0049771

ENGINEERING CHANGE NOTICE	Page 1 of 2	1. ECN 644458 Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [x] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	M. J. Kupfer, LMHC, H5-49 376-6631	[] Yes [x] No	08/26/97
	6. Project Title/No./Work Order No. Tank 241-AN-106	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-569, 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

Add Appendix C, Evaluation to Establish Best-Basis Inventory for Double-Shell Tank 241-AN-106.

14a. Justification (mark one)

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

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for double-shell tank 241-AN-106 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

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

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	R. T. Winward	H5-49
File	H5-49	J. M. Conner	R2-11
T. E. Jones	H5-49		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 644458

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

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

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

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

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

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng.	M. J. Kupfer *M J Kupfer*	8-27-97	PE		
Cog. Mgr.	K. M. Hodgson *K. M. Hodgson*	8-27-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other	J. M. Conner *B. C. Simpson for J.M Conner via Telecom*	8-27-97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Double-Shell Tank 241-AN-106

T. E. Jones (Meier Associates), R. T. Winward (Meier Associates), and M. J. Kupfer
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 644458 UC: 712
Org Code: 74610 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 101

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 double-shell tank 241-AN-106 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

AUG 27 1997
DATE: HANFORD RELEASE
STA: 37 ID: 20

Janis Bishop 8/27/97
Release Approval Date

Release Stamp

Approved for Public Release

RECORD OF REVISION

(1) Document Number: WHC-SD-WM-ER-569

Page 1

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AN-106

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 08/22/96 on EDT 617508.	J. G. Douglas	J. G. Kristofzski
0A RS	Incorporate per ECN-644458.	M. J. Kupfer	K. M. Hodgson
		M. J. Kupfer 8-27-97	K. M. Hodgson 8-27-97

APPENDIX C

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AN-106

This page intentionally left blank.

APPENDIX C

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AN-106

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 double-shell tank 241-AN-106 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-AN-106 includes:

- The information included in Sections 2.0, 3.0, 4.0, 5.0 and Appendix A of this Tank Characterization Report (TCR).
- Characterization information on tank 241-AN-106 from a Hanford Grout Disposal Program test plan (Hendrickson et al. 1993).
- Inventory estimates for this tank that were generated from the Hanford Defined Waste (HDW) model (Agnew et al. 1997a).

Almost all tank inventory estimates reported in Appendix C are extrapolated from analytical data of materials transferred into the tank or from modified HDW model values.

A list of references used in this evaluation is provided in Section C5.0.

C2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Tank 241-AN-106 is an active tank and is categorized as containing complexed concentrate (Hanlon 1997). Since this tank is designated as "active," routine transfers of waste into and out of this tank are executed at the direction of Tank Farm Operations. The HDW model-derived tank inventory estimate in Agnew et al. (1997a) has an effective date of January 1, 1994. Thus, the information listed in Agnew et al. (1997a) is no longer applicable to the tank inventory estimate determination. However, the waste concentration estimates listed in Agnew et al. (1997a) may be useful in estimating the inventory for the solids heel in this tank.

The HDW model tank inventory estimate information from Agnew et al. (1997a) is not included in Section C2.0 in of this document because a number of waste transfers have been made since January 1, 1994.

C3.0 COMPONENT INVENTORY EVALUATION

The following evaluation was conducted to assess various estimates of tank contents.

C3.1 WASTE HISTORY FOR TANK 241-AN-106

The waste transfer history for this tank (through 1994) is documented in Section 2.3.1 of this TCR. Tank 241-AN-106 began receiving concentrated phosphate and dilute noncomplexed waste in 1983. By the end of 1984, the tank contained 4,013 kL (1,060 kgal) of waste. Minor losses between 1984 and 1992 were attributed to evaporation caused by the active ventilation system. In 1992, 3,676 kL (971 kgal) of waste were transferred from tank 241-AN-106 to 241-AP-102 leaving a total volume of 87.1 kL (23 kgal) which included 64.4 kL (17 kgal) of solids. (Hanlon [1997] still lists the tank as containing 64.4 kL [17 kgal] of solids. Agnew et al. [1997a] list the waste volume as 79.5 kgal [21 kgal] as of January 1, 1994.)

In 1994, the tank received 1,510 kL (399 kgal) of double-shell slurry feed (DSSF) and dilute noncomplexed wastes from tank 241-AW-106. This DSSF was part of the 242-A Evaporator 94-1 Campaign. In January 1997, 668 kL (176 kgal) of supernatant was transferred from tank 241-AN-106 to 241-AP-108 (Hanlon 1997). In March 1997, 86.4 kL (22.8 kgal) of supernatant was transferred out of tank 241-AN-106. Another transfer of 672 kL (178 kgal) was completed in July 1997. As of July 1, 1997, tank 241-AN-106 is believed to contain approximately 64.4 kL (17 kgal) of solids and 100 kL (26.5 kgal) of supernatant. A more detailed transfer history for this tank is available from Agnew et al. (1997b). (Note: The plutonium inventory tracking system reports a tank waste volume in tank 241-AN-106 as 153 kL [40.3 kgal], as of July 31, 1997, rather than the 165 kL [43.5 kgal] estimate used in this engineering assessment. Use of the lower value would have lead to approximately 12% decrease in the supernatant inventory estimates. The 12 percent is well within the overall uncertainty of any of the inventory estimates reported in this document.)

C3.2 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

As previously noted, the tank inventory estimates given by Agnew et al. (1997a) are no longer valid because of recent waste transfers. However, the concentration estimates given by Agnew et al. (1997a) may be useful in predicting the composition of the 64.4 kL (17 kgal) solids heel dating back to 1992. It is likely the heel developed between 1984 and 1992 while concentrated phosphate waste was stored in the tank. The supernatant is a mixture of DSSF and dilute noncomplexed waste.

C3.3 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

The general approach in this engineering assessment is to utilize all available information to formulate the best-basis estimate of the tank's contents. The sources of information used to develop an inventory may include analytical data from samples taken from the tank of interest, analytical data from other tanks believed to contain waste types similar to those believed to be in the tank of interest, and data from models incorporating historical process records.

The composition of the supernatant in tank 241-AN-106 was estimated in Appendix A of this TCR. The estimated supernatant concentration was developed by combining original supernatant concentrations and volumes with analytical data and volumes of a double-shell slurry feed that had been transferred into the tank. The approach and results are documented in Appendix A of this TCR.

The present supernatant volume estimate of 100 kL (26.5 kgal) was used to develop an inventory estimate for the supernatant. It should be noted that these estimates are valid as of July 31, 1997 but become invalid with any transfer of waste into or out of the tank.

An inventory estimate was developed for the 64.4 kL (17 kgal) solids heel from the two data sources, neither of which involve direct analysis of materials from tank 241-AN-106 (Agnew et al. 1997a and Hendrickson et al. 1993). The inventory estimates for the heel would not be expected to change significantly with the transfer of supernatants into or out of the tank. However, in the absence of analytical data on the heel, large uncertainties are associated with the inventory estimates.

The concentrated phosphate waste stored in tank 241-AN-106 between 1984 and 1992 was evaluated as a feed material for the Hanford Grout Disposal Program. Concentration estimates for this material are available in Hendrickson et al. (1993).

C3.3.1 Supernatant Inventory Estimate

The composition of the supernatant in tank 241-AN-106 is estimated in Section 2.3.2 and Appendix A of this document. These values were used with the current supernatant volume given in Hanlon (1997) to develop inventory estimates for the supernatant. The analyte concentrations listed in Table A-1 of this document are reproduced in Table C3-1. Inventory estimates calculated assuming a supernatant volume of 100 kL (26.5 kgal) are also shown in Table C3-1. The chemical species are reported without charge designation per the best-basis inventory convention.

Table C3-1. Composition of Supernatant in Tank 241-AN-106.[a]

Analyte	Supernatant concentration (μg/mL)	Supernatant based inventory estimate[b] (kg)	Analyte	Supernatant concentration (μg/mL)	Supernatant based inventory estimate[b] (kg)
Al	3,220	322	NO_3	65,800	6,580
Ca	9.29	0.929	PO_4	2,020	202
Cl	960	96.0	SO_4	5,500	550
Cr	99.1	9.91	CO_3	21,850	2,185
F	5,110	511	TOC	4390	439
Fe	1.77	0.177	Density	1.19	
Na	75,600	7,560	%Water	76.6	
NO_2	17,600	1,760			
Radionuclides[c]					
Analyte	μCi/mL	Ci	Analyte	μCi/mL	Ci
^{90}Sr	0.0385	3.85	^{137}Cs	77.9	7,790

[a] Data from Appendix A, Table A-1
[b] Supernatant volume as of August 1997 = 100 kL (26.5 kgal)
[c] Radionuclide analyses completed in 1994.

The major goal of the Best-Basis Inventory Task was to establish the most defensible estimate of the total tank contents. Generally, when analytical data or flowsheet information were not available for certain analytes then HDW modeling results were used as the basis for developing inventory estimates. However, with the active tanks (i.e., that are still involved in waste transfers) the use of HDW modeling results becomes much more difficult.

Since tank 241-AN-106 has been involved in major transfers since January 1994, HDW model results are not applicable for the current waste in that tank. However, a review of waste transfer records (Agnew et al. 1997b) suggests that HDW model results from tank

241-AW-106 would be applicable for developing inventory estimates for tank 241-AN-106 (in the absence of tank-specific information). The waste in tank 241-AW-106 on January 1, 1994, was used as evaporator feed for 242-A Evaporator Campaign 94-1. The DSSF from 94-1 evaporator campaign was transferred to tank 241-AN-106. Approximately 100 kL (26.5 kgal) of this waste remains in tank 241-AN-106.

As was done in the case of tank 241-AP-108 (Jones et al. 1997), it is assumed the waste materials originally in tank 241-AW-106 were concentrated by a factor of two during the evaporator operations. Tank inventory estimates were developed for analytes (which lacked tank-specific analytical data) in tank 241-AN-106 by multiplying the HDW model Supernatant Mixing Model (SMM) analyte inventory by two and by the ratio of the tank volumes. The HDW model lists the volume of tank 241-AW-106 to be 4,202 kL (1,110 kgal) on January 1, 1994, thus, the ratio would be 26.4/1,110 or 0.0238. Supernatant inventory estimates for analytes determined by this approach are listed in Table C3-2 for the non-radionuclides and Table C3-3 for the radionuclides.

Table C3-2. Non-Radionuclide Supernatant Estimates in Tank 241-AN-106 using Hanford Defined Waste Model Values from Tank 241-AW-106.[a]

Analyte	Supernatant-based inventory estimate (kg)	Analyte	Supernatant-based inventory estimate (kg)
Bi	13.9	Pb	14.9
Hg	0.316	Si	197
K	1,190	Sr	0
La	0.228	U_{TOTAL}	418
Mn	83.8	Zr	30.3
Ni	55.7		

[a] Includes only those analysis of interest not included in Table 3-1, (Agnew et al. 1997a).

Table C3-3. Radionuclide Supernatant Estimates in Tank 241-AN-106 using Hanford Defined Waste Model Supernatant Mixing Model Values from Tank 241-AW-106.[a] (2 Sheets)

Analyte	Supernatant inventory estimate (Ci)	Analyte	Supernatant inventory estimate (Ci)
^{3}H	16.2	^{228}Ra	0.0154
^{14}C	189	^{229}Th	3.58 E-04
^{59}Ni	0.126	^{231}Pa	3.100 E-04

Table C3-3. Radionuclide Supernatant Estimates in Tank 241-AN-106 using Hanford Defined Waste Model Supernatant Mixing Model Values from Tank 241-AW-106.[a] (2 Sheets)

Analyte	Supernatant inventory estimate (Ci)	Analyte	Supernatant inventory estimate (Ci)
^{60}Co	2.84	^{232}Th	1.46 E-03
^{63}Ni	12.3	^{232}U	0.0552
^{79}Se	0.287	^{233}U	0.212
^{93}Zr	1.36	^{234}U	0.191
^{93m}Nb	1.02	^{235}U	0.00733
^{99}Tc	13.8	^{236}U	0.0138
^{106}Ru	0.00141	^{237}Np	0.0500
^{113m}Cd	6.38	^{238}Pu	0.460
^{125}Sb	22.1	^{238}U	0.155
^{126}Sn	0.442	^{239}Pu	6.85
^{129}I	0.0267	^{240}Pu	1.46
^{134}Cs	0.0150	^{241}Am	8.47
^{151}Sm	1.02	^{241}Pu	0.457
^{152}Eu	0.323	^{242}Cm	0.0139
^{154}Eu	46.7	^{242}Pu	1.78 E-04
^{155}Eu	20.5	^{243}Am	7.81 E-04
^{226}Ra	1.32 E-05	^{243}Cm	0.00145
^{227}Ac	8.14 E-05	^{244}Cm	0.0245

[a] Includes only those radionuclides of interest not included in Table C3-1 (Agnew et al. 1997a), radionuclides decayed to January 1, 1994.

C3.3.2 Sludge (Heel) Inventory Estimate

It is assumed the 64.4 kL (17 kgal) heel formed between 1984 and 1992 when concentrated phosphate (CP) supernatant waste was stored in tank 241-AN-106. It is also assumed that the heel composition would parallel the composition of CP waste that was in the tank. That is, no attempt was made to selectively increase the concentration of any analyte in the solid phase as compared with the liquid phase because no data were available to support selective precipitation of certain analytes.

The CP waste composition in this tank was estimated in 1991 as potential grout feed material. These data were reported by Hendrickson et al. (1993) and are listed in Table C3-4. An inventory estimate for the 64.4 kL (17 kgal) heel was calculated assuming the heel was similar to the CP supernatant waste. The inventory estimates are also listed in Table C3-4.

The HDW model tank inventory estimates were calculated when the tank contained 79.5 kL (21 kgal) of waste (Agnew et al. 1997a). The 79.5 kL (21 kgal) would include the 64.4 kL (17 kgal) heel plus about 15 kL (4 kgal) of supernatant liquids. Thus, the analyte concentrations determined by the HDW model may be a good representation of the composition of a CP waste heel. The analyte concentrations reported by Agnew et al. (1997a) are listed in Table C3-4, as are inventory estimates based on the HDW model for the 64.4 kL (17 kgal) heel.

Table C3-4. Composition of Sludge Heel in Tank 241-AN-106. (2 Sheets)

Analyte	CP sludge concentration estimates[a] (μg/mL)	CP-based sludge heel inventory estimate[b] (kg)	HDW model-based concentration estimates[c]	Modified HDW model-based sludge heel inventory estimate[d] (kg)
Al	9,590	618	22,400	2,090
Bi	<145	<9.3	130	12.1
Ca	77.3	4.98	840	78.5
Cl	NR	NR	4,280	400
Cr	569	36.6	3,560	333
F	NR	NR	629	58.7
Fe	NR	NR	342	31.9
Hg	<0.05	<0.003	0.934	0.0866
K	1020	65.7	1,300	121
La	<0.4	<0.026	1.74	0.162
Mn	NR	NR	113	10.6
Na	89,300	5,750	165,000	15,400
Si	50.2	3.23	1,070	99.9
Ni	NR	NR	235	21.9
NO_2	27,600	1,780	55,200	5,160
NO_3	73,600	4,740	148,000	13,800
Pb	NR	NR	119	11.1
PO_4	17,900	1,150	12,100	1,130

Table C3-4. Composition of Sludge Heel in Tank 241-AN-106. (2 Sheets)

Analyte	CP sludge concentration estimates[a] (µg/mL)	CP-based sludge heel inventory estimate[b] (kg)	HDW model-based concentration estimates[c]	Modified HDW model-based sludge heel inventory estimate[d] (kg)
SO_4	2,580	166	12,700	1,190
Sr	NR	NR	0	0
CO_3	21,000	1,350	14,600	1,360
TOC	3,260	210	8,290	774
P as PO_4	19,200	1,240	12,000	1,130
U	4	<0.26	1,030	96.3
Zr	<27.4	<1.76	9.63	0.899
Density	1.27	NA	1.45	NA
%Water	NR	NA	45.5	NA
Radionuclides[e]				
Analyte	µCi/mL	Ci	µCi/g	Ci
^{90}Sr	2.08	134	57.5	5,390
^{137}Cs	197	12,700	142	13,300

CP = Concentrated Phosphate
HDW = Hanford Derive Waste
NA = Not applicable
NR = Not reported
[a] Hendrickson et al. (1993)
[b] Sludge heel volume = 64.4 kL
[c] Agnew et al. (1997a)
[d] Agnew et al. (1997a) data adjusted for heel volume of 64.4 kL
[e] Radionuclides decayed to January 1, 1994.

C3.4 TANK INVENTORY ESTIMATES

The tank inventory for tank 241-AN-106 is given in the following tables. Nonradioactive analytes are developed in Table C3-5 and radionuclides in Table C3-6.

Table C3-5. Tank Inventory Estimates for Nonradioactive Components in Tank 241-AN-106.

Analyte	Supernatant Inventory Estimate[a] (kg)	Sludge Inventory Estimate[b] (kg)	Tank Inventory Estimate (kg)
Al	322	618	940
Bi	13.9	12.1	26
Ca	0.929	4.98	5.91
Cl	96	400	496
CO_3	2,185	1,350	3,540
Cr	9.91	36.6	46.5
F	511	58.7	570
Fe	0.177	31.9	32.1
Hg	0.316	0.0866	0.403
K	1,190	65.7	1,260
La	0.228	0.162	0.39
Mn	83.8	10.6	94.4
Na	7,560	5,750	13,300
Ni	55.7	21.9	77.6
NO_2	1,760	1,780	3,540
NO_3	6,580	4,740	11,400
Pb	14.9	11.1	26
P as PO_4	202	1,150	1,350
Si	209	3.23	212
SO_4	550	166	716
Sr	0	0	0
TOC	439	210	649
U_{TOTAL}	418	96.3	514
Zr	30.3	0.899	31.2

[a] From Tables C3-1 and C3-2

[b] Based on concentrated phosphate sludge data when available, otherwise modified Hanford Defined Waste model data was used (Table C3-4).

Table C3-6. Tank Inventory Estimates for Radioactive Components in Tank 241-AN-106.[a] (2 Sheets)

Analyte	Supernatant inventory estimate[b] (Ci)	Sludge inventory estimate[c] (Ci)	Tank inventory estimate (Ci)
^{3}H	16.2	11.3	27.5
^{14}C	1.89	1.68	3.57
^{59}Ni	0.126	0.0996	0.227
^{60}Co	2.84	2.03	4.87
^{63}Ni	12.3	9.8	22.1
^{79}Se	0.287	0.17	0.458
^{90}Sr	3.42	134	137
^{90}Y	3.42	134	137
^{93}Zr	1.36	0.834	2.20
^{93m}Nb	1.02	0.604	1.62
^{99}Tc	13.8	12.5	26.3
^{106}Ru	0.00141	3.69 E-04	0.00178
^{113m}Cd	6.38	4.48	10.9
^{125}Sb	22.1	9.15	31.2
^{126}Sn	0.442	0.257	0.699
^{129}I	0.0267	0.024	0.0507
^{134}Cs	5.28	0.315	5.60
^{137}Cs	7,790	12,700	20,500
^{137m}Ba	7,370	12,000	19,400
^{151}Sm	1,023	599	1,620
^{152}Eu	0.323	0.213	0.536
^{154}Eu	46.7	32.2	78.9
^{155}Eu	20.5	12.7	33.2
^{226}Ra	1.32 E-05	6.85 E-06	2.00 E-05
^{227}Ac	8.14 E-05	4.28 E-05	1.24 E-04
^{228}Ra	0.0154	0.0127	0.0281
^{229}Th	3.58 E-04	2.95 E-04	6.53 E-04
^{231}Pa	3.10 E-04	2.00 E-04	5.10 E-04
^{232}Th	0.00146	1.25 E-03	0.00271
^{232}U	0.0552	0.044	0.0992

Table C3-6. Tank Inventory Estimates for Radioactive Components in Tank 241-AN-106.[a] (2 Sheets)

Analyte	Supernatant inventory estimate[b] (Ci)	Sludge inventory estimate[c] (Ci)	Tank inventory estimate (Ci)
^{233}U	0.212	0.168	0.380
^{234}U	0.191	0.0358	0.227
^{235}U	0.00733	0.00143	0.00876
^{236}U	0.0138	0.00115	0.0150
^{237}Np	0.0500	0.0444	0.094
^{238}Pu	0.460	0.0682	0.528
^{238}U	0.155	0.0454	0.201
^{239}Pu	6.85	2.26	9.11
^{240}Pu	1.46	0.39	1.85
^{241}Am	8.47	2.92	11.4
^{241}Pu	43.1	4.7	47.8
^{242}Cm	0.0139	0.00765	0.0216
^{242}Pu	1.78 E-04	2.58 E-05	2.06 E-04
^{243}Am	7.81 E-04	1.10 E-04	8.61 E-04
^{243}Cm	0.00145	7.18 E-04	0.00217
^{244}Cm	0.0245	0.00636	0.0309

[a] Radionuclides decayed to January 1, 1994

[b] From Tables C3-1 and C3-3

[c] From Table 3-4 or calculated as 81 percent of the Hanford Defined Waste model inventories for tank 241-AN-106 (Agnew et al. 1997a).

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 assessments 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, processing and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage.

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 information for double-shell tank (DST) 241-AN-106 was performed. An assessment of available chemical information for tank 241-AN-106 was performed, including the following:

- A Hanford Grout Disposal Program test plan containing information on the concentrated phosphate waste once stored in tank 241-AN-106.
- The HDW model waste composition estimates.

Based on this engineering assessment, a best-basis inventory was developed for tank 241-AN-106 using concentration data developed by the grout disposal program, when available, or the HDW model tank inventory estimates reported by Agnew et al. (1997a).

Best-basis tank inventory values were 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 were only reported for total beta, total alpha, ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium, while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., were 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 nuclides 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.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with valences of other analytes. In some cases, this approach required that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. No adjustments were required for this tank. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Table C4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AN-106 (Effective July 31, 1997).

Analyte	Tank inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	940	E	
Bi	26	M/E	
Ca	5.91	E	
Cl	496	M/E	
TIC as CO_3	3,540	E	
Cr	46.5	E	
F	570	M/E	
Fe	32.1	M/E	
Hg	0.403	M/E	
K	1,260	M/E	
La	0.39	M/E	
Mn	94.4	M	
Na	13,300	E	
Ni	77.6	M	
NO_2	3,540	E	
NO_3	11,400	E	
OH_{TOTAL}	3,930	C	
Pb	26	M/E	
PO_4	1,350	E	
Si	212	E	
SO_4	716	E	
Sr	0	M	
TOC	649	E	
U_{TOTAL}	514	M/E	
Zr	31.2	M/E	

[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 "hydroxide" not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table C4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AN-106, Decayed to January 1, 1994 (Effective July 31, 1997). (2 Sheets)

Analyte	Tank inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	27.5	M/E	
^{14}C	3.57	M/E	
^{59}Ni	0.257	M/E	
^{60}Co	4.87	M/E	
^{63}Ni	22.1	M/E	
^{79}Se	0.458	M/E	
^{90}Sr	137	E	
^{90}Y	137	E	Referenced to ^{90}Sr
^{93}Zr	2.20	M/E	
^{93m}Nb	1.62	M/E	
^{99}Tc	26.3	M/E	
^{106}Ru	0.00178	M/E	
^{113m}Cd	10.9	M/E	
^{125}Sb	31.2	M/E	
^{126}Sn	0.699	M/E	
^{129}I	0.0507	M/E	
^{134}Cs	5.28	M/E	
^{137}Cs	20,500	E	
^{137m}Ba	19,400	E	Referenced to ^{137}Cs
^{151}Sm	1,620	M/E	
^{152}Eu	0.536	M/E	
^{154}Eu	78.9	M/E	
^{155}Eu	33.2	M/E	
^{226}Ra	2.00 E-05	M/E	
^{227}Ac	1.24 E-04	M/E	
^{228}Ra	0.0281	M/E	
^{229}Th	6.53 E-04	M/E	
^{231}Pa	5.10 E-04	M/E	
^{232}Th	0.00271	M/E	
^{232}U	0.0992	M/E	

Table C4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AN-106, Decayed to January 1, 1994 (Effective July 31, 1997). (2 Sheets)

Analyte	Tank inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	0.380	M/E	
^{234}U	0.227	M/E	
^{235}U	0.00876	M/E	
^{236}U	0.0150	M/E	
^{237}Np	0.094	M/E	
^{238}Pu	0.528	M/E	
^{238}U	0.201	M/E	
^{239}Pu	9.11	M/E	
^{240}Pu	1.85	M/E	
^{241}Am	11.4	M/E	
^{241}Pu	47.8	M/E	
^{242}Cm	0.0216	M/E	
^{242}Pu	2.06 E-04	M/E	
^{243}Am	8.61 E-04	M/E	
^{243}Cm	0.00217	M/E	
^{244}Cm	0.0309	M/E	

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

C5.0 APPENDIX C 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.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending January 31, 1997*, HNF-EP-0182-105, 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.

Hendrickson, D. W., T. L. Welsh, and D. M. Nguyen, 1993, *Hanford Grout Disposal Program Campaign 102 Characterization and Test Plan*, Westinghouse Hanford Company, Richland, Washington.

Jones, T. E., and R. T. Winward (Meier Associates), and M. J. Kupfer, 1997, *Tank Characterization Report for Double-Shell Tank 241-AP-108*, WHC-SD-WM-ER-593, Rev. 0A, Lockheed Martin 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.

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.