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ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 612282

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 [ ]	D. E. Place, SESC, H5-27, 376-0176	[ ] Yes [X] No	7/9/97
	6. Project Title/No./Work Order No. Tank 241-AZ-101	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-410, 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-AZ-101.

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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-AZ-101 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		
File	H5-49	J. H. Baldwin	R2-12
D. E. Place	H5-27		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 612282

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	7-9-97	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson	7/21/97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J. H. Baldwin	John Baldwin	7/22/97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Double-Shell Tank 241-AZ-101

D. E. Place
SGN Eurisys Services Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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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-AZ-101 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-410	Page 1

(2) Title
Tank Characterization Report for for Double-Shell Tank 241-AZ-101

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 7/26/95 on EDT 612676.	K. M. Hodgson	J. G. Kristofzski
0A RS	Incorporate per ECN-612282.	M. J. Kupfer	K. M. Hodgson
		M J Kupfer 7-9-97	K.M. Hodgson 7/21/97

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AZ-101

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR DOUBLE-SHELL TANK 241-AZ-101

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

D1.0 CHEMICAL INFORMATION SOURCES

Considerable information is available concerning the contents of tank 241-AZ-101. Data sources include the following:

- Section 4.0 and Appendices A, B, and C of this Tank Characterization Report (TCR) contain sample data for tank 241-AZ-101 based on two core samples and three supernatant samples (Peterson et al. 1989 and Gray et al. 1993)
- The Plutonium-Uranium Extraction (PUREX) flowsheet (Allen et al. 1985)
- PUREX operating data, including essential material usage, fuel charging records, and uranium rework.
- The Hanford Defined Waste (HDW) model (Agnew et al. 1996)
- The ORIGEN2 model for predicting radionuclides in N Reactor fuels.

The data available allow preparation of both a sample-based estimate and a process estimate based on PUREX Plant operation/flowsheets. The results will then be compared to the HDW model prediction.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The inventory estimate for tank 241-AZ-101 is based on two core samples taken in 1989 and three supernatant samples taken in 1995 (Peterson et al. 1989, Gray et al. 1993, Rollison 1995). The HDW model (Agnew et al. 1996) provides an additional inventory estimate based on process knowledge and historical information. The chemical and radionuclide inventories in tank 241-AZ-101, based on the data and the HDW model, are included in Table D2-1. The chemical species are reported without charge designation per the best-basis inventory convention.

Table D2-1. Existing Tank 241-AZ-101 Inventory Estimates. (2 Sheets)

Analyte	HDW model[a] (kg)	Sample-based[b] (kg)
Ag	NR	78.2
Al	31,100	37,900
Bi	34.9	NR
Ca	2,200	467
Cd	NR	1,070
Cl	5,770	636
TIC as CO_3	8,070	107,000
Cr	371	343
F	1,680	6,000
Fe	18,100	19,100
Hg	0.259	NR
K	1,460	1,260
La	0.473	724
Mn	47.3	4,260
Na	212,000	350,300
Ni	344	855
NO_2	69,300	208,400
NO_3	70,100	241,100
OH	167,000	39,900
Pb	35.3	101
PO_4	1,520	4,720
Si	7,360	1,130
SO_4	37,600	57,200

Table D2-1. Existing Tank 241-AZ-101 Inventory Estimates. (2 Sheets)

Analyte	HDW model[a] (kg)	Sample-based[b] (kg)
Sr	0.0994	95.3
TOC	NR	5,630
U	24,800	1,070
Zr	8.71	6,720
Radionuclide[c]		
^{241}Am	NR	66,900
^{14}C	NR	0.353
^{224}Cm	NR	946
^{60}Co	NR	2,910
^{134}Cs	NR	1,940
^{137}Cs	7.13 E+06	6.25 E+06
^{154}Eu	NR	27,400
^{3}H	NR	3.26
^{129}I	NR	5.82
^{237}Np	NR	10.3
^{238}Pu	NR	135
^{239}Pu	NR	781
^{240}Pu	NR	222
^{241}Pu	NR	8,140
^{106}Ru	NR	39,600
^{125}Sb	NR	37,400
^{79}Se	NR	0.451
^{90}Sr	6.09 E+06	6.40 E+06
^{99}Tc	NR	474

HDW = Hanford Defined Waste
NR = Not reported
[a] Agnew et al. (1996)
[b] Table 4-2 and Appendices A, B, and C
[c] Radionuclides decayed to January 1, 1994.

D3.0 COMPONENT INVENTORY EVALUATION

D3.1 CONTRIBUTING WASTE TYPES

The chemical and radionuclide inventory consists primarily of Neutralized Current Acid Waste (NCAW) resulting from PUREX Plant processing of 2,470 MTU of zirconium-clad N Reactor fuel elements. Tank 241-AZ-101 was sluiced to remove a residual solids level before introduction of NCAW; however, a sludge inventory of 65.8 kL (17.4 kgal) remained. NCAW from PUREX Plant operation was routed to this tank between December 1983 and March 13, 1986. Additionally, dilute PUREX Plant wastes (such as cell drainage) that contained unusually high levels of radionuclides were also routed to the aging waste tanks on an infrequent basis.

The HDW model (Agnew et al. 1996) lists the following waste types for tank 241-AZ-101:

PL2	PUREX Plant Low-Level Waste (LLW) (1983 to 1988)
BL	B Plant LLW (1967 to 1976)
UNK	Unknown
P3	PUREX Plant High-Level Waste (HLW) (1983 to 1988).

P3 would be the predominant waste type for the aging waste tanks. The PL2 designation was used to account for the non-NCAW transfers that occurred during PUREX Plant operations.

The BL designation is beyond the time range for this defined waste. The B Plant transfers occurred in 1982 and were assumed to account for the tank heel at PUREX Plant startup. The material was actually waste from strontium purification and contained primarily sodium and sulfate ions, significantly different than the defined composition for BL. It is unlikely that much of this material remained in tank 241-AZ-101 after sluicing.

D3.2 RECOMMENDED ADJUSTMENTS TO TANK CHARACTERIZATION REPORT INVENTORIES

Improvement to the sample-based inventories can be made based on revised sludge volume estimates, waste layer/washed solids analyses of the 1989 core samples, analyses of the interstitial liquid in the core samples, and unreported chemical analyses for the three 1995 supernatant samples. The recommended adjustments are discussed in Sections D3.2.1 through D3.2.4. The results of these adjustments are summarized in the sample-based column of Table D3-11.

D3.2.1 Adjustment to Sludge Volume

The sludge volume used in the sample-based estimates (130 kL [34 kgal]) is low compared to that calculated from the actual sludge measurement data sheets. The average sludge level measured on May 30, 1989, was 34.54 cm (equivalent to 142,000 L). However, riser number 24D was not included in this measurement due to installation of the waste sampler. Previous measurements up to February 8, 1989, indicated significant sludge mounding at this location.

The core sample #2 segments measured 60.61 cm (23.8 in.), confirming that mounding was present at the sampling riser (24D). The sludge depth is 38.9 cm (15.3 in.) after averaging the core segment length with the other five measurements. The overall increase in sludge volume is 22.6 percent.

D3.2.2 Significant Waste Transfers

There were no significant inputs to the tank besides the PUREX Plant HLW generated from the processing of N Reactor fuels. A 37.8-kL (10-kgal) transfer was made to B Plant in March 1986. This constituted approximately 1 percent of tank volume content and a disproportionally low solids fraction. This small transfer occurred before all of the sampling events used for the sample-based inventory.

D3.2.3 Additional Supernatant Inventories

The sample-based reported inventories for K, Cr, and ^{99}Tc included only the contribution from the sludge layer. Inductively-coupled plasma analytical results for Cr and K are actually available for the three 1995 supernatant samples. Technetium-99 analyses were performed on the interstitial liquid for both core samples, which should be fairly comparable to the supernatant. The additional inventory can be calculated from the supernatant volume (3,500 kL [924 kgal]), the supernatant density (1.19 g/mL) and the average concentration.

Table D3-1. Additional Supernatant Inventories in Tank 241-AZ-101.

Analyte	Average supernatant concentration	Additional inventory
Cr	638 μg/mL	2,230 kg
K	4,040 μg/mL	14,200 kg
^{99}Tc	0.296 μCi/g	1,230 Ci

D3.2.4 Other Analytical Data

The waste oxide analyses (Peterson et al. 1989, Table 9) for the first core sample of tank 241-AZ-101 provide additional data for adjusting several questionable laboratory results. The washed solids analyses (Peterson et al. 1989, Table 2) would normally provide a similar opportunity; however, the material balances were poor. The layer samples for the second core sample provide a similar opportunity to check and adjust analytical results.

D3.2.4.1 Core Sample #1 Adjustments.

Silver. An Ag analysis was not completed for core #1, but the ratio of Ag to Fe for the oxides indicates a concentration of 1,740 μg/g centrifuged sludge. This translates to an Ag inventory of 302 kg that will then be averaged with the results from core #2.

Cadmium. The analytical result for the composite core is low compared to core # 2 and process estimates. The ratio of Cd to Fe from the oxide analyses indicates a centrifuged sludge concentration of 3,740 μg/g. This translates to 647 kg Cd, which is 33.3 times the composite core result. Again, this inventory will be averaged with the core #2 result.

Uranium. The analytical result for the composite core is extremely low considering normal PUREX Plant losses. The ratio of U to Fe in the oxides indicates a centrifuged sludge concentration of 10,800 μg/g, which translates to a U inventory of 1,860 kg This is 1,590 times the composite core result. This inventory will be averaged with the core #2 result.

D3.2.4.2 Core Sample #2 Concentration Adjustments. The layer samples (Gray et al. 1993, Table 2) for Ni, Al, and K indicate higher concentrations than were detected in the core composite. The washed solids analyses (Gray et al. 1993, Table 9) also indicate that some adjustment of the Ni concentration (the only fully insoluble metal of the three) is needed. The adjustments are comparatively small from a total tank inventory standpoint, but are included here for consistency with ongoing HLW feed processability studies.

Nickel. Averaging of the mean layer concentration with the value calculated from the washed solids Ni/Fe ratio indicates a concentration of 9,180 μg/g centrifuged solids, 40 percent above the analytical results for the composite core. This translates to a sludge inventory of 1,610 kg Ni, which will be averaged with the core #1 result.

Aluminum. The average of the layer samples is 25,400 μg/g sludge. This translates to a sludge inventory of 5,510 kg. This is 54 percent higher than the sample-based inventory that was based on analysis of the composite core. This adjusted sludge inventory will be averaged with the result from core #1.

Potassium. The average of the layer samples is 3,600 $\mu g/g$ sludge. This translates to a sludge inventory of 781 kg, a 42 percent increase from the sample-based inventory that was based on analyses of the composite core. This adjusted sludge inventory will be averaged with the result from core #1.

D3.3 INVENTORY ESTIMATE BASED ON PUREX FLOWSHEET/OPERATING RECORDS

The NCAW from 3,890 MTU of N Reactor fuel processed between 1983 and 1990 contained essentially all of the chemicals used for fuel dissolution, solvent extraction separations, and PuO_2 conversion. Additionally, most of the non-volatile radionuclides present in the irradiated N Reactor fuel would be contained in the NCAW. The flowsheet for processing of these fuels was well established and the amount of cold U rework is known. It is, therefore, possible to make a reasonable process-based estimate of the waste composition for the two aging waste tanks (241-AZ-101 and 241-AZ-102).

For chemical species, the process estimate consists of the estimated initial tank 241-AZ-101 sludge heel, plus chemical additions based on the PUREX flowsheet or actual essential material usage when available, plus estimated corrosion of the PUREX processing vessels (Fe, Cr, and Ni). For radionuclides, the process estimate consists of the estimated initial 241-AZ-101 tank heel, plus additions based on the ORIGEN2 model. The overall process estimate is summarized in the "Process Estimate" column of Table D3-11.

D3.3.1 PUREX Plant Operations Summary

A summary of pertinent information for PUREX Plant operations between 1983 and 1990 is provided in Table D3-2.

Table D3-2. PUREX Plant Processing Summary 1983 to 1990.

Process data	Total PUREX Plant processing	Tank 241-AZ-101	Tank 241-AZ-102
Hot Fuel Charged	3,890 MTU	2,470 MTU	1,420 MTU
Cold Uranium Charged	30 MTU	30 MTU	0 MTU
Cold Uranium Recycled	2,480 MTU	1,630 MTU	855 MTU
Processed for Neptunium Recovery[a]	2,500 MTU	229 MTU	2,270 MTU
Fraction 12 percent ^{240}Pu	8.63%	8.53%	8.81%

PUREX = Plutonium-Uranium Extraction
[a] Schofield (1991).

D3.3.2 Chemical Additions Per the PUREX Flowsheet

The PUREX flowsheet for reprocessing of N Reactor fuels (Allen et al. 1985) provides a basis for estimating waste composition. Minor chemical contributions from radionuclides in the fuel elements (Ag, Cd, La, Sr, and Zr) can be predicted from the ORIGEN2 model. The chemical additions per MTU processed are provided in Table D3-3.

Table D3-3. Chemical Additions per PUREX Flowsheet.

Chemical/source	Flowsheet usage	
	6 percent ^{240}Pu (kg/MTU)	12 percent ^{240}Pu (kg/MTU)
ANN-Head End	177.7	177.7
ANN-Solvent Extraction	30.0	30.0
ANN-Pu Oxide Line	0.77	0.77
Total ANN	208	208
$Cd(NO_3)_2$	2.25	2.25
$Fe(SO_3NH_2)_2$ - 1BX Stream	7.05	15.8
HSO_3NH_2	3.94	9.72
NaF	0.03	0.03
NaOH	137	172
$NaNO_2$	10.1	8.43
Additions for Np Recovery		
$Fe(SO_3NH_2)_2$ - "2N" Scrub Stream[a]	6.49	7.49
$NaNO_2$ - "HA" Column	0.42	0.41
Fission Products[b]		
Ag	0.0013	0.0052
Cd	0.0019	0.0059
La	0.044	0.109
Sr	0.033	0.077
Zr	0.141	0.338

ANN = Aluminum nitrate nonahydrate ($Al(NO_3)_3 \cdot 9H_2O$)
PUREX = Plutonium-Uranium Extraction
[a] Usage rate three times flowsheet: a compromise between usage rates reported by PUREX process engineers and the factor of four assumed in Schofield (1991)
[b] Fission product contributions based on ORIGEN2.

The total chemical additions to the aging waste tanks can be calculated based on the PUREX Plant processing history (Table D3-2) and the chemical additions per the PUREX flowsheet (Table D3-3). The results are summarized in Table D3-4.

Table D3-4. PUREX Plant Chemical Additions to the Aging Waste.

Chemical	Tank 241-AZ-101 (kg)	Tank 241-AZ-102 (kg)	Total (kg)
Ag (FP)	4	2	7
ANN	570,700	320,900	891,600
Cd (FP)	6	3	9
$Cd(NO_3)_2$	5,570	3,190	8,750
$Fe(SO_3NH_2)_2$	33,700	32,700	66,400
HSO_3NH_2	18,300	10,100	28,400
La (FP)	123	80	202
NaF	74	42	117
NaOH	579,900	319,100	899,000
$NaNO_2$	41,200	22,600	63,800
Sr (FP)	91	52	143
Zr (FP)	390	224	614

ANN = Aluminum nitrate nonahydrate ($Al(NO_3)_3 \cdot 9H_2O$)
FP = Fission product
PUREX = Plutonium-Uranium Extraction.

The waste analytes were calculated from the chemical compounds and tabulated in Table D3-5.

Table D3-5. Waste Analyte Additions per PUREX Flowsheet. (2 Sheets)

Analyte	Tank 241-AZ-101 (kg)	Tank 241-AZ-102 (kg)	Total (kg)
Ag (FP)	4	2	7
Al	41,000	23,100	64,100
Cd	2,650	1,520	4,170
F	34	19	53
Fe	7,580	7,360	14,900
La (FP)	123	80	202
Na	347,200	191,000	538,200

Table D3-5. Waste Analyte Additions per PUREX Flowsheet. (2 Sheets)

Analyte	Tank 241-AZ-101 (kg)	Tank 241-AZ-102 (kg)	Total (kg)
SO_4	44,200	35,300	79,600
Sr (FP)	91	52	143
Zr (FP)	390	224	614

FP = Fission product
PUREX = Plutonium-Uranium Extraction.

D3.3.3 PUREX Plant Chemical Usage per Essential Material Records

The quantities of aluminum nitrate nonahydrate [$Al(NO_3)_3 \cdot 9H_2O$ or ANN], ferrous sulfamate [$Fe(NH_2SO_3)_2$], and sulfamic acid (NH_2SO_3H) used for PUREX Plant processing between 1983 and 1990 are known. The actual chemical usage provides a basis for estimating Al, Fe (that portion added as an essential material), and sulfate in the aging waste tanks.

Table D3-6. PUREX Plant Essential Material Usage.

Chemical	Usage
Aluminum nitrate nonahydrate	935,400 kg
Ferrous sulfamate	103,300 kg
Sulfamic acid	54,500 kg

PUREX = Plutonium-Uranium Extraction.

The Al, sulfate, and Fe waste analytes can be calculated from the essential material usage and distributed between the two NCAW tanks based on the flowsheet estimate in Section D3.2. The results are provided in Table D3-7. These numbers will replace those calculated from the PUREX flowsheet for the process estimate.

Table D3-7. 241-AZ-101 Waste Inventories Based on PUREX Plant Essential Materials.

Analyte	241-AZ-101 inventory (kg)	241-AZ-102 inventory (kg)	Total NCAW (kg)
Al	43,100	24,300	67,400
Fe	11,800	11,500	23,300
SO_4	74,700	59,600	134,300

NCAW = Neutralized current acid waste
PUREX = Plutonium-Uranium Extraction.

Additionally, the PUREX head-end usage of rare earth nitrates (lanthanum-neodymium nitrate mixture) is known from operating data (see Kupfer et al. 1997, Section 5.11). These rare earth NO_2 were precipitated as a fluoride, dissolved in nitric acid, and combined with the feed to solvent extraction. The rare earth nitrate additions contributed 303 kg of La to tank 241-AZ-101 that will be added to the fission product La present in the irradiated fuel elements.

D3.3.4 Estimated PUREX Plant Corrosion

Corrosion of the PUREX process equipment, in particular the reactor fuel dissolvers and the process concentrators, contribute Fe, Cr, and Ni to the NCAW waste stream. Schofield (1991) estimates this corrosion loosely based on the PUREX Plant tank F15 waste analyses and equipment failure history. Corrosion was estimated to be 0.84 kg stainless steel/MTU charged to the dissolvers plus up to an additional 6.4 kg stainless steel/MTU processed through solvent extraction. Estimated corrosion for the waste concentrators was highly uncertain due the reliance on PUREX process dilution samples of tank F15 waste and should be considered an upper bound.

Chromium concentration data from tank 241-AZ-101 also can be used to calculate the PUREX Plant corrosion since most equipment in the PUREX Plant is 304 L stainless steel, which has a fixed composition of 71 wt% Fe, 19 wt% Cr, and 10 wt% Ni. Chromium was chosen over Ni for this estimate since approximately 80 percent of the Cr is soluble in tank 241-AZ-101 and is, therefore, less subject to sampling/analytical error than the almost totally insoluble Ni. The resulting corrosion product inventories are given in Table D3-8.

Table D3-8. Estimated Corrosion Products.

Corrosion analyte	PUREX Plant corrosion products
Cr (adjusted sample-based inventory minus heel)	2,220 kg
Ni (calculated)	1,170 kg
Fe (calculated)	8,290 kg

PUREX = Plutonium-Uranium Extraction
Schofield (1991) corrosion estimate would be a factor of 2.4 higher.

D3.3.5 Estimated Initial Tank Heel

Although tank 241-AZ-101 was sluiced before reuse as a NCAW receiver, a significant solids layer remained in the tanks. Sludge measurements taken on November 30, 1983, show a heel of 16 cm (6.3 in.) (average of 7 readings).

Layer analyses were included for the second core sample of tank 241-AZ-101. The bottom layer (L3 in Gray et al. 1993) taken 6 cm (2.4 in.) from the rotary valve of the sampler should be representative of the initial tank heel. The estimated initial tank inventory is provided in Tables D3-9 and D3-10.

Table D3-9. Estimated Composition of the Initial Tank 241-AZ-101 Sludge Heel for Nonradioactive Components. (2 Sheets)

Analyte	Layer L3 (μg/g)	Heel inventory (kg)
Ag	873.747	96
Al	53,693.19	5,900
Ca	1,058.112	116
Cd	674.4	74
Cl	319.077	35
Cr	3,800.908	418
F	1,850.444	203
Fe	46,855.63	5,150
K	2,799.417	308
La	416.73	46
Mn	5,334.48	586
Na	1.38 E+05	15,200
Ni	639.939	70

Table D3-9. Estimated Composition of the Initial Tank 241-AZ-101 Sludge Heel for Nonradioactive Components. (2 Sheets)

Analyte	Layer L3 (μg/g)	Heel inventory (kg)
NO_2	58,420	6,420
NO_3	41,416	4,550
Pb	4,143.8	455
PO_4	455.856	50
Si	4,044.384	444
SO_4	16,522.32	1,820
Sr	52.572	6
TOC	22,460.85	2,470
Zr	4,159.632	457
Sludge level	6.3 in.	
Volume	65,800 L	
Density	1.67 g/mL	

Table D3-10. Estimated Composition of the Initial Tank 241-AZ-101 Sludge Heel for Radioactive Components.

Radionuclide[a]	Layer L3 (μCi/g)	Heel inventory (Ci)
^{134}Cs	17.5	1,920
^{137}Cs	996	109,400
^{154}Eu	213	23,400
^{155}Eu	356	39,100
^{106}Ru	3,270	359,200
^{125}Sb	480	52,700

[a] Radionuclides measured in August 1991.

D3.3.6 Suspended Solids

Five supernatant samples, taken from three different tank depths (Peterson 1990), indicate that the average suspended solids was 0.73 vol% during a time period that the tank air lift circulators were operated routinely. Chemical analyses were not performed on these suspended solids, but they are slower settling materials and, therefore, probably rich in Al. The inventory of suspended solids was not added to the sludge level due to the lack of

analytical data, the unknown accuracy of the solids determination, and the fact that process estimates of Al are likely to account for most of the mass of the suspended solids.

D3.3.7 Radionuclide Estimates

The radionuclide inventories can be estimated from the reactor fuel exposure and the date that the fuel was reprocessed at the PUREX Plant. The radionuclide estimates are provided in Table D3-11. These estimates are based on the same ORIGEN2 calculations submitted for inclusion in Revision 4 of the HDW model (data version referred to as U6). The development of the ORIGEN2 estimate is described in more detail in Section 6.1 of Kupfer et al. (1997). The only adjustments made for tank 241-AZ-101 process estimate were as follows:

- The fraction of ^{134}Cs, ^{137}Cs, and ^{137}Ba originally present in the reactor fuel and lost to the neutralized cladding removal waste (NCRW) coating wastes was revised to 4.8 percent based on data from PUREX Plant campaigns A03 and A04. The value assumed by ORIGEN2 model was 2 percent.

- The small fraction of Np recovered during the filling of tank 241-AZ-101 (4.1 percent) was credited to tank 241-AZ-102. All recovered Np stored at the PUREX Plant was transferred to tank 241-AZ-102 on January 13, 1993.

D3.4 EVALUATION/RECONCILIATION OF INVENTORY ESTIMATES

The HDW model, sample-based, adjusted sample-based, and process estimates of tank 241-AZ-101 chemical and radionuclide inventory are provided in Table D3-11. In general, there is relatively good agreement between the adjusted sample-based and the process estimate for major components, but the HDW model values for the major chemical species are usually significantly lower.

Table D3-11. Comparison of Tank 241-AZ-101 Inventory Estimates. (4 Sheets)

Analyte	HDW model[a] (kg)	Sample-based[b] (kg)	Adjusted sample-based (kg)	Process estimate (kg)
Ag	NR	78.2	233	100
Al	31,100	37,900	40,100	49,000
Bi	34.9	NR	NR	NR
Ca	2,200	467	573	116
Cd	NR	1,070	1,700	2,720
Cl	5,770	636	637	35

Table D3-11. Comparison of Tank 241-AZ-101 Inventory Estimates. (4 Sheets)

Analyte	HDW model[a] (kg)	Sample-based[b] (kg)	Adjusted sample-based (kg)	Process estimate (kg)
TIC as CO_3	8,070	107,000	107,000	NR
Cr	371	343	2,640	2,640[c]
F	1,680	6,000	6,060	237
Fe	18,100	19,100	23,400	25,300
Hg	0.259	NR	NR	NR
K	1,460	1,260	15,700	308
La	0.473	724	888	472
Mn	47.3	4,260	5,220	586
Na	212,000	350,300	351,500	362,400
Ni	344	855	1,360	1,240
NO_2	69,300	208,400	208,900	NR
NO_3	70,100	241,100	241,500	NR
OH	167,000	39,900	39,600	NR
Pb	35.3	101	124	455
PO_4	1,520	4,720	4,720	50
Si	7,360	1,130	1,380	444
SO_4	37,600	57,200	57,500	76,500
Sr	0.0994	95.3	117	97
TOC	NR	5,630	6,060	2,470
U	24,800	1,070	2,460	7,270
Zr	8.71	6,720	8,240	847
Radionuclide[d]				
^{227}Ac	NR	NR	NR	0.001
^{241}Am	NR	66,900	82,000	22,600
^{243}Am	NR	NR	NR	9.98
^{137m}Ba	NR	NR	NR	6.93 E+06
^{14}C	NR	0.353	0.433	334
^{113m}Cd	NR	NR	NR	2,120
^{224}Cm	NR	946	1,160	25.4
^{243}Cm	NR	NR	NR	4.36
^{244}Cm	NR	NR	NR	102

Table D3-11. Comparison of Tank 241-AZ-101 Inventory Estimates. (4 Sheets)

Analyte	HDW model[a] (kg)	Sample-based[b] (kg)	Adjusted sample-based (kg)	Process estimate (kg)
^{60}Co	NR	2,910	3,570	4,610
^{134}Cs	NR	1,940	2,380	43,400
^{137}Cs	7.13 E+06	6.25 E+06	6.28 E+06	7.43 E+06
^{152}Eu	NR	NR	NR	273
^{154}Eu	NR	27,400	33,600	57,600
^{155}Eu	NR	NR	NR	71,500
^{3}H	NR	3.26	3.99	25,900
^{129}I	NR	5.82	7.14	2.78
^{93m}Nb	NR	NR	NR	87.4
^{59}Ni	NR	NR	NR	19.9
^{63}Ni	NR	NR	NR	2,300
^{237}Np	NR	10.3	12.6	19.6
^{231}Pa	NR	NR	NR	0.00307
^{238}Pu	NR	135	165	199
^{239}Pu	NR	781	958	1,500
^{240}Pu	NR	222	272	460
^{241}Pu	NR	8,140	9,990	19,400
^{242}Pu	NR	NR	NR	0.0739
^{226}Ra	NR	NR	NR	1.82 E-04
^{228}Ra	NR	NR	NR	1.31 E-08
^{106}Ru	NR	39,600	48,500	106,000
^{125}Sb	NR	37,400	45,800	131,000
^{79}Se	NR	0.451	0.553	41.3
^{151}Sm	NR	NR	NR	142,000
^{126}Sn	NR	NR	NR	65.7
^{90}Sr	6.09 E+06	6.40 E+06	7.85 E+06	6.36 E+06
^{99}Tc	NR	474	1,800	1,100
^{229}Th	NR	NR	NR	1.25 E-06
^{232}Th	NR	NR	NR	1.58 E-08
^{232}U	NR	NR	NR	1.37 E-03
^{233}U	NR	NR	NR	7.95 E-04

Table D3-11. Comparison of Tank 241-AZ-101 Inventory Estimates. (4 Sheets)

Analyte	HDW model[a] (kg)	Sample-based[b] (kg)	Adjusted sample-based (kg)	Process estimate (kg)
^{234}U	NR	NR	NR	3.55
^{235}U	NR	NR	NR	0.132
^{236}U	NR	NR	NR	0.292
^{238}U	NR	NR	NR	2.44
^{90}Y	NR	NR	NR	6.36 E+06
^{93}Zr	NR	NR	NR	199

HDW = Hanford Defined Waste
NR = Not reported
[a] Agnew et al. (1996)
[b] The adjusted sample-based inventory for chromium was used to estimate Fe and Ni corrosion products, consequently the process estimate for Cr is not an independent estimate
[c] Table 4-2 and Appendices A, B, and C
[d] Radionuclides decayed to January 1, 1994.

D3.4.1 Hanford Defined Waste Model Discussion

The HDW model assumes a waste volume of 263 gal/ton U, whereas, solvent extraction rework of U and Pu increased this to about 351 gal/ton U (excluding transfer line flush). Additionally, there needs to be a distinction between chemicals added to the fuel dissolvers (ANN and HNO_3) and those chemicals added to the solvent extraction system and, therefore, subject to increases with product rework.

The HDW model assumes a constant volume percent solids for the NCAW waste stream, while the actual value is highly dependant on the OH concentration that in turn controls Al solubility. The OH concentration for tank 241-AZ-101 is much higher than tank 241-AZ-102, hence, the solids percent will be much lower even though they are both the same waste type.

The HDW model Si concentration was selected based on the unexplained presence of Si in previous PUREX Plant HLW. However, the Si actually comes from the bonding layer in aluminum-clad fuel and would not be present when processing zirconium-clad fuel elements. The adjusted sample-based inventory provides a better estimate.

The HDW model iron concentration appears comparatively high (0.117*M*). This includes 0.05*M* contribution for corrosion (25 percent more than the fixed 0.04*M* normally

used). In contrast, the flowsheet estimate for this report was 0.078*M*, about half of which is due to corrosion. Part of this discrepancy probably results from assuming that the ferrous sulfamate was consistently added for Np recovery. Actually, only about 4 percent of fuel processed during the filling of tank 241-AZ-101 included Np recovery. This also affects the sulfate concentration in the NCAW waste stream.

The HDW model inventories for NO_2 and NO_3 ions are also low compared to the adjusted sample-based values (see Table D3-11). The HDW model apparently over estimates the efficiency of the PUREX sugar denitration process. The efficiency of the sugar denitration process varies with reaction time and the composition of the waste stream (RHO 1983), making modeling difficult. For tank 241-AZ-101, the adjusted sample-based inventory for chemical N (total of NO_2 and NO_3 on mole basis) is 3.2 times the HDW model estimate.

Although a minor contribution, the HDW model assumes that the initial tank 241-AZ-101 sludge heel was attributable to the BL waste type. Since the waste was transferred to tank 241-AZ-101 in 1992, the B Plant waste was more likely to consist primarily of Na and sulfate ions. The 6 MT of Al indicated in Table D3-9 suggests that the solids material may have precipitated from another waste type previously stored in the tank (such as double-shell slurry feed [DSSF]).

For these reasons, the HDW model estimates will be used for the best-basis inventory only when other process estimates or sample data are not available.

D3.4.2 Reconciliation of Tank Characterization Report and Process Estimates

The individual chemical and radionuclide inventories, as determined from different methodologies, often do not agree. The rationale for selection of a best-basis value is provided in this section.

Silver. Silver nitrate was used to recharge the dissolver Ag reactors, although this material should not been included with NCAW transfers. The process estimate includes only the Ag present in the initial tank 241-AZ-101 heel and fission product silver in the fuel. Hence, the sample-based estimate is judged to be more reliable.

Aluminum. The overall NCAW process flowsheet estimate and essential material usage for Al agreed within about 5 percent. Additional Al was present in the initial tank heel. The process estimate was 22 percent higher than the adjusted sample-based inventory for tank 241-AZ-101.

A possible explanation for this difference is the precipitation of Al between the 1989 core sample events and the 1995 supernatant sampling. It is extremely likely that additional Al precipitated as the OH was depleted by carbon dioxide absorption from the air (22 air lift circulators were in operation for several years). Analytical data do, in fact, indicate that the

supernatant Al concentration declined between 1987 and 1995 (0.449, 0.398, and 0.345*M* in 1987, 1989, and 1995, respectively).

Bismuth. The HDW model predicts an inventory of 35 kg Bi, which is the only available estimate. The source of the Bi is unclear since Bi is not present in the P3, PL2, or BL waste types. No Bi was added to the PUREX process during processing of zirconium-clad N Reactor fuels and none would be expected in NCAW.

Calcium. The Ca inventory cannot be accurately estimated from the PUREX flowsheet since it originates as an impurity in essential materials. Raw water also contains Ca, but demineralized water was used for PUREX Plant chemical makeups. The adjusted sample-based inventory is the best data source.

Cadmium. The PUREX flowsheet does contain an estimate of cadmium nitrate usage. However this estimate is not based on a routine process stream and is only an approximation. The adjusted sample-based inventory is the best data source.

Chloride. Chlorides may be present in PUREX Plant essential materials (especially sodium hydroxide). It is not a primary constituent of any PUREX Plant essential material, hence, the adjusted sample-based inventory provides the best data source.

Carbonate. Sodium carbonate was used in the PUREX solvent treatment systems, however, these wastes were disposed separately and not combined with the NCAW stream. The carbonate ion present in tank 241-AZ-101 results primarily from the absorption of carbon dioxide from the air into the caustic NCAW solution. This process was accelerated by the use of airlift circulators in the aging waste tanks. Since the absorption of carbon dioxide is continuous, sampling is the only way to accurately determine the carbonate inventory. The adjusted sample-based inventory is the best data source.

Chromium. Chromium is not added as an essential material in the PUREX process. Chromium constitutes 10 percent of the 304L used in PUREX process equipment, hence, Cr will be present in the NCAW waste stream as the result of corrosion. Good process estimates are not possible due to the limited accuracy of the PUREX dilution samples take of the HLW. The adjusted sample-based inventory provides the best data source.

Fluoride. Fluorides could carry-over from the fuel decladding operations to the solvent extraction feed and the NCAW waste. The adjusted sample-based inventory provides the best data source.

Iron. The adjusted sample-based inventory and the process estimate are in excellent agreement (within 10 percent). The sample-based inventory will be used.

Mercury. The HDW model predicts an inventory of 0.26 kg Hg, which is the only available estimate. The HDW source of the Hg is unclear since Hg is not included in the

P3, PL2, or BL waste types. No Hg was added to the PUREX process during processing of zirconium-clad N Reactor fuels and none would be expected in NCAW.

Potassium. The process estimate predicts little K while the adjusted sample-based inventory is 15,700 kg. Part of the K might be explained by periodic use of potassium hydroxide for waste neutralization in place of sodium hydroxide or carry-over of small quantities from head-end metathesis processes. However, the 15,700 kg inventory suggests that another source might exist. Sodium hydroxide used in the PUREX Plant might have contained a small fraction of potassium hydroxide. The essential material specification for sodium hydroxide contained no limit for K. The adjusted sample-based inventory provides the best-basis.

Lanthanum. The adjusted sample-based estimate is almost twice the process estimate. Either inventory estimate could be in error. To be conservative, the adjusted sample-based inventory is selected as the best-basis.

Manganese. The adjusted sample-based inventory is nearly a factor of ten higher than process estimate. Manganese is not a significant fission product. Potassium permanganate is added to the solvent treatment systems, but this waste stream is not combined with the NCAW. There is no logical explanation for the higher Mn inventory. The sample-based inventory will be used for the best-basis to be conservative.

Sodium. The process estimate and the adjusted sample-based inventories are in excellent agreement (within 5 percent). The adjusted sample-based inventory will be used as the best-basis.

Nickel. The process estimate and the adjusted sample-based inventory are in excellent agreement (within 10 percent). The adjusted sample-based inventory will be used as the best-basis.

Nitrite. There are currently no process models capable of accurately predicting the nitrite concentration after the sugar denitration process. The adjusted sample-based inventory will be used as the best-basis.

Nitrate. There are currently no process models capable of accurately predicting the NO_3 concentration after the sugar denitration process. The adjusted sample-based inventory will be used as the best-basis.

Lead. The L3 layer sample from core #2 indicated unusually high lead concentration in the initial tank heel. As a consequence, the process estimate is 3.7 times the adjusted sample-based inventory. To be conservative, the process estimate of 455 kg will be used as the best-basis.

Phosphate. Phosphate is a constituent of the PUREX Plant solvent (as tributyl phosphate). Solvent degradation could easily add phosphate to the NCAW waste that could

not be predicted from the PUREX flowsheet. The adjusted sample-based inventory will be used for the best-basis.

Silicon. Silicon is not a primary constituent of PUREX Plant essential materials. A defoaming agent used in the HLW treatment system contained approximate 3 wt% Si, but the usage was only 0.65 L/day. The Si indicated from the adjusted sample-based inventory results from the initial tank 241-AZ-101 heel and incidental sand-like material either infiltrating through ventilation systems or present as an impurity in the PUREX Plant essential materials. The adjusted sample-based inventory will be used for the best-basis.

Sulfate. There is a significant difference between the adjusted sample-based inventory (57,500 kg) and the process estimate. The process estimate was based on the actual essential material usage (76,500 kg sulfate), but the essential material usage is much high than that predicted directly from the PUREX flowsheet (46,100 kg). Furthermore, most of the sulfate is in the supernatant, so there is less likelihood of analytical error. There is a possibility that the essential material usage is incorrect. The adjusted sample-based inventory will be used for the best-basis.

Strontium. The adjusted sample-based inventory and the process estimate are reasonably close (within 20 percent). The adjusted sample-based inventory will be used for the best-basis inventory.

Total Organic Carbon. The process estimate includes only the total organic carbon (TOC) present in the initial tank heel. Undigested sugar from the PUREX Plant denitration process as well a solvent degradation products would add to the TOC inventory. Sampling is the only reasonable method for determining this TOC inventory. The adjusted sample-based inventory will be used for the best-basis inventory.

Uranium. The process estimate is based on the assumed loss fraction for the ORIGEN2 radionuclide estimates (0.29 percent of U charged). Actual PUREX Plant solvent extraction U losses were usually well below 0.1 percent, which is consistent with the adjusted sample-based inventory. The adjusted sample-based inventory will be used for the best-basis inventory.

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. In some cases, this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, the number of significant figures is not increased. This charge balance approach is consistent with that used by Agnew et al. (1997).

Radionuclides. Due to the limited number of radionuclides that were analyzed in both the sludge and supernatant, most best-basis inventories are based on the process estimate that includes the initial tank inventory and reactor fuel inventories from the ORIGEN2 model.

The ORIGEN2 model overestimated PUREX Plant solvent extraction Pu losses; therefore, the adjusted sample-based inventories were selected as the best-basis inventory. The ORIGEN2 model similarly overestimates the PUREX Plant solvent extraction U losses. However, the curies of each U isotope is not included in the sample data, so it was necessary to use the process estimate inventories. The process estimates for U isotopes were multiplied by a factor of 0.34 to account for the lower chemical U inventory indicated by the adjusted sample-based inventory and provide the best-basis values.

The pathway of several radionuclides within the PUREX process is not precisely known due to volatility or extraction by the PUREX Plant solvent. These include ^{3}H, ^{14}C, ^{99}Tc, and ^{129}I. The sample-based inventory value would normally be preferred for these radionuclides. However, the adjusted sample-based inventory for ^{99}Tc was 178 percent of the process estimate, and it is known that approximately 31 percent of the ^{99}Tc was contained in the PUREX Plant U product or was released to the PUREX process condensates (Colby and Peterson 1995). Consequently the process estimate was used as the best-basis inventory for ^{99}TC, but should be considered an upper bound.

The adjusted sample-based inventory for ^{137}Cs was 15 percent lower than the process estimate, whereas, the adjusted sample-based inventory for ^{90}Sr was 23 percent higher than the process estimate. The process estimates were selected as the best-basis inventory for ^{137}Cs and ^{90}Sr to maintain consistency between these two major radionuclides.

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

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes and facilities for retrieving wastes, and processing them into a form that is suitable for long-term storage. Chemical and radiological inventory information are generally derived using three approaches: (1) component inventories are estimated using the results of sample analyses, (2) component inventories are predicted 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. Not surprisingly, the information derived from these different approaches is often inconsistent.

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

- Data from two 1989 core samples (Peterson et al. 1989 and Gray et al. 1993)
- Data from three supernatant samples collected in 1995
- An inventory estimate generated by the HDW model (Agnew et al. 1996)
- Estimation of the residual tank inventory before NCAW introduction in 1983
- Evaluation of the PUREX flowsheet in conjunction with PUREX Plant operating data for November 1983 to March 1986
- Evaluation of PUREX Plant essential material usage during this operating period
- Estimation of corrosion in PUREX Plant processing equipment
- Estimation of radionuclides based on the ORIGEN 2 model.

Based on this evaluation, a best-basis inventory was developed. In general, the sample-based results were preferred when they were reasonable and consistent with other results. Process estimates were generally used when the sample-based inventory was not available or reasonable. Frequently, the more conservative inventory value was selected when there was disagreement between the sample-based inventory and a process estimate. The HDW model contains flaws relating to NCAW waste volume generation rates and the

waste composition and was used only for minor components where no other data were available.

The waste in tank 241-AZ-101 consists primarily of the HLW generated by the PUREX process during the processing of 2,474 MTU of irradiated, zirconium-clad N Reactor fuel. The best-basis inventory for tank 241-AZ-101 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Defined scope of work in fiscal year 1997 did not permit update to include HDW Rev. 4 values (Agnew et al. 1997). 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-AZ-101 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	49,000	E	
Bi	35	M	Expected to be a minor component.
Ca	570	S	
Cl	640	S	
TIC as CO_3	107,000	S	Concentration will increase as CO_3 is absorbed from the air.
Cr	2,640	S	
F	6,060	S	
Fe	23,400	S	
Hg	0.26	M	
K	15,700	S	
La	890	S	
Mn	5,220	S	
Na	351,500	S	
Ni	1,360	S	
NO_2	208,900	S	
NO_3	241,500	S	Converted to NO_2 by ionizing radiation.
OH	210,000	C	
Pb	455	E	Tank heel had high lead concentration.
PO_4	4,720	S	Not "P as PO_4"
Si	1,380	S	
SO_4	57,500	S	Essential material usage was 33 percent higher. Not "S as SO_4"
Sr	117	S	
TOC	6,060	S	
U_{TOTAL}	2,460	S	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AZ-101 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Zr	8,240	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based
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-AZ-101 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	4.0	S	Sludge layer only.
^{14}C	0.43	S	Sludge layer only.
^{59}Ni	19.9	E	
^{60}Co	4,610	E	
^{63}Ni	2,300	E	
^{79}Se	41.3	E	
^{90}Sr	6.36 E+06	E	
^{90}Y	6.36 E+06	E	
^{93}Zr	199	E	
^{93m}Nb	87.4	E	
^{99}Tc	1,100	E	Should be considered an upper bound.
^{106}Ru	106,000	E	
^{113m}Cd	2,120	E	
^{125}Sb	131,000	E	
^{126}Sn	65.7	E	
^{129}I	7.1	S	Should be considered an upper bound.
^{134}Cs	43,400	E	
^{137}Cs	7.43 E+06	E	
^{137m}Ba	6.93 E+06	E	
^{151}Sm	142,000	E	
^{152}Eu	273	E	
^{154}Eu	57,600	E	
^{155}Eu	71,500	E	
^{226}Ra	1.8 E-04	E	
^{227}Ac	0.0010	E	
^{228}Ra	1.3 E-08	E	
^{229}Th	1.2 E-06	E	
^{231}Pa	0.0031	E	
^{232}Th	1.6 E-08	E	
^{232}U	4.6 E-04	S/E	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AZ-101 Decayed to January 1, 1994 (Effective January 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	2.7 E-04	S/E	
^{234}U	1.20	S/E	
^{235}U	0.044	S/E	
^{236}U	0.099	S/E	
^{237}Np	19.6	E	
^{238}Pu	165	S	
^{238}U	0.82	S/E	
^{239}Pu	958	S	
^{240}Pu	272	S	
^{241}Am	22,600	E	
^{241}Pu	9,990	S	
^{242}Pu	0.074	E	
^{242}Cm	25.4	E	
^{243}Am	9.98	E	
^{243}Cm	4.36	E	
^{244}Cm	102	E	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based.

D5.0 APPENDIX D REFERENCES

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