AUG 28 1997 43
Sta 22

ENGINEERING DATA TRANSMITTAL

1. EDT 161482

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) A. L. Boldt, LMHC, H5-49	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: Tank 241-T-112	6. Design Authority/ Design Agent/Cog. Engr.: M. J. Kupfer	7. Purchase Order No.: NA
8. Originator Remarks: Approval & Release		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks: 11A. Design Baseline Document? [] Yes [X] No		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	HNF-SD-WM-ER-699	-	0	Preliminary Tank Characterization Report for Single-Shell Tank 241-T-112: Best-Basis Inventory	NA	1,2	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority				3		Central Files			A3-88
		Design Agent				3		DOE Reading Room			H2-53
1	1	Cog.Eng. M. J. Kupfer	[signature]	8-27-97	H5-49	3		A. L. Boldt			
1	1	Cog. Mgr. K. M. Hodgson	K. M. Hodgson	8-27-97	R2-11	3		TCSRC			R1-10
		QA				3		M. D. LeClair (4)			H0-50
		Safety				3		K. M. Hall			R2-12
		Env.				3					

18.	19.	20.	21. DOE APPROVAL (if required)
M. J. Kupfer [signature] 8-27-97 Signature of EDT Originator / Date	Authorized Representative for Receiving Organization / Date	K. M. Hodgson [signature] 8-27-97 Design Authority/ Cognizant Manager / Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

BD-7400-172-1 (07/91)

Preliminary Tank Characterization Report for Single-Shell Tank 241-T-112: Best-Basis Inventory

A. L. Boldt
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 161482 UC: 712
Org Code: 74610 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 29

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-T-112 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

AUG 28 1997
DATE: HANFORD RELEASE
STA: 22 ID: 43

Release Approval — AUG 28 1997 — Date — Release Stamp

Approved for Public Release

HNF-SD-WM-ER-699
Revision 0

PRELIMINARY TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-T-112: BEST-BASIS INVENTORY

August 1997

A. L. Boldt
Lockheed Martin Hanford Corporation
Richland, Washington

Prepared for
U.S. Department of Energy
Richland, Washington

This page intentionally left blank.

PRELIMINARY TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-T-112: BEST-BASIS INVENTORY

This document is a preliminary Tank Characterization Report (TCR). It only contains the current best-basis inventory (Appendix D) for single-shell tank 241-T-112. No TCRs have been previously issued for this tank, and current core sample analyses are not available. The best-basis inventory, therefore, is based on an engineering assessment of waste type, process flowsheet data, early sample data, and/or other available information.

The *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes* (Kupfer et al. 1997) describes standard methodology used to derive the tank-by-tank best-basis inventories. This preliminary TCR will be updated using this same methodology when additional data on tank contents become available.

REFERENCE

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, and R. A. Watrous (LMHC), S. L. Lambert, and D. E. Place (SESC), R. M. Orme (NHC), G. L. Borsheim (Borsheim Associates), N. G. Colton (PNNL), M. D. LeClair (SAIC), R. T. Winward (Meier Associates), and W. W. Schulz (W²S Corporation), 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

This page intentionally left blank.

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-T-112

This page intentionally left blank.

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-T-112

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-T-112 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

Analytical data from the most recent sampling event for this tank are published in Steen (1997). Two core samples were obtained in 1997. Unpublished statistical analysis of the analytical results from the 1997 sampling event were performed for differential scanning calorimetry (DSC), thermal gravimetric analysis (TGA), total alpha, bulk density, ion chromatography (IC), inductively coupled plasma spectroscopy (ICP), and percent water.

Other information sources include component concentrations based on analytical data are available from core samples from tank 241-T-111 (Field et al. 1997) which historically contains the same sludge waste type as tank 241-T-112. The Hanford Defined Waste (HDW) model (Agnew et al. 1997a) also provides tank content estimates in terms of component concentrations and inventories.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Inventories derived from the analytical concentration data for tank 241-T-112 (Steen 1997) and HDW model inventories (Agnew et al. 1997a) are compared in Tables D2-1 and D2-2. The tank volume used to generate these inventories is 254 kL (67 kgal) or 227 kL (60 kgal sludge) and 26 kL (7 kgal supernatant). This volume is reported in Hanlon (1997) and is the same as that reported by Agnew et al. (1997a, and b). (The chemical species are reported without charge designation per the best-basis inventory convention.)

Table D2-1. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-T-112.

Analyte	Sampling inventory estimate[a] (kg)	HDW model inventory estimate[b] (kg)	Analyte	Sampling inventory estimate[a] (kg)	HDW model inventory estimate[b] (kg)
Al	1,490	0	NO_2	9,200	130
Bi	8,370	1,950	NO_3	5,650	9,040
Ca	<550	2,510	PO_4	3,640	3,030
Cl	138	129	Pb	<500	0
Cr	630	60.4	Si	2,560	117
F	110	472	SO_4	2,880	554
Fe	4,770	9,950	Sr	92	0
Hg	NR	0	TIC as CO_3	NR	3,760
K	NR	31	TOC	NR	0
La	1,400	0	U_{TOTAL}	<2,500	112
Mn	1,740	0	Zr	<50	0
Na	21,000	6,250	H_2O (wt%)	73.9 (solids) 85.1 (liquid)	83.1
Ni	NR	20.2	Density (kg/L)	1.28 (solids) 1.10 (liquid)	1.11

HDW = Hanford Defined Waste
NR = Not reported
[a] Steen (1997)
[b] Agnew et al. (1997a).

Table D2-2. Sample-Based and Hanford Defined Waste-Based Inventory Estimates for Radioactive Components in Tank 241-T-112.

Analyte	Sampling inventory estimate[a] (Ci)	HDW model inventory estimate[b] (Ci)
^{137}Cs	NR	325
^{90}Sr	NR	285
^{238}Pu	NR	0.146
^{239}Pu	NR	18.1
^{240}Pu	NR	1.77
^{241}Am	NR	0.00747
Total alpha	75	19.9[c]

HDW = Hanford Defined Waste
NR = Not reported
[a] As of sample analysis date
[b] Appendix E of Agnew et al. (1997a), decayed to January 1, 1994
[c] By summation.

D3.0 COMPONENT INVENTORY EVALUATION

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.

D3.1 CONTRIBUTING WASTE TYPES

Reported Waste Types in Tank 241-T-112

Anderson (1990): 2C, 224, DW
Agnew et al. (1997a): 2C2, DW

Model-Based Current Inventory (Agnew et al. 1997a)

Waste Type	Waste Vol. kL (kgal)
2C2	227 (60)
SU	27 (7)

The following abbreviations were used to designate waste types:

2C = Second decontamination cycle $BiPO_4$ waste no distinction for time period
2C1 = Second decontamination cycle $BiPO_4$ waste (1944 to 1949).
2C2 = Second decontamination cycle $BiPO_4$ waste (1950 to 1956).
224 = Waste from final decontamination stage of $BiPO_4$ process
DW = Wash solution from equipment decontamination at T Plant
SU = Supernatant

D3.1.1 Waste Transaction History

Tank 241-T-112 is the third tank in a cascade that includes tanks 241-T-110 and 241-T-111. Tank 241-T-112 first received second-cycle decontamination (2C) waste from the bismuth phosphate process (1945 to 1952) with supernates jetted to crib. From 1953 to 1955, tank 241-T-112 was used to cascade 2C waste and bismuth phosphate concentration and purification (224) waste from T Plant to a crib. Tank 241-T-112 remained in 2C service through the third quarter 1956.

For some reason Agnew et al. (1997a) does not carry the 2C1 and 224 waste in tank 241-T-111 over to the third tank in the cascade. It is reasonable to assume the same ratio of 2C1, 2C2, and 224 that exists in tank 241-T-111 also exists in this tank.

Both Anderson (1990) and Agnew et al. (1997a) identified decontamination waste from T Plant added to tank 241-T-112 in 1973. Agnew et al. identifies the decontamination waste volume as 16.7 kL (4.4 kgal) containing 1 vol% solids.

D3.1.2 Predicted Current Waste Types and Volumes

It is assumed that tank 241-T-112 contains 2C1, 2C2, and 224 waste solids in the same proportions as tank 241-T-111. The resulting predicted waste volumes for tank 241-T-112 are:

Waste Type	Waste Vol. kL (kgal)
2C1	69 (18.3)
2C2	140 (37.0)
224	18 (4.7)
SU	27 (7.0)

D3.2 BASIS FOR ASSESSING INVENTORIES IN 241-T-112

Component analyses for tanks 241-T-111 and 241-T-112 with the HDW model predicted concentrations for tank 241-T-112 are shown in Table D3-1.

Table D3-1. Composition of Wastes in Tanks 241-T-111 and 241-T-112. (2 Sheets)

Analyte	241-T-111[a] solids (μg/g)	241-T-112[b]		HDW model[c] 241-T-112	
		Solids (μg/g)	Supernatant (μg/ml)	Solids (μg/g)	Supernatant (μg/g)
Al	556	5,110	<10	0	0
Bi	24,750	28,800	44	7,630	0
Ca	2,150	<1,890	<20	9,840	0
Cr	1,890	2,110	691	236	0
Fe	18,250	16,400	<10	39,000	0
Hg	1.43	NR	NR	0	0
K	1,140	NR	603	121	0
La	4,165	4,800	<10	0	0
Mn	6,305	5,970	<20	0	0
Na	36,950	67,300	57,200	24,500	0
Ni	132	NR	24	79	0
Pb	356	<1,730	46	0	0
Si	5,670	8,810	<10	460	0
Sr	299	313	<20	0	0
U	2,790	<8,630	<20	397	0
Zr	NR	<172	8	0	0
CO_3	4,465	NR	NR	14,700	0
Cl	450	428	511	506	0
F	2,300	339	439	1,850	0
OH	NR	NR	NR	36,600	0
NO_3	41,200	17,300	23,300	35,400	0
NO_2	NR	28,100	38,800	510	0
P as PO_4	31,718	12,350	2,004	11,900	0
S as SO_4	3,615	9,030	9,500	2,170	0
TOC	3,120	NR	NR	0.00	0
Percent water	76.5	73.9	85.1	81.4	100
SpG, kg/L	1.24	1.28	1.10	1.12	1.00

Table D3-1. Composition of Wastes in Tanks 241-T-111 and 241-T-112. (2 Sheets)

Analyte	241-T-111[a] solids (μg/g)	241-T-112[b]		HDW model[c] 241-T-112	
		Solids (μg/g)	Supernatant (μg/ml)	Solids (μg/g)	Supernatant (μg/g)
Radionuclide	μCi/g[e]	μCi/g[e]	μCi/mL[e]	μCi/g[c]	μCi/g[c]
^{137}Cs	0.166	NR	NR	1.27	0
^{90}Sr	5.41	NR	NR	1.12	0
^{99}Tc	0.00792	NR	NR	7.70 E-05	0
^{238}Pu	NR	NR	NR	5.71 E-04	0
^{239}Pu	NR	NR	NR	0.0709	0
^{240}Pu	NR	NR	NR	0.00692	0
^{241}Am	0.0424	NR	NR	2.92 E-05	0
$^{239/240}Pu$	0.139	NR	NR	0.0778[d]	NR
Total alpha	0.373	0.256	0.0233	0.078[d]	NR

HDW = Hanford Defined Waste
NR = Not reported
[a] Field et al. (1997)
[b] Steen (1997)
[c] Agnew et al. (1997a), radionuclides decayed to January 1, 1994
[d] By summation
[e] Reported as of the sample analysis date.

To provide a common basis for comparison of the data for waste solids in Table D3-1 the reported water mass was removed, i.e., the results for waste solids are compared on a water-free basis and shown in Table D3-2. The HDW model composition for tank 241-T-112 solids (also on a water-free basis) is included in Table D3-2 for comparison.

Table D3-2. Composition of Tanks 241-T-111 and 241-T-112 Waste Solids, Water Free Basis. (2 Sheets)

Analyte	241-T-111[a] (μg/g)	241-T-112[b] (μg/g)	HDW model[c] 241-T-112 (μg/g)
Al	2,360	19,600	0
Bi	105,300	110,300	41,000
Ca	9,150	<7,240	52,900
Cr	8,040	8,080	1,270
Fe	77,700	62,800	210,000
Hg	6.06	NR	0.00
K	4,850	NR	650
La	17,700	18,400	0.00
Mn	26,800	22,900	0.00
Na	157,000	258,000	131,700
Ni	560	NR	425
Pb	1,520	<6,600	0
Si	24,100	33,800	2,470
Sr	1,270	1,200	0
U	11,900	<33,000	2,130
Zr	NR	<660	0
CO_3	19,000	NR	79,000
Cl	1,920	1,640	2,720
F	9,800	1,300	9,950
OH	NR	NR	197,000
NO_3	175,000	66,300	190,000
NO_2	NR	107,700	2,740
P as PO_4	135,000	47,300	64,000
S as SO_4	15,400	28,800	11,700
TOC	13,300	NR	0

Table D3-2. Composition of Tanks 241-T-111 and 241-T-112 Waste Solids, Water Free Basis. (2 Sheets)

Analyte	241-T-111[a] (μg/g)	241-T-112[b] (μg/g)	HDW model[c] 241-T-112 (μg/g)
Percent water	0	0	0
SpG, kg/L	-	-	-
Radionuclide	μCi/g[e]	μCi/g[e]	μCi/g[c]
^{137}Cs	0.706	NR	6.8
^{90}Sr	23.0	NR	6.0
^{99}Tc	0.0337	NR	4.14 E-04
^{238}Pu	NR	NR	0.0031
^{239}Pu	NR	NR	0.38
^{240}Pu	NR	NR	0.037
^{241}Am	0.18	NR	1.6 E-04
$^{239/240}$Pu	0.59	NR	0.42[d]
Total alpha	1.59	0.98	0.42[d]

HDW = Hanford Defined Waste
NR = Not reported
[a] Field et al. (1997)
[b] Steen (1997)
[c] Agnew et al. (1997a), radionuclides decayed to January 1, 1994
[d] By summation
[e] Radionuclides reported as of the sample analysis date.

As shown in Table D3-2, the concentrations of most components in tank 241-T-112 (with the exception of Al, Na, PO_4, and SO_4) agree quite well with those for tank 241-T-111.

The potassium, nickel, and TOC solids concentrations on a water free basis for tank 241-T-111 are considered an appropriate basis for the solids concentrations in tank 241-T-112 where these analytes are not reported (NR). These concentrations are assumed to be the concentrations for calculation of the tank 241-T-112 best basis inventory.

The lead and uranium solids concentrations on a water free basis for tank 241-T-111 are considered an appropriate basis for the solids concentration of lead and uranium in tank 241-T-112 whose concentrations are reported as less than values. The less than concentrations for calcium and zirconium in tank 241-T-112 are assumed to be the concentrations for calculating the tank 241-T-112 best basis inventory.

The water free analyte concentrations are adjusted for the water content of 73.9 wt% in tank 241-T-112 solids. The inventories of analytes in tank 241-T-112 solids are calculated using a solids volume of 227 kL (60 kgal) and a solids density of 1.28 kg/L established by sample analyses.

The supernatant analyte concentrations in Table D3-1 and supernatant volume of 26.5 kL (7 kgal) are used calculate tank 241-T-112 best-basis inventory contributions from the liquid fraction.

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. (1997a). In the case of tank 241-T-112, the calculation results in a large concentration hydroxide in excess of the hydroxide required to precipitate aluminum, bismuth, and iron. The excess hydroxide would exist as sodium hydroxide that could not be present in the supernatant. For tank 241-T-112, the best-basis sodium inventory was reduced until there is a small amount of excess hydroxide calculated to be present in the tank wastes as free hydroxide. The adjustment reduces the total sodium inventory to 13,500 kg with 12,000 kg calculated to be present in the solid phase. The corresponding concentration on a water free basis is a calculated 157,000 μg/g versus the value of 258,000 μg/g shown in Table D3-2. The calculated tank 241-T-112 sodium value of 157,000 μg/g compares favorably with the tank 241-T-111 sodium value of 157,000 μg/g. The best-basis concentration for sodium in tank 241-T-112 solids is 157,000 μg/g on a water free basis or 41,000 μg/g with a water content of 73.9 wt%.

Radionuclide analysis for tank 241-T-112 sample was limited to total alpha measurements. The total alpha determination was 0.256 μCi/g in the liquid phase and 0.0233 μCi/mL in the liquid phase. For the engineering assessment-based inventory of individual alpha decay radionuclides, the total alpha determination was split between ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am by the fractional distribution predicted by the HDW model (Agnew et al. 1997a). The sample analysis of tank 241-T-111 determined ^{90}Sr, ^{99}Tc, and ^{137}Cs concentrations in the solids (Table D3-1). This concentration, corrected for differences in solids water content (Table D3-2) is used as the basis for tank 241-T-112 solids ^{99}Tc concentration. There is not an adequate sample basis to determine the other radionuclide inventories in tank 241-T-112. The HDW model (Agnew et al.) inventories are used for radionuclides other than the alpha decay radionuclides and ^{90}Sr, ^{99}Tc, and ^{137}Cs.

The resulting tank 241-T-112 engineering assessment-based concentrations and inventories for the solid and liquid phases are shown in Table D3-3.

Table D3-3. Tank 241-T-112 Engineering Assessment-Based Solid and Liquid Compositions and Inventory. (2 Sheets)

Analyte	241-T-112 concentration		Tank 241-T-112 inventory		
	Solids[b] (μg/g)	Supernatant[b] (μg/mL)	Solids (kg)	Supernatant (kg)	Total (kg)
Al	5,110	<10	1,490	0.3	1,490
Bi	28,800	44	8,370	1.2	8,370
Ca	<1,890	<20	<550	0.5	<550
Cr	2,110	691	613	18	630
Fe	16,400	<10	4,770	0.3	4,770
Hg[a]	1.57	NR	0.457	-	0.457
K[a]	1,270	603	368	16	380
La	4,800	<10	1,395	0.3	1,400
Mn	5,970	<20	1,735	0.5	1,740
Na	41,000	57,200	12,000	1,500	13,500
Ni[a]	150	24	44	0.6	45
Pb	395	46	115	1.2	115
Si	8,810	<10	2,560	0.3	2,560
Sr	313	<20	91	0.5	92
U	3,100	<20	900	25	925
Zr	<172	8	<50	0.2	<50
CO_3[a]	4,960	NR	1,440	NR	1,440
Cl	428	511	124	13.5	138
F	339	439	99	11.6	110
OH[c]	36,600	9,800	10,000	260	10,300
NO_3	17,300	23,300	5,030	618	5,650
NO_2	28,100	38,800	8,170	1030	9,200
P as PO_4	12,350	2,004	3,590	53	3,640
S as SO_4	9,030	9,500	2,630	250	2,880
TOC[a]	3,160	3,000	920	80	1,000
Percent water	73.9	85.1	73.9	85.1	74.9

Table D3-3. Tank 241-T-112 Engineering Assessment-Based Solid and Liquid Compositions and Inventory. (2 Sheets)

Analyte	241-T-112 concentration		Tank 241-T-112 inventory		
	Solids[b] (μg/g)	Supernatant[b] (μg/mL)	Solids (kg)	Supernatant (kg)	Total (kg)
SpG, kg/L	1.28	1.10	1.28	1.10	1.26
Radionuclides[d]	μCi/g	μCi/g	Ci	Ci	Ci
^{137}Cs[a,d]	0.184	NR	54	-	54
^{90}Sr[a,d]	6.0	NR	1,750	-	1,750
^{99}Tc[a,d]	0.0088	NR	2.6	-	2.6
^{238}Pu[c]	5.71 E-04	0	0.146	0	0.146
^{239}Pu[c]	0.0709	0	18.1	0	18.1
^{240}Pu[c]	0.00692	0	1.77	0	1.77
^{241}Am	1.0 E-04	9.0 E-06	0.028	2.3 E-04	0.028
Total alpha	0.256	0.0233	74.4	0.62	75

HDW = Hanford Defined Waste
NR = Not reported
[a] Field et al. (1997)
[b] Steen (1997)
[c] Agnew et al. (1997a), radionuclides decayed to January 31, 1994
[d] Radionuclides reported as of the sample analysis date.

D3.3 COMPARISON OF INVENTORY ESTIMATES

Estimated inventories from this evaluation are compared with the HDW model-based inventories (Agnew et al. 1997a) in Table D3-4. The inventories from this evaluation differ significantly from the HDW inventories.

Table D3-4. Engineering Assessment-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-T-112.

Analyte	Engineering assessment inventory estimate (kg)	HDW model inventory estimate[a] (kg)	Analyte	Engineering assessment inventory estimate (kg)	HDW model inventory estimate[a] (kg)
Al	1,490	0	NO_2	9,200	130
Bi	8,370	1,950	NO_3	5,650	9,040
Ca	<550	2,510	OH	10,300	33,100
Cl	138	129	PO_4	3,640	3,030
Cr	630	60.4	Pb	115	0
F	110	472	Si	2,560	117
Fe	4,770	9,950	SO_4	2,880	554
Hg	0.457	0	Sr	92	0
K	347	31	TIC as CO_3	1,300	3,760
La	1,400	0	TOC	1,000	0
Mn	1,740	0	U_{TOTAL}	925	112
Na	13,500	6,250	Zr	<50	0
Ni	39	20.2	H_2O (wt%)	74.9	83.1

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

As stated previously, the analyte concentrations in solids samples from for tanks 241-T-111 and 241-T-112 are comparable as would be expected for tanks operated for solids settling in a cascade. An engineering assessment of predicted solids composition in tank 241-T-111 based on published flowsheet compositions of 2C and 224 wastes was performed by Field et al. (1997). The results from this evaluation support using the sampling data from tanks 241-T-111 and 241-T-112 as the basis for the best estimate inventory for tank 241-T-112, for the following reasons:

1. Data from two tank 241-T-111 core composite samples were used to estimate the component inventories. The core sample recovery was quite complete.

2. With the exception of PO_4 and U, results from the engineering flowsheet assessment compare favorably with the sample-based results.

3. The inventory estimate generated by the HDW model is based on a predicted 2C:224 waste volume ratio 92:8, whereas sample analyses of components that are unique to these two waste types indicate a higher contribution of 224 waste, for example, 80:20 or 75:25.

4. The fraction precipitated basis used for the independent analysis for major components result in inventory estimates that compare favorably with sample analyses. The concentration factors (CF) calculated for fully precipitated components (i.e., Bi) were based on comparing flowsheet concentrations with analytical-based concentrations. The relative concentrations of components in the waste solids are consistent with those expected for waste resulting from $BiPO_4$ process 2C and 224 process flowsheets. For nearly all components, the calculated CF and partition factor resulted in inventories that are consistent with the predicted chemical behaviors of the components in alkaline media.

5. The flowsheet bases and waste volumes used for the tank 241-T-111 assessment are believed to reflect the processing conditions more closely than those that govern the HDW model inventories.

This page intentionally left blank.

D4.0 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 are seldom completely consistent.

An effort is underway to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort an evaluation of chemical information for tank 241-T-112 was performed, including the following:

- Data from two 1997 core samples (Steen 1997)
- An inventory estimate generated by the HDW model (Agnew et al. 1997a)
- Comparing total waste concentrations with similar T Tank Farm tank samples.

Based on this evaluation, a best-basis inventory was developed for tank 241-T-112 (Tables D4-1 and D4-2). The evaluation used the sample-based analytical data from tank 241-T-112. The evaluation also used sample-based analytical data from tank 241-T-111, which historically contain the same waste type as tank 241-T-112, to define the best-basis inventory where analyses were absent for the tank 241-T-112 samples. The best-basis inventory used sample analyses because the solubility data in Agnew et al. (1997a) for several chemical components are not consistent with the sample-based data for tanks 241-T-111 and 241-T-112.

The inventories of analytes are calculated using a solids volume of 227 kL (60 kgal), a liquid volume of 26.5 kL (7 kgal) and a solids density of 1.28 g/cc established by the sample analyses (Steen 1997). HDW model bases were used as best-basis where there were poor (or no) sample bases. 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. (1997a).

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. 1997a). 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.

The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-T-112 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	1,490	S	
Bi	8,370	S	
Ca	<550	S	
Cl	138	S	
TIC as CO_3	1,440	E	241-T-111 sample basis
Cr	630	S	
F	110	S	
Fe	4,770	S	
Hg	0.457	E	241-T-111 sample basis
K	380	E	241-T-111 sample basis
La	1,400	S	
Mn	1,740	S	
Na	13,500	E/C	Reduced from 21,000 kg so that calculated OH would be small excess of that required to precipitate Al, Bi, and Fe.
Ni	45	E	241-T-111 sample basis
NO_2	9,200	S	
NO_3	5,650	S	
OH_{TOTAL}	11,100	C	
Pb	115	E	241-T-111 sample basis
PO_4	3,640	S	
Si	2,560	S	
SO_4	2,880	S	
Sr	92	S	
TOC	1,000	E	241-T-111 sample basis

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-T-112 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
U_{TOTAL}	925	S	
Zr	<50	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
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 Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	0.0072	M	
^{14}C	0.00283	M	
^{59}Ni	8.03 E-04	M	
^{60}Co	7.62 E-04	M	
^{63}Ni	0.0733	M	
^{79}Se	5.97 E-04	M	
^{90}Sr	1,590	E	
^{90}Y	1,590	E	Equilibrium value with ^{90}Sr
^{93m}Nb	0.00237	M	
^{93}Zr	0.00283	M	
^{99}Tc	2.6	E	241-T-111 sample basis
^{106}Ru	3.88 E-10	M	
^{113m}Cd	0.00745	M	
^{125}Sb	7.75 E-04	M	
^{126}Sn	9.03 E-04	M	
^{129}I	3.72 E-05	M	
^{134}Cs	3.56 E-05	M	
^{137m}Ba	46.4	E	Equilibrium value with ^{137}Cs
^{137}Cs	49.1	E	
^{151}Sm	2.21	M	
^{152}Eu	0.00347	M	
^{154}Eu	0.0145	M	
^{155}Eu	0.233	M	
^{226}Ra	1.21 E-07	M	
^{227}Ac	6.27 E-07	M	
^{228}Ra	9.57 E-12	M	
^{229}Th	1.86 E-09	M	
^{231}Pa	1.41 E-06	M	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-112 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}Th	7.73 E-13	M	
^{232}U	8.84 E-07	M	
^{233}U	4.05 E-08	M	
^{234}U	0.0367	M	
^{235}U	0.00162	M	
^{236}U	3.76 E-04	M	
^{237}Np	1.23 E-04	M	
^{238}Pu	0.54	E/M	Based on total alpha analysis/ HDW radionuclide distribution
^{238}U	0.0374	M	
^{239}Pu	67.8	E/M	Based on total alpha analysis/ HDW radionuclide distribution
^{240}Pu	6.6	E/M	Based on total alpha analysis/ HDW radionuclide distribution
^{241}Am	0.028	E/M	Based on total alpha analysis/ HDW radionuclide distribution
^{241}Pu	6.4	M	
^{242}Cm	6.88 E-05	M	
^{242}Pu	2.92 E-05	M	
^{243}Am	5.40 E-08	M	
^{243}Cm	1.42 E-06	M	
^{244}Cm	1.29 E-06	M	

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

D5.0 APPENDIX D REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997a, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Waste Status and Transaction Record Summary (WSTRS Rev. 4)*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Anderson, J. D., 1990, *A History of the 200 Area Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

Field, J. G., J. H, Baldwin, M. J. Kupfer, and L. Jensen, 1997, *Tank Characterization Report for Single-Shell Tank 241-T-111*, HNF-SD-WM-ER-540, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending January 31, 1997*, WHC-EP-182-106, Lockheed Martin Hanford Corporation, Richland, Washington.

Hodgson, K. M., and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, and R. A. Watrous (LMHC), S. L. Lambert, and D. E. Place (SESC), R. M. Orme (NHC), G. L. Borsheim (Borsheim Associates), N. G. Colton (PNNL), M. D. LeClair (SAIC), R. T. Winward (Meier Associates), and W. W. Schulz (W^2S Corporation), 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Steen, F. H., 1997, *Tank 241-T-112 Cores 185 and 186 Analytical Results for the Final Report*, HNF-SD-WM-DP-243, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989*, HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

This page intentionally left blank.