineering Assessment Total Inventory Calculations. (2 Sheets)

Analyte	241-BX-101 Supernatant (kg)	241-BX-101 Solids (kg)	241-BX-101 Tank Total (kg)
Zr	<0.0127	346	346
Radionuclides[a] (Ci)			
^{90}Sr	14.6	60,500	60,500
^{137}Cs	552	21,100	21,700
$^{239/240}Pu$	0.0674	100	100

[a] Sample radionuclide inventories reported as of January 1, 1994.

C3.3.3 Inventory Comparisons

Table C3-6 provides a comparison of the engineering assessment and HDW model results for this tank.

Table C3-6. Comparison of Selected Component Inventory Estimates for Tank 241-BX-101 Waste. (2 Sheets)

Component	BX Tank Farm Engineering Assessment (kg)	HDW[a] estimated (kg)
Al	31,620	4,180
Bi	150	0.688
Ca	520	772
Cl	297	94.9
Cr	1,740	18.3
F	<240	3.89
Fe	1,760	6,790
K	300	24.4
Mn	423	0.654
Na	20,500	21,300

Table C3-6. Comparison of Selected Component Inventory Estimates for Tank 241-BX-101 Waste. (2 Sheets)

Component	BX Tank Farm Engineering Assessment (kg)	HDW[a] estimated (kg)
Ni	43	3,490
NO_2	6,900	1,650
NO_3	13,610	996
Pb	260	0.942
PO_4	2,355	4,230
Si	520	3,300
SO_4	495	1,160
Sr	14	0.00
TIC as CO_3	6,860	13,600
TOC	1,450	225
U	10,560	45,800
Zr	346	0.0114
Radionuclides[b] (Ci)		
^{90}Sr	60,500	366,000
^{137}Cs	21,700	595
$^{239/240}Pu$	100	265.2
Physical Properties		
H_2O (percent)	43.2	46.6

CWP = PUREX Cladding Waste
HDW = Hanford Defined Waste
[a] Agnew et al. (1997b), radionuclides decayed to January 1, 1994
[b] Sample radionuclides decayed to January 1, 1994.

In the absence of representative samples from this tank, the best-basis estimates were derived from samples taken from tanks 241-BX-104, 241-BX-105, and 241-BX-106, as referenced in Section C3.2. These engineering assessment values were used because these tanks are in the adjacent cascade and received similar wastes.

The best basis radionuclide values are also derived from the engineering assessment values. Based on the heat load of tank 241-BX-101 from Kummerer (1995), the engineering assessment values for ^{90}Sr and ^{137}Cs represent 63 percent of the estimated heat load for this tank. The analytical values for this tank appear to be consistent with the thermal modelling results.

C4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage/disposal.

Chemical and radiological inventory information are generally derived using three approaches: (1) component inventories are estimated using results of sample analyses, (2) component inventories are estimated using the HDW model based on process knowledge and historical information, or (3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data. The information derived from these different approaches is often inconsistent

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

- An inventory estimate generated by the HDW model Agnew et al. (1997b).
- An engineering assessment which produced inventory estimates based on component concentrations for similar tanks in the BX Tank Farm (241-BX-104 for the sludge and 241-BX-104, 241-BX-105 and 241-BX-106 for supernatant).

Based on this evaluation, a best-basis inventory was developed for tank 241-BX-101 for which no sampling information was available. The inventory based on the average concentration of analytes in tanks 241-BX-104 through 241-BX-106 was chosen as the best basis for the following reasons:

- The sample-based inventory analytical concentrations from tanks in the adjacent cascade are consistent with what is expected for tank 241-BX-101, based on common waste transaction history.
- For those few analytes where no values were available from the engineering assessment-based inventory, the HDW model values were used.

Where available, the BX Tank Farm engineering assessment radionuclide values are the best-basis values. Based on the heat load of tank 241-BX-101 from Kummerer (1995), the

engineering assessment values for ^{90}Sr and ^{137}Cs represent 63 percent of the estimated heat load for this tank.

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

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. 1997b). 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.

The best-basis inventory for tank 241-BX-101 is presented in Tables C4-1 and C4-2. The inventory values reported in Tables C4-1 and C4-2 are subject to change. Refer to the Tank Characterization Database (TCD) (LMHC 1998) for the most current inventory values.

Table C4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BX-101 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	31,600	E	
Bi	150	E	
Ca	520	E	
Cl	297	E	
TIC as CO_3	6,860	E	
Cr	1,740	E	
F	240	E	Upper bounding estimate
Fe	1,760	E	
Hg	0	E	Simpson (1998)
K	300	E	
La	0	E	La is relatively insoluble in the supernates added to this tank
Mn	423	E	
Na	20,500	E	
Ni	43	E	
NO_2	6,900	E	
NO_3	13,600	E	
OH_{TOTAL}	71,000	C	
Pb	260	E	
PO_4	2,350	E	
Si	520	E	
SO_4	495	E	
Sr	14	E	
TOC	1,450	E	

Table C4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BX-101 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
U_{TOTAL}	10,600	E	
Zr	346	E	

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

Table C4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BX-101, Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	1.40	M	
^{14}C	0.135	E	
^{59}Ni	9.31	M	
^{60}Co	7.18	E	
^{63}Ni	922	M	
^{79}Se	0.0506	M	
^{90}Sr	61,200	E	
^{90}Y	61,200	E	Referenced to ^{90}Sr.
^{93}Zr	0.233	M	
^{93m}Nb	0.186	M	
^{99}Tc	9.05	E	
^{106}Ru	0.0785	M	
^{113m}Cd	0.816	M	
^{125}Sb	1.28	M	
^{126}Sn	0.0787	M	
^{129}I	0.012	E	
^{134}Cs	0.00359	M	
^{137}Cs	17,500	E	
^{137m}Ba	16,600	E	Referenced to ^{137}Cs.
^{151}Sm	184	M	
^{152}Eu	7.42	M	
^{154}Eu	5.22	M	
^{155}Eu	426	M	
^{226}Ra	3.25E-04	M	
^{227}Ac	0.00139	M	
^{228}Ra	0.00187	M	
^{229}Th	4.37E-05	M	

Table C4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BX-101, Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{231}Pa	7.36E-05	M	
^{232}Th	2.31E-04	M	
^{232}U	9.65E-04	M/E	Based on total U: Used HDW isotopic ratios
^{233}U	0.00354	M/E	Based on total U: Used HDW isotopic ratios
^{234}U	3.48	M/E	Based on total U: Used HDW isotopic ratios
^{235}U	0.157	M/E	Based on total U: Used HDW isotopic ratios
^{236}U	0.0222	M/E	Based on total U: Used HDW isotopic ratios
^{237}Np	0.00504	M	
^{238}Pu	4.68	M/E	Based on ^{239}Pu: Used HDW isotopic ratios
^{238}U	3.53	M/E	Based on total U: Used HDW isotopic ratios
^{239}Pu	82.2	M/E	Based on $^{239/240}Pu$: Used HDW isotopic ratios
^{240}Pu	17.8	M/E	Based on $^{239/240}Pu$: Used HDW isotopic ratios
^{241}Am	173	E	
^{241}Pu	328	M/E	Based on ^{239}Pu: Used HDW isotopic ratios
^{242}Cm	0.339	M/E	Based on ^{241}Am: Used HDW isotopic ratios
^{242}Pu	0.00214	M/E	Based on ^{239}Pu: Used HDW isotopic ratios
^{243}Am	0.0131	M/E	Based on ^{241}Am: Used HDW isotopic ratios
^{243}Cm	0.0361	M/E	Based on ^{241}Am: Used HDW isotopic ratios
^{244}Cm	0.968	M/E	Based on ^{241}Am: Used HDW isotopic ratios

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

C5.0 APPENDIX C REFERENCES

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