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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 649441

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	8/31/98
	6. Project Title/No./Work Order No.: Tank 241-BY-111	7. Bldg./Sys./Fac. No.: NA	8. Approval Designator: NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): HNF-SD-WM-ER-687, Rev. 0A	10. Related ECN No(s).: NA	11. Related PO No.: NA

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

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

This ECN compiles all reconciliation changes made to the Best-Basis Inventory in FY 1998 and should replace *Section 3.0 and* Appendix D, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-BY-111, 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	H6-15	M. J. Kupfer	~~H5-49~~ R3-75
DOE Reading Room	H2-53	M. D. LeClair (3)	~~H5-49~~ R3-75
TCSRC	R1-10	J. Jo	R2-12
K. M. Hall	R2-12		

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ENGINEERING CHANGE NOTICE

Page 2 of 2

1. ECN (use no. from pg. 1) 649441

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	9-2-98	PE		
Cog. Mgr.	K. M. Hodgson K.M. Hodgson	9-9-98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other	J. Jo R2-12 JJo	9-8-98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

S

HNF-SD-WM-ER-687, Rev. 0B

Tank Characterization Report for Single-Shell Tank 241-BY-111

B. A. Higley
Numatec Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 649441 UC: 721
Org Code: 7A110 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 175

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-BY-111, 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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RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-687	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-BY-111

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 07/15/97 on EDT-617660.	J. Jo	K.M. Hall
0-A RS	Incorporate per ECN-635510.	J. Jo	K.M. Hall
		JN Cor	Kathleen M. Hall
		per telecon	8/25/97
RS 0-B	Incorporate per ECN-649441.	M.J. Kupfer	K.M. Hodgson
		MJ Kupfer	K.M. Hodgson
		9-2-98	9-9-98

A-7320-005 (08/91) WEF168

3.0 BEST-BASIS INVENTORY ESTIMATE

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, 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 chemical information for tank 241-BY-111 was performed, including the following:

- Data from two partial 1996 push-mode core samples (Appendix B)
- An inventory estimate generated by the HDW model (Agnew et al. 1997a)
- Evaluation of the BYSltCk data from other BY Tank Farm tanks.
  Two engineering assessments were performed. One compared this tank to other BY Farm tanks without ITS heaters. The second engineering assessment compared this tank to the two ITS evaporator tanks (241-BY-102 and 241-BY-112). The composition of the waste in tank 241-BY-111 is more like that for the two tanks with the ITS heaters.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. The sampling-based inventory was chosen as the best basis for those analytes for which sampling-based analytical values were available, for the following reasons:

- The sample-based inventory analytical concentrations for tank 241-BY-111 compared favorably to those of other BY tanks, specifically the evaporator tanks for the ITS.
- No methodology is available to fully predict BYSltCk from process flowsheet or historical records.

- Waste transfer records are not complete and not always accurate.

For those few analytes for which no values could be calculated from the sample-based inventory, the engineering evaluation data or the HDW model values were used. These values are less reliable than the values for which sample data are available.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. The best-basis inventory for tank 241-BY-111 is presented in Tables 3-1 and 3-2. The inventory values reported in Tables 3-1 and 3-2 are subject to change. Refer to the Tank Characterization Database (TCD) (LMHC 1998) for the most current inventory values. Appendix D contains the complete narrative regarding the derivation of the inventory estimates shown in Tables 3-1 and 3-2.

When the sample-based inventory had a high less-than value or was not measured, the engineering assessment-based values were used (if applicable). Some high less-than values are reported because all three tanks used in the second engineering assessment also had high less than values. Results for radionuclides were not available for the sample-based inventory. Strontium-90 and ^{137}Cs values were based on the heat load of tank 241-BY-111 from Kummerer (1995) and the ^{90}Sr/^{137}Cs ratio of BY saltcake. Uranium isotopes are derived from the chemical analysis for U. The remaining radionuclide values are HDW model values or by enginnering analysis.

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 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 Hanford Defined Waste 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. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	68,300	S	
Bi	0.0	E	Bi is highly insoluable in the supernate added to this tank.
Ca	840	E	Based on BY saltcake samples from other tanks. Sample reports <11,400.
Cl	2,980	S	
TIC as CO_3	266,000	S	Changed value from C to CO_3
Cr	5,630	S	
F	26,300	S	
Fe	16,300	S	
Hg	0.0	E	Simpson (1998)
K	4,650	E	Used average concentration from other tanks in BY Farm, these tanks are less representative of tank 241-BY-111, but have data.[2]
La	0.0	E	Sample reports <2,640. No history of 224 waste.
Mn	292	M	Sample reports <672.
Na	660,000	S	
Ni	23,400	S	This value may be biased high by a local deposit. 50% of inventory due to one sample result.
NO_2	38,800	S	
NO_3	418,000	S	
OH_{TOTAL}	177,000	C	Calculated from charge balance
Pb	223	E	Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110.
PO_4	54,500	S	Determined by IC
Si	94,200	S	This value may be biased high by a local deposit.
SO_4	94,000	S	Determined by IC

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Sr	173	E	Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110. Sample reports <559
TOC	16,700	S	
U_{TOTAL}	26,400	E	ICP:fusion sample reports <26,400. Tank has history of metal waste.
Zr	24	E	Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110. Sample reports <528

Notes:

[1]S = Sample-based, M = HDW model-base, E = Engineering assessment-based, and 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 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (3 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	214	M	
^{14}C	55.9	M	
^{59}Ni	5.95	M	
^{60}Co	52.1	M	
^{63}Ni	591	M	
^{79}Se	4.68	M	
^{90}Sr	61,500	E	Based on heat load and BY saltcake $^{90}Sr/^{137}Cs$ ratio. HDW estimate was 209,000
^{90}Y	61,500	E	Based on ^{90}Sr
^{93}Zr	22.6	M	
^{93m}Nb	16.3	M	
^{99}Tc	310	M	
^{106}Ru	0.0104	M	
^{113m}Cd	120	M	
^{125}Sb	234	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (3 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{126}Sn	7.00	M	
^{129}I	0.601	M	
^{134}Cs	2.54	M	
^{137}Cs	226,000	E	Based on heat load and BY salt $^{90}Sr/^{137}Cs$ ratio. HDW estimate was 247,000
^{137m}Ba	214,000	E	Based on ^{137}Cs
^{151}Sm	16,200	M	
^{152}Eu	7.34	M	
^{154}Eu	880	M	
^{155}Eu	445	M	
^{226}Ra	2.38E-04	M	
^{227}Ac	0.00321	M	
^{228}Ra	2.79	M	
^{229}Th	0.0643	M	
^{231}Pa	0.0164	M	
^{232}Th	0.103	M	
^{232}U	7.96	S/M	Based on total U: used HDW isotopic ratios.
^{233}U	30.5	S/M	Based on total U: used HDW isotopic ratios.
^{234}U	9.09	S/M	Based on total U: used HDW isotopic ratios.
^{235}U	0.392	S/M	Based on total U: used HDW isotopic ratios.
^{236}U	0.116	S/M	Based on total U: used HDW isotopic ratios.
^{237}Np	1.04	M	
^{238}Pu	3.65	S/M	Based on total alpha: used HDW isotopic ratios.
^{238}U	8.81	S/M	Based on total U: used HDW isotopic ratios.
^{239}Pu	131	S/M	Based on total alpha: used HDW isotopic ratios.

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (3 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{240}Pu	22.4	S/M	Based on total alpha: used HDW isotopic ratios.
^{241}Am	64.1	S/M	Based on total alpha: used HDW isotopic ratios.
^{241}Pu	263	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Cm	8.47E-04	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Pu	0.00127	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Am	0.00222	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Cm	1.72E-05	S/M	Based on total alpha: used HDW isotopic ratios.
^{244}Cm	2.94E-04	S/M	Based on total alpha: used HDW isotopic ratios.

Notes:

[1]S = Sample-based, M = HDW model-based, and E = Engineering assessment-based

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-111

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-BY-111

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 tank 241-BY-111 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

Available waste (chemical) information for tank 241-BY-111 includes the following:

- Data from two partial push-mode core samples that were collected in 1996. See Appendix B for data.
- The inventory estimate for this tank generated from the Hanford Defined Waste (HDW) model developed at Los Alamos National Laboratory, (Agnew et al. 1997a).
- Data from other tanks identified historically as having the same BY saltcake (BYSltCk) waste type. (See Section D3.3 for specific tanks and references.)

A list of references used in this evaluation is provided at the end of this Appendix (Section D5.0).

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Sampling-based inventories (see Appendix B), derived from the analytical concentration data from the core samples, and the HDW model inventories are compared in Tables D2-1 and D2-2. Table D2-1 compares nonradioactive components on a kilogram (kg) basis, and Table D2-2 compares the radioactive components on a total curie basis. The HDW model document (Agnew et al. 1997a) provides tank content estimates in terms of component concentrations and inventories. The chemical species are reported without charge designation per the best-basis inventory convention.

Sampling-based inventories listed in Appendix B were calculated by multiplying the mean concentration of an analyte by the current waste mass, derived using the current tank volume and the mean density of the waste. However, the sample data are based on incomplete core samples. A full profile of the waste was not obtained. The tank is reported to contain 1,740 kL (459 kgal) of total waste, partitioned as 1,660 kL (438 kgal) of saltcake and 80 kL (21 kgal) of sludge by (Hanlon 1997), and the mean density is reported to be 1.57 g/mL (Appendix B).

The HDW model inventory is based on a waste volume of 1,740 kL (459 kgal) and a density of 1.63 g/mL. The waste in the HDW model is partitioned in this manner: 1,640 kL (433 kgal) BY saltcake, and 100 kL (26 kgal) metal waste sludge.

The sampling-based inventory was developed by assuming that the last unsampled portion of the waste at the tank bottom had the same mean concentrations as the rest of the tank. In one core only six of nine segments were recovered, and the other core had seven of nine segments recovered. It is possible that a small layer of ferrocyanide waste or another unspecified sludge remains in the bottom of this tank, but no firm documentation is available to support this assumption. The assumption used for this assessment is that there is no sludge at the bottom of the tank (see Sections D3.1 and D3.2). The potential sludge layer is only a small portion of this tank's waste volume (<5 percent). Only a sample taken from the bottom of the tank can indicate if this is correct.

Table D2-1. Sampling-Based and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-BY-111. (2 Sheets)

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
Al	68,300	93,400	NO_3	418,000	665,000
Bi	<5,280	307	OH	NR	290,000
Ca	<11,400	5,120	Oxalate	52,800	0.387
Cl	2,980	7,650	Pb	<5,280	1,930
Cr	5,630	4,690	P as PO_4	54,500	14,400
F[3]	26,300	1,730	Si	94,200	3,530
Fe	16,300	2,650	S as SO_4	94,000	31,200
Hg	NR	11.9	Sr	<559	0
K	NR	2,550	TIC as CO_3	266,000	60,800
La	<2,640	0.466	TOC	16,700	11,900
Mn	<672	292	U_{total}	<26,400	51,500
Na	660,000	505,000	Zr	<528	5.08
NH_3	NR	375	H_2O (wt%)	31.7	36.9
Ni	23,400	1,300	Density (kg/L)	1.57	1.63

Table D2-1. Sampling-Based and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-BY-111. (2 Sheets)

Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)	Analyte	Sampling[1] Inventory Estimate (kg)	HDW[2] Inventory Estimate (kg)
NO_2	38,800	126,000			

Notes:

NR = Not reported
HDW = Hanford defined waste

[1]Appendix B
[2]Agnew et al. (1997a)
[3]Fluoride based on water soluble portion only.

Table D2-2. Sampling-Based and Hanford Defined Waste Defined Model-Based Inventory Estimates for Radioactive Components in Tank 241-BY-111.

Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)	Analyte	Sampling[1] Inventory Estimate (Ci)	HDW[2] Inventory Estimate (Ci)
^{90}Sr	NR	209,000	^{239}Pu	NR	149
^{137}Cs	NR	247,000	Total α	278	

Notes:

NR = Not reported
[1]Appendix B
[2]Agnew et al. (1997a)

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 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT

The reported waste types in tank 241-BY-111 are as follows. (See Appendix A for a detailed summary of the waste transfer history.)

(Agnew et al. 1997a and 1997b): MW, BYSltCk
(Hill et al. 1995): TBP-F, EB-ITS, OWW, CW

Abbreviations:

BYSltCk	=	BY Saltcake (same as EB-ITS)
TBP-F	=	Tributyl phosphate-ferrocyanide scavenged UR (TBP) supernatants (Equivalent to HDW Model defined waste PFeCN2)
CW	=	Coating waste from the bismuth phosphate process
EB-ITS	=	Evaporator bottoms from in-tank solidification
MW	=	Metal waste from the bismuth phosphate process
OWW	=	Organic Solvent Wash Waste from PUREX Plant

The estimated volumes of waste are addressed in Section D2.0.

A sludge layer may or may not exist at the bottom of tank 241-BY-111. During 1955, the tank was sluiced, and was declared empty in May of 1955 (Rodenhizer 1987). However, the HDW assumes that none of the MW solids were removed during the sluicing and attributes 98.4 kL (26 kgal) of the waste volume to MW sludge.

There is also a stronger possibility that TBP-F supernatants, transferred to the tank after it was sluiced, deposited sludge in the tank (Anderson 1990 and Agnew et al.1997b). Grigsby et al. (1992) strongly suggests a sludge layer in this tank, but because the sampling did not extend to the projected bottom 2 to 3 segments of the tank, none of these assumptions can be verified. The potential sludge layer is only a small portion of this tank's waste volume (<5 percent), and only a sample taken at the bottom of the tank could verify its existence.

The position taken in this document is that a sludge layer does not exist, and that the data taken from the core sample event can be extended to the unsampled portion of the tank.

D3.2 ASSUMPTIONS USED

The following sections provide an engineering evaluation of tank 241-BY-111 contents. For this evaluation, the following assumptions and observations were made:

- Total waste mass is calculated using the sampling-based measured density of 1.57 g/mL and the tank volume listed in (Hanlon 1997) (1,740 kL [459 kgal]). In (Hanlon 1997) 80 kL (21 kgal) are listed as sludge while (Agnew et al. 1997a) lists 100 kL (26 kgal) as sludge. The sampling based inventories and this assessment assume no sludge layer. As a result, the inventory estimates are not made on exactly the same waste type basis but are close (if MW is discounted).

- Only the BYSltCk waste stream contributed to solids formation.

- 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.

D3.3 BASIS FOR CALCULATIONS USED IN THIS EVALUATION

Table D3-1 summarizes the engineering evaluation approach used on tank 241-BY-111.

Table D3-1. Assessment Methodology Used For Tank 241-BY-111.

Type of Waste	How Calculated	Check Method
Supernatant	No supernatant predicted	N/A
Saltcake Vol. = 1,740 kL (459 kgal)	Used the sample-based inventory, which was calculated by multiplying the average tank analyte concentration by the total mass of the waste in tank 241-BY-111. The density used was the average measured density (1.57 g/mL).	Used sample-based concentrations for three other 241-BY tanks, multiplied by saltcake total mass in tank 241-BY-111. The density used was the density of tank 241-BY-111 (1.57 g/mL). As a second check method, the average concentration of tanks 241-BY-102, 241-BY-111 and 241-BY-112 were used with the density of tank 241-BY-111 (1.57 g/mL)
Sludge	No sludge predicted.	N/A

N/A = Not applicable.

BY saltcake (BYSltCk), the abbreviation used by Agnew et al. (1997a), denotes salt waste supernatants that were evaporated and concentrated using in-tank heaters. In-tank solidification (ITS) campaigns were performed in the BY Tank Farm from 1964 through 1976. Evaporated waste supernatants originated primarily from the $BiPO_4$ process operations in B Plant. Heaters were placed in tanks 241-BY-101, 241-BY-102, and 241-BY-112. Tank 241-BY-101 was heated for only a short time. The heater was then transferred to tank 241-BY-102. Certain BY tanks were designated as feed tanks. Concentrates from the heated tanks were transferred to other tanks in the BY tank farm and some BX tank farm tanks where they cooled and crystallized (Agnew et al. 1997b). Analyses have shown that the saltcake compositions for these tanks are somewhat different than those for the tanks that contained the heaters (Sasaki et al. 1997).

A defined waste composition for BYSltCk is provided in Agnew et al. (1997a). Because of the complicated waste supernatant transfer history of feed to the ITS campaign and the lack of a flowsheet basis for the waste, it is difficult to perform an independent assessment to estimate a saltcake composition that can be compared to the model-based BYSltCk composition. However, samples from BY tank farm tanks other than tank 241-BY-111 that contain BYSltCk which did not contain in-tank heaters have been analyzed and the results have been reported. The analytical results for these tanks were evaluated at the core segment level, and the BYSltCk was identified. Table D3-2 summarizes the compositions of saltcake from tank 241-BY-105, 241-BY-106, and 241-BY-110, based on the segment-level analysis reported, respectively, in Simpson et al. (1996a), Bell et al. (1996), and Simpson et al. (1996b). For comparison, the waste component concentrations for tank 241-BY-111 and the BYSltCk defined waste composition from

Agnew et al. (1997a) are also shown in Table D3-2 as well as the total calculated inventory for tank 241-BY-111.

As indicated in Table D3-2, the concentrations of major waste components such as sodium, aluminum, nitrate, fluoride, and sulfate vary among the three comparison tanks (tanks 241-BY-105, 241-BY-106, and 241-BY-110) by no more than a factor of about three. However, the variation among tanks for minor components is much higher.

Note that the fluoride, iron, oxalate, silicon, phosphate, and sulfate concentrations in tank 241-BY-111 samples are higher than the corresponding average concentrations of those components in the three BY farm comparison tanks. A few other analyte concentrations may also be higher in tank 241-BY-111 but are reported as less than values. The high sulfate and phosphate concentrations in tank 241-BY-111, as compared to other tanks without a ITS unit, are apparently compensated by lower nitrate concentrations than for the other tanks without a ITS unit. Some of the apparent anomalies for tank 241-BY-111 likely result from the use of tank 241-BY-112 as the ITS unit 2 (ITS-2). Tank 241-BY-111 received several direct inputs from 241-BY-112 which contained the heater, whereas several of the other BY farm tanks received some previously cooled evaporated supernatant from tank 241-BY-112. In particular, components with slightly lower solubilities would likely concentrate and precipitate from solution and collect on or near the cooler surfaces of the ITS unit in tanks 241-BY-112 or in 241-BY-111, which received more waste from 241-BY-112.

The average sampling-based composition for tanks 241-BY-105, 241-BY-106, and 241-BY-110 compares favorably with the HDW model BYSltCk composition than does the tank 241-BY-111 composition for some analytes and less favorably in others. The HDW do not consistently compare well with any of the tanks.

The total estimated inventories for tank 241-BY-111, from this engineering assessment, were determined by taking the average concentration of the three tanks (241-BY-105, 241-BY-106, and 241-BY-110) and multiplying by 459 (kgal) by 3785 (kgal to L) and by 1.57 kg/L (the density of 241-BY-111) and then by dividing by 1,000,000 (conversion factor to report as kg).

Table D3-2. Concentrations of Components in BY Tank Farm Saltcake Samples. (2 Sheets)

Analyte	Component Concentration (μg/g)						
	BY-105	BY-106	BY-110	Average Concentration	BY-111[1]	BY-111 Estimated Inventory (kg)	HDW Avg.[2] BYSltCk
Non-radioactive components							
Al	18,400	20,400	14,100	17,633	25,000	48,100	34,974
Bi	55.6	<49.2	NR	<52.4	<1,930	<143	114.9
Ca	216	308	400	308	<4,180	840	1,791
Chloride	897	2,060	2,250	1,736	1,090	4,730	2,860
Cr	321	855	2,900	1,359	2,060	3,710	1,754
Fluoride	4,100	5,130	5,420	4,883	9,620	13,300	649
Fe	476	215	924	538	5,960	1,470	749
Pb	50.3	64.5	130	82	<1,930	223	721
Mn	54.8	9.57	52.8	39.1	<246	107	109
Ni	75.9	47.9	193	106	NR	288	487
Nitrate	491,000	329,000	184,000	335,000	153,000	913,000	249,000
Nitrite	9,410	32,100	30,600	24,037	14,200	65,600	47,144
Oxalate	11,300	8,990	13,600	11,297	19,300	30,800	0.145
Phosphate	4,890	5,270	14,200	8,120	20,000	22,100	3,998
K	712	2,470	1,930	1,704	NR	4,650	956
Si	180	184	451	272	34,500	741	1,320
Na	198,000	203,000	237,000	213,000	241,000	580,000	185,000
Sr	88.3	44.4	58.1	64	<205	173	0
Sulfate	10,600	11,300	18,400	13,433	34,400	36,600	11,373
TIC as CO_3	NR	36,800	159,000	97,900	97,500	267,000	18,591
TOC	3,250	2,500	5,920	3,890	6,100	10,600	4,465
U	261	164.2	697	374	<9,660	1,020	3,930
Zr	5.23	6.28	14.4	8.64	<193	24	1.9
Density (g/mL)	NR	1.71	NR	1.71	1.57	1.71	1.63
wt% H_2O	16.1	25.5	23.2	21.6	31.7	21.6	36.3

Table D3-2. Concentrations of Components in BY Tank Farm Saltcake Samples. (2 Sheets)

Analyte	Component Concentration (µCi/g)						
	BY-105	BY-106	BY-110	Average Concentration	BY-111[1]	BY-111 Estimated Inventory (kCi)	HDW Avg.[2] BYSltCk
Radionuclides							
^{90}Sr	NR	<4.26	22.5	22.5	NR	61.5	78
^{137}Cs	NR	106	60	83	NR	226	92.2
$^{239/240}Pu$	NR	NR	0.0192	0.0192	NR	0.0525	0.056

Note:

NR = Not reported.
[1]From Appendix B.
[2]Agnew et al. (1997a).

The component concentrations in tank 241-BY-111 appear more like those for the tanks that contained the ITS units (241-BY-112 or 241-BY-102), than the other tanks listed in Table D3-2. This was somewhat unexpected because tank 241-BY-111 did not have an ITS unit and, as such, it was expected that the component concentrations in tank 241-BY-111 would be more closely aligned to other BY farm tanks without an ITS unit.

A second engineering assessment was performed in which the analyte concentrations for tank 241-BY-111 were compared to those two ITS unit tanks, tank 241-BY-102 and tank 241-BY-112 (Table D3-3). Tank 241-BY-111 was included in the average of the three tanks. These three tanks form a group that can be used to predict concentrations of similar tanks and to be compared to the HDW model inventories for such tanks. These tanks show more variability because of the ITS units, and in using all three tanks, the larger differences are buffered. The sampling-based average of these three tanks will be compared to the HDW model for evaluation. By including 241-BY-111 in this assessment, the reported value for the engineering assessment of each analyte is lowered by an average of about 7 percent. For those analytes with more variance this percent may be higher as is it lower for others.

This assessment estimates the total inventories for tank 241-BY-111, by multiplying the average analyte concentrations for these three tanks by 459 (kgal), by 3785 (kgal to L), and by 1.57 kg/L (the density of 241-BY-111) and by dividing by 1,000,000 (conversion factor to report as kg).

Table D3-3. Tank 241-BY-111 Inventory Calculations.

	µg/g	µg/g	µg/g	µg/g	BY-111 SC (kg)
Element	BY-102(SC)	BY-111(SC)	BY-112(SC)	Average Concentration	(SC Volume of 459 kgal)
Al	41,600	25,000	18,200	28,267	77,100
Bi	<2,030	<1,930	<2,040	<2,000	<5,460
Ca	<2,100	<4,180	<2,040	<2,774	<7,570
Chloride	1,220	1,090	1,150	1,153	3,150
Cr	1,870	2,060	17,500	7,143	19,500
Fluoride	18,000	9,620	9,410	12,343	33,700
Fe	1,860	5,960	2,960	3,593	9,800
Pb	<2,030	<1,930	<2,040	<2,000	<5,460
Mn	372	<246	<292	<303	<826
Ni	4,820	8,550	NR	6,685	18,300
NO_3	95,000	153,000	73,400	107,133	293,000
NO_2	13,900	14,200	20,400	16,167	44,100
Oxalate	19,300	19,300	29,600	22,733	62,000
PO_4	27,000	20,000	16,600	21,200	57,800
P	<9,500	9,810	<7,770	<9,000	<24,500
K	NR	NR	NR	NR	NR
Si	4,350	34,500	2,430	13,760	37,500
Na	267,000	241,000	334,000	280,667	766,000
Sr	<203	<205	<204	<204	<560
SO_4	57,700	34,400	25,000	39,033	106,000
TIC as CO_3	139,000	97,500	203,000	146,500	399,600
TOC	4,360	6,100	8,510	6,320	17,200
U	<10,000	<9,660	<10,200	<9,954	<27,200
Zr	<203	<193	<204	<200	<546
Radionuclides					
µCi/g	BY-102(SC)	BY-111 (SC)	BY-112(SC)	AVERAGE	Total 241-BY-112
^{90}Sr	NR	NR	NR	NR	NR
^{137}Cs	NR	NR	NR	NR	NR
$^{239/240}Pu$	NR	NR	NR	NR	NR

Notes:

NR = Not reported

SC = Saltcake

D3.4 ESTIMATED COMPONENT INVENTORIES

Estimated chemical inventories for tank 241-BY-111 are summarized in Table D3-4. Shown are the sample-based inventory, and the inventory estimated by the HDW model. Also shown are the predicted engineering assessment inventories from Tables D3-2 and D3-3. The first engineering assessment inventory is based on the average analytical values for the three BY farm comparison tanks without ITS units (241-BY-105, 241-BY-106, and 241-BY-110). The second engineering assessment inventory is based on the average of the two ITS tanks, 241-BY-102 and 241-BY-112, with the non-ITS tank 241-BY-111. Comments and observations are provided in the following text.

Tanks 241-BY-112 and tank 241-BY-102 were the designated tanks in the BY tank farm for the ITS heaters. Because of its configuration (that is, a heater in one tank and subsequent tanks connected in a series for cooling the concentrated supernatant), the ITS system caused a different mix of analytes to settle in the ITS heater tanks and apparently the initial cooling tank, 241-BY-111, than in the tanks further down stream.

For example, there is significantly less nitrate and nitrite in tank 241-BY-111 than in the other BY comparison tanks (241-BY-105, 241-BY-106, and 241-BY-110). There also appears to be higher concentrations of silicon, sulfate, phosphate, fluoride, and iron than in the BY saltcake in the first set of three comparison tanks (see Section D3.3). At this time, there is no way to accurately predict the saltcake analytical values through an engineering assessment, other than by using analytical data from other tanks containing BYSltCk. However, because of the unique position of the tank 241-BY-111 between the boiler tank (241-BY-112) and the other downstream cooling tanks and the substantial differences in solution equilibria between these situations, using either case (boiler or downstream) exclusively as a basis for representing 241-BY-111 will not provide an accurate description of the tank composition, although the boiler comparison still comes closest in most cases.

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-BY-111 Waste. (2 Sheets)

Component	Engineering Assessment (kg)[1]	Engineering Assessment (kg)[2]	Sample-based (kg)	HDW Estimate (kg)
Al	48,100	77,100	68,300	93,400
Bi	<143	<5,460	<5,280	307
Ca	840	<7,570	<11,400	5,120
Cl	4,730	3,150	2,980	7,650
Cr	3,710	19,500	5,630	4,690
F	13,300	33,700	26,300	1,730
Fe	1,470	9,800	16,300	2,650
K	4,650	NR	NR	2,550

Table D3-4. Comparison of Selected Component Inventory Estimates for Tank 241-BY-111 Waste. (2 Sheets)

Component	Engineering Assessment (kg)[1]	Engineering Assessment (kg)[2]	Sample-based (kg)	HDW Estimate (kg)
La	NR	NR	<2,640	0.466
Mn	107	<826	<672	292
Na	580,000	766,000	660,000	505,000
Ni	288	18,300	23,400	1,300
NO_3	913,000	293,000	418,000	665,000
NO_2	65,600	44,100	38,800	126,000
Oxalate	30,800	62,000	52,800	0.387
Pb	223	<5,460	<5,280	1,930
PO_4	22,100	57,800	54,500	14,400
Si	741	37,500	94,200	3,530
SO_4	36,600	106,000	94,000	31,200
Sr	173	<560	<559	0
TIC as CO_3	267,000	339,600	266,000	60,800
TOC	10,600	17,200	16,700	11,900
U	1,020	<27,200	<26,400	51,500
Zr	24	<546	<528	5.08
H_2O (percent)	31.7	31.7	31.7	36.9

Notes:

NR = Not reported.

[1]Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110.

[2]Based on average concentrations for components in tanks 241-BY-102, 241-BY-111, and 241-BY-112.

The HDW model does not properly represent the decreased solubilities for components in tank 241-BY-111 (for example, phosphate, sulfate, and fluoride) that are normally quite soluble in other tanks containing BYSltCk. The increased temperatures and rapid boil-off in tank 241-BY-112 likely resulted in a concentration and precipitation of these components, not only in that tank but in immediate transfers to tank 241-BY-111. The concentrated supernatants were also transferred to other BY farm tanks for cooling and further precipitation of the more soluble components.

Because of the unique history of tank 241-BY-102 and 241-BY-112 as ITS evaporator tanks and the relationship of 241-BY-111 to 241-BY-112, it is judged the analytical data from the 1996 core sample best represents the component concentrations for this tank. This receiver tank, 241-BY-111, exhibits concentrations much like the two ITS evaporator tanks. This was not expected based on data from other tanks but may have been anticipated based on a careful consideration of physical principles. The waste in the other BY receiver tanks exhibit markedly different concentrations of certain components.

For presently unexplained reasons, core 171 for tank 241-BY-111 has an unusually high concentration of Si. The high Si concentrations were consistently observed for segments 1-4 for this core. The sample data from this tank are thus used as the inventory for Si.

Total Hydroxide. 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).

Radionuclides were not measured in tanks 241-BY-102, 241-BY-111, or 241-BY-112. The best basis Radionuclide values were either engineering assessment values based on the heat load of tank 241-BY-111 from Kummerer (1995), engineering assessment #1, (Grigsby et al. 1992), or HDW values.

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, 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 chemical information for tank 241-BY-111 was performed, including the following:

- Data from two partial 1996 push-mode core samples (Appendix B)

- An inventory estimate generated by the HDW model (Agnew et al. 1997a)

- Evaluation of the BYSltCk data from other BY Tank Farm tanks. Two engineering assessments were performed. One compared this tank to other BY Farm tanks without ITS heaters. The second engineering assessment compared this tank to the two ITS evaporator tanks (241-BY-102 and 241-BY-112). The composition of the waste in tank 241-BY-111 is more like that for the two tanks with the ITS heaters.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. The sampling-based inventory was chosen as the best basis for those analytes for which sampling-based analytical values were available, for the following reasons:

- The sample-based inventory analytical concentrations for tank 241-BY-111 compared favorably to those of other BY tanks, specifically the evaporator tanks for the ITS.

- No methodology is available to fully predict BYSltCk from process flowsheet or historical records.

- Waste transfer records are not complete and not always accurate.

For those few analytes for which no values could be calculated from the sample-based inventory, the engineering evaluation data or the HDW model values were used. These values are less reliable than the values for which sample data are available.

Based on this evaluation, a best-basis inventory was developed for tank 241-BY-111. The best-basis inventory for tank 241-BY-111 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) (LMHC 1998) for the most current inventory values.

When the sample-based inventory had a high less-than value or was not measured, the engineering assessment-based values were used (if applicable). Some high less-than values are reported because all three tanks used in the second engineering assessment also had high less than values. Results for radionuclides were not available for the sample-based inventory. Strontium-90 and ^{137}Cs values were based on the heat load of tank 241-BY-111 from Kummerer (1995) and the $^{90}Sr/^{137}Cs$ ratio of BY saltcake. Uranium isotopes are derived from the chemical analysis for U. The remaining radionuclide values are HDW model values or by enginnering analysis.

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 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 Hanford Defined Waste 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. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	68,300	S	
Bi	0.0	E	Bi is highly insoluable in the supernate added to this tank.
Ca	840	E	Based on BY saltcake samples from other tanks. Sample reports <11,400.
Cl	2,980	S	
TIC as CO_3	266,000	S	Changed value from C to CO_3
Cr	5,630	S	
F	26,300	S	
Fe	16,300	S	
Hg	0.0	E	Simpson (1998)
K	4,650	E	Used average concentration from other tanks in BY Farm, these tanks are less representative of tank 241-BY-111, but have data.[2]
La	0.0	E	Sample reports <2,640. No history of 224 waste.
Mn	292	M	Sample reports <672.
Na	660,000	S	
Ni	23,400	S	This value may be biased high by a local deposit. 50% of inventory due to one sample result.
NO_2	38,800	S	
NO_3	418,000	S	
OH_{TOTAL}	177,000	C	Calculated from charge balance
Pb	223	E	Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110.
PO_4	54,500	S	Determined by IC
Si	94,200	S	This value may be biased high by a local deposit.
SO_4	94,000	S	Determined by IC
Sr	173	E	Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110. Sample reports <559
TOC	16,700	S	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-BY-111 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
U_{TOTAL}	26,400	E	ICP:fusion sample reports <26,400. Tank has history of metal waste.
Zr	24	E	Based on average concentrations for components in tanks 241-BY-105, 241-BY-106, and 241-BY-110. Sample reports <528

Notes:

[1]S = Sample-based, M = HDW model-base, E = Engineering assessment-based, and 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 D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (3 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	214	M	
^{14}C	55.9	M	
^{59}Ni	5.95	M	
^{60}Co	52.1	M	
^{63}Ni	591	M	
^{79}Se	4.68	M	
^{90}Sr	61,500	E	Based on heat load and BY saltcake $^{90}Sr/^{137}Cs$ ratio. HDW estimate was 209,000
^{90}Y	61,500	E	Based on ^{90}Sr
^{93}Zr	22.6	M	
^{93m}Nb	16.3	M	
^{99}Tc	310	M	
^{106}Ru	0.0104	M	
^{113m}Cd	120	M	
^{125}Sb	234	M	
^{126}Sn	7.00	M	
^{129}I	0.601	M	
^{134}Cs	2.54	M	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (3 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{137}Cs	226,000	E	Based on heat load and BY salt $^{90}Sr/^{137}Cs$ ratio. HDW estimate was 247,000
^{137m}Ba	214,000	E	Based on ^{137}Cs
^{151}Sm	16,200	M	
^{152}Eu	7.34	M	
^{154}Eu	880	M	
^{155}Eu	445	M	
^{226}Ra	2.38E-04	M	
^{227}Ac	0.00321	M	
^{228}Ra	2.79	M	
^{229}Th	0.0643	M	
^{231}Pa	0.0164	M	
^{232}Th	0.103	M	
^{232}U	7.96	S/M	Based on total U: used HDW isotopic ratios.
^{233}U	30.5	S/M	Based on total U: used HDW isotopic ratios.
^{234}U	9.09	S/M	Based on total U: used HDW isotopic ratios.
^{235}U	0.392	S/M	Based on total U: used HDW isotopic ratios.
^{236}U	0.116	S/M	Based on total U: used HDW isotopic ratios.
^{237}Np	1.04	M	
^{238}Pu	3.65	S/M	Based on total alpha: used HDW isotopic ratios.
^{238}U	8.81	S/M	Based on total U: used HDW isotopic ratios.
^{239}Pu	131	S/M	Based on total alpha: used HDW isotopic ratios.
^{240}Pu	22.4	S/M	Based on total alpha: used HDW isotopic ratios.
^{241}Am	64.1	S/M	Based on total alpha: used HDW isotopic ratios.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-111 Decayed to January 1, 1994 (Effective May 31, 1997). (3 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{241}Pu	263	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Cm	8.47 E-04	S/M	Based on total alpha: used HDW isotopic ratios.
^{242}Pu	0.00127	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Am	0.00222	S/M	Based on total alpha: used HDW isotopic ratios.
^{243}Cm	1.72E-05	S/M	Based on total alpha: used HDW isotopic ratios.
^{244}Cm	2.94E-04	S/M	Based on total alpha: used HDW isotopic ratios.

Notes:

[1]S = Sample-based, M = HDW model-based, and E = Engineering assessment-based

D5.0 APPENDIX D REFERENCES

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