0049791

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 640362

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 [ ] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	L. W. Shelton, NHC, H5-49, 376-6199	[] Yes [x] No	8/8/97
	6. Project Title/No./Work Order No. Tank 241-AP-104	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-596, 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 D, Evaluation to Establish Best-Basis Inventory for Double-Shell Tank 241-AP-104.

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-AP-104 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	W. D. Winkleman	R2-12
File	H5-49		
L. W. Shelton	H5-49		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

RELEASE STAMP

AUG 27 1997

DATE: HANFORD RELEASE

STA: 37 ID:

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

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 640362

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	W. D. Winkleman *B.C. Simpson for W.D Winkleman*	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-AP-104

L. W. Shelton
Numatec Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 640362 UC: 712
Org Code: 74610 Charge Code: N4G3A
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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-AP-104 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

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RECORD OF REVISION

(1) Document Number: WHC-SD-WM-ER-596 — Page 1

(2) Title: Tank Characterization Report for Double-Shell Tank 241-AP-104

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release: (5) Cog. Engr.	Authorized for Release: (6) Cog. Mgr. Date
0	(7) Initially released 08/07/96 on EDT 617503.	W. D. Winkleman	J. G. Kristofzski
0A RS	Incorporate per ECN-640362.	M. J. Kupfer	K. M. Hodgson
		M J Kupfer 8-27-97	K.M. Hodgson 8-27-97

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AP-104

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AP-104

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-AP-104 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.O CHEMICAL INFORMATION SOURCES

Available composition information for the waste in tank 242-AP-104 is as follows:

- Appendix A of this report provides characterization results from the June 1996 grab sampling event.
- The Hanford Defined Waste (HDW) model document (Agnew et al. 1997) provides tank content estimates derived from the Los Alamos National Laboratory (LANL) model, in terms of component concentrations and inventories.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Typically, best-basis inventory documents include a comparison of sampled-based inventories derived from analytical concentration data with inventories generated by the HDW model (Agnew et al. 1997). However, the HDW model estimates for all tanks are valid as of January 1, 1994. At that time tank 241-AP-104 contained 68 kL (18 kgal) of dilute non-complexed (DN) supernatant. Since that time, tank 241-AP-104 has been filled with other DN waste and then emptied approximately down to its current level of 98.4 kL (26 kgal). Data obtained from the January 1996 sampling data are the most appropriate source of information pertaining to the waste currently in tank 241-AP-104. Therefore, the HDW model estimates are of limited value. No solids are expected to be in tank 241-AP-104.

The chemical species in this appendix are reported without charge designation per the best-basis inventory convention.

D3.0 COMPONENT INVENTORY EVALUATION

When tank 241-AP-104 was sampled in January, 1996, it contained 4,258 kL (1,125 kgal) of supernatant. As explained in section 5.3, laboratory analysis indicated a concentration gradient for the supernatant. Samples taken 244 cm (96 in) from the bottom were more concentrated than samples taken closer to the waste surface. Unfortunately, samples were not taken at depths lower than 244 cm (96 in.). It may be that at depths lower than 244 cm (96 in.), the concentrations continue to increase.

Shortly after the tank was sampled, the waste level in tank 241-AP-104 was pumped down to 25 cm (9.7 in.) using a deep well turbine pump that is located near the tank bottom. The concentration gradient present before the transfer rules out using mean concentrations calculated from samples taken from all sampling locations. Since the inlet of the pump is near the tank bottom, a subset of samples taken from regions close to the waste surface are more appropriate for the waste remaining in tank 241-AP-104. Samples labeled by the laboratory as Pacific Northwest National Laboratory (PNNL) 96-3096, S96V000018, S96V000007, S96V000010, and S96V000022 were taken nearest to the waste surface at a depth 274 cm (108 in.) from the waste surface.

The best-basis inventory for the small supernatant heel remaining in tank 241-AP-104 was calculated from samples taken from the uppermost region of the waste before tank 241-AP-104 was emptied in 1996. Each analyte is represented in the data by only one sample; usually this is sample S96V000010. The sample concentrations used to generate the best-basis inventory, taken from Appendix A, are provided in Tables D3-1 and D3-2. Inventory estimates are also included in Tables D3-1 and D3-2.

Inventory estimates were developed for three elements (Ca, Cl, and K) from HDW model values reported by Agnew et al. (1997). The HDW values were corrected for volume differences (68 kL [18 kgal] in 1994 and 98 kL [26 kgal] in 1997) and normalized to the sodium ion concentration. That is, the HDW value was multiplied by the ratios of tank volumes (26/18), and sodium concentrations (4,530/12,400). The inventory estimates are reported in Table D3-1.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valence of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997). In this cases, this approach required that some anion analyte (e.g. nitrite, sulfate, phosphate or nitrate) inventories be adjusted to achieve the charge balance. The nitrate inventory estimate was reduced from 289 kg down to 275 kg to bring the total hydroxide up from a -5.22 kg up to 0 kg. The analytical data led to an inventory estimate for hydroxide of 45.5 kg. The imbalance in the hydroxide calculation strongly suggests that the selection of analyte concentration values was flawed.

Table D3-1. Supernatant Concentrations for Chemicals near the Surface Level and Inventory Estimates in Tank 241-AP-104 as of January 1996.

Analyte	Mean concentration (μg/mL)	Inventory Estimate[a] (kg)
Al	41.3	4.06
Bi	NR	NR
Ca	NR	11.2
Cl	NR	3.51
CO_3	2,930	288
Cr	17.1	1.68
F	113	11.1
Fe	<0.50	<0.049
Hg	NR	NR
K	NR	0.840[b]
La	NR	NR
Mn	<0.10	<0.0098
Na	4,530	446
Ni	0.326	0.0321
NO_2	1,090	107
NO_3	2,940	289
OH	462	45.5
Pb	NR	NR
PO_4	657	64.6
Si	20.1	1.98
SO_4	560	55.1
Sr	NR	NR
TOC	118	11.6
U	33.2	3.27
Zr	NR	NR

NR = Not reported
[a] Based on a supernatant volume of 98.4 kL (26 kgal)
[b] Estimated from the Hanford Defined Waste model values (Agnew et al 1997); refer to text.

Table D3-2. Supernatant Concentrations for Radionuclides near the Surface Level and Inventory Estimates in Tank 241-AP-104 as of January 1996.

Analyte	Mean concentration[a] (μCi/mL)	Inventory estimate[b] (Ci)
^{3}H	0.0139	1.36
^{14}C	1.60 E-04	0.0157
^{60}Co	4.10 E-04	0.0403
^{79}Se	<3.37 E-07	<3.32 E-05
^{90}Sr	0.082	8.07
^{99}Tc	7.24 E-04	0.0712
^{106}Ru	<0.1413	<13.9
^{129}I	<6.00 E-06	<5.9 E-04
^{134}Cs	0.00358	0.352
^{137}Cs	3.85	379
^{154}Eu	<0.00113	<0.111
^{155}Eu	<0.00842	<0.829
^{226}Ra	<0.0489	<4.81
^{237}Np	<2.78 E-04	<0.0274
^{238}Pu	<3.97 E-05	<0.0039
$^{239/240}Pu$	<3.58 E-05	<0.0035
^{241}Am	<1.44 E-04	<0.0142
$^{243/244}Cm$	<1.56 E-04	<0.0154

[a] Decayed to January 1, 1994
[b] Based on a supernatant volume of 98.4 kL (26 kgal).

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

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 chemical information for tank 241-A-102 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.

Inventories based on a subset of samples taken during the January 1996 sampling event should serve as the basis for the best estimate inventory to tank 241-AP-104 for the following reasons:

1. The January 1996, sampling event provides the most recent data for the waste.

2. Most of the waste in the tank when it was sampled was later removed, leaving only a small waste heel of supernatant that had been the top portion of the waste before the transfer took place.

3. The HDW model estimates have been invalidated due to transfers into and out of the tank subsequent to the HDW model cutoff date of January 1, 1994.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valence of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997). In this case, this approach required some anion analyte (e.g. nitrite, sulfate, phosphate or nitrate) inventories be adjusted to achieve the charge balance. The nitrate inventory estimate was reduced from 289 kg to 275 kg to bring the total hydroxide up from a -5.22 kg up to 0 kg. The analytical data led to an inventory estimate of 45.5 kg. The imbalance in the hydroxide calculation strongly suggests that the selection analyte concentration values was flawed.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Best-basis inventory estimates for tank 241-AP-104 are presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-104 (Effective April 30, 1997). (2 Sheets)

Analyte	Supernatant inventory (kg)	Basis (S, M, E or C)[1]	Comment
Al	4.06	S	
Bi	0	M	
Ca	11.2	M/E	
Cl	3.51	M/E	
TIC as CO_3	288	S	
Cr	1.68	S	
F	11.1	S	
Fe	<0.049	S	
Hg	0	M	
K	0.840	M/E	
La	0	M	
Mn	<0.0098	S	
Na	446	S	
Ni	0.0321	S	
NO_2	107	S	
NO_3	275	S/C	Nitrate value reduced from 289 kg to 275 kg in order to raise total hydroxide value to 0.
OH_{TOTAL}	0	C	
Pb	0	M	
PO_4	64.6	S	
Si	1.98	S	
SO_4	55.1	S	
Sr	0	M	
TOC	11.6	S	
U_{TOTAL}	3.27	S	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AP-104 (Effective April 30, 1997). (2 Sheets)

Analyte	Supernatant inventory (kg)	Basis (S, M, E or C)[1]	Comment
Zr	0	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al (1997)
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-104 Decayed to January 1, 1994 (Effective April 30, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	1.36	S	
^{14}C	0.0157	S	
^{59}Ni	0	M	
^{60}Co	0.0403	S	
^{63}Ni	0	M	
^{79}Se	<3.32 E-05	S	
^{90}Sr	8.07	S	
^{90}Y	8.07	S	Referenced to ^{90}Sr.
^{93}Zr	0	M	
^{93m}Nb	0	M	
^{99}Tc	0.0712	S	
^{106}Ru	<13.9	S	
^{113m}Cd	0	M	
^{125}Sb	0	M	
^{126}Sn	0	M	
^{129}I	<5.90 E-04	S	
^{134}Cs	0.352	S	
^{137}Cs	372	S	
^{137m}Ba	359	S	Referenced to ^{137}Cs
^{151}Sm	0	M	
^{152}Eu	0	M	
^{154}Eu	<0.111	S	
^{155}Eu	<0.829	S	
^{226}Ra	<4.81	S	
^{227}Ac	0	M	
^{228}Ra	0	M	
^{229}Th	0	M	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AP-104 Decayed to January 1, 1994 (Effective April 30, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{231}Pa	0	M	
^{232}Th	0	M	
^{232}U	0	M	
^{233}U	0	M	
^{234}U	0	M	
^{235}U	0	M	
^{236}U	0	M	
^{237}Np	<0.0274	S	
^{238}Pu	<0.0039	S	
^{238}U	0	M	
$^{239/240}Pu$	<0.0035	S	
^{241}Am	<0.0142	S	
^{241}Pu	0	M	
^{242}Cm	0	M	
^{242}Pu	0	M	
^{243}Am	0	M	
^{243}Cm	<6.16 E-04	S	4 percent of $^{243/244}Cm$
^{244}Cm	<0.0147	S	96 percent of $^{243/244}Cm$

[1]S = Composite sample-based, no segment data
M = Hanford Defined Waste model-based, Agnew et al. (1997)
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, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

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.

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.

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