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Preliminary Tank Characterization Report for Single-Shell Tank 241-T-103: Best-Basis Inventory

S. L. Lambert
SGN Eurisys Services Corporation, Richland, WA 99352
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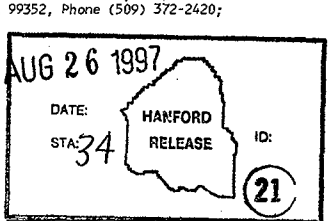
Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-T-103 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.



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PRELIMINARY TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-T-103: BEST-BASIS INVENTORY

July 1997

S. L. Lambert
SGN Eurisys Services Corporation
Richland, Washington

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

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PRELIMINARY TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-T-103: BEST-BASIS INVENTORY

This document is a preliminary Tank Characterization Report (TCR). It only contains the current best-basis inventory (Appendix D) for single-shell tank 241-T-103. No TCRs have been previously issued for this tank, and current core sample analyses are not available. The best-basis inventory, therefore, is based on an engineering assessment of waste type, process flowsheet data, early sample data, and/or other available information.

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

REFERENCE

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-T-103

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-T-103

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-T-103 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

This section briefly describes the sampling events for this tank since 1973. The first two samples were obtained in July and August of 1973 to estimate the chemical and radionuclide composition of the supernate. In 1974, another liquid sample was obtained to study the characteristics of this waste as a potential feed to the 242-S Evaporator. The 1973 data provide a comprehensive set of results for the supernatant, but virtually no analytical data for the sludge. Since most of the supernatant was transferred to tanks 241-S-110 and 241-T-101 during the second and third quarters of 1974, the 1974 supernatant sample represents the remaining supernatant fraction in this tank.

The waste history of this tank is provided in Anderson (1990) and Agnew et al. (1997b). Tank 241-T-103, operating as the third tank in a metal waste cascade, received metal waste from the fourth quarter of 1945 until the first quarter of 1946. This waste was removed by sluicing in late 1953. Metal waste was once again introduced to this tank during the second quarter of 1956 from tanks 241-T-101 and 241-T-102. Most of the metal waste was sluiced out in 1956 and early 1957, leaving about 3.7 kL (1 kgal) of residual metal waste in the bottom of the tank. Tank 241-T-103 received three large transfers of secondary Plutonium-Uranium Extraction (PUREX) coating (CWP2) waste from tanks 241-C-102 and 241-T-102 between 1965 and 1969, and one large transfer of secondary reduction and oxidation (REDOX) coating (CWR) waste from tank 241-T-101 also in 1969.

Two large transfers of B-Plant cesium recovery ion exchange wastes were received in 1972, with subsequent transfers to tanks 241-S-110 and 241-T-101 in 1974, followed by a small volume of liquid transferred via saltwell pumping to tank 241-AN-103 in 1983. Tank 241-T-103 was removed from service during the fourth quarter of 1974 and declared to be of questionable integrity by the second quarter of 1979. The Hanford Defined Waste (HDW) model (Agnew et al. 1997a) currently provides the only available set of waste composition estimates for this waste.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The average waste level is currently 13.1 cm (5.15 in.) in this tank (Swaney 1993). This inventory is consistent with current inventory estimates for this tank (87 kL of sludge and 15 kL of supernatant) (Hanlon 1997). The tank farm log data for this tank also shows that the waste level has varied from 11.9 to 13.5 cm (4.7 to 5.3 in.) since May 1980, which is roughly equivalent to an inventory of 102 kL (27 kgal) of waste (sludge and supernatant).

Since nearly identical inventory estimates have been developed from various sources of data, the best basis inventory will be based on the commonly accepted value of 102 kL (27 kgal) of sludge and drainable liquid in this tank (Hanlon 1997). In the HDW model, Agnew assumed 68 kL (18 kgal) of sludge and 34 kL (9 kgal) of salt cake (or salt slurry) to derive the HDW estimates for this waste.

D3.0 COMPONENT INVENTORY EVALUATION

The HDW model is primarily based on process waste production records and waste transaction records for each tank. Primary wastes are process wastes added directly to tank 241-T-101, while secondary wastes were transferred to the tank from another tank. Based on Agnew et al. 1997b, tank 241-T-103 contains the following waste types:

- 3.8 kL (1 kgal) of $BiPO_4$ metal waste (MW) sludge
- 64.4 kL (17 kgal) of PUREX coating waste (CWP2) sludge
- 18.9 kL (5 kgal) of Supernatant Mixing Model 242-T Evaporator salt cake period (SMMT2) salt cake
- 15.1 kL (4 kgal) of supernatant.

Table D3-1 provides estimates of the chemical composition of the waste, based on the HDW model, while Table D3-2 provides similar estimates for radioactive components in this waste. The chemical species are reported without charge designation per the best-basis inventory convention.

Table D3-1. Hanford Defined Waste Estimates[a] for Nonradioactive Components in Tank 241-T-103.

Analyte	HDW model sludge inventory (kg)	HDW model salt cake inventory (kg)	HDW model-tank inventory (kg)
Al	10,200	195	10,400
Bi	0	0.2	0.2
Ca	841	5	846
Cl	20.3	37.5	57.8
CO_3	1,670	159	1,830
Cr	8.1	32.8	40.9
F	0	0.9	0.9
Fe	1,670	3.2	1,670
Hg	76.3	0.00524	76.3
K	4.86	11	15.9
La	0	1.74 E-06	1.74 E-06
Mn	0	1.82	1.82
Ni	4.56	1.44	6
OH	23,800	794	24,600
NO_3	2,080	1,130	3,210
NO_2	665	585	1,250
Pb	4,340	0.8	4,340
PO_4	144	13.7	157
Si	0.18	12	12.2
Na	2,270	1,480	3,750
Sr	0	0	0
SO_4	92.2	124	216
TOC	0	57	57
U	4,220	10.6	4,230
Zr	0	0.013	0.013

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

Table D3-2. Hanford Defined Waste Estimates[a] for Radioactive Components in Tank 241-T-103.

Radionuclide	HDW model sludge inventory (Ci)	HDW model salt cake inventory (Ci)	HDW model tank inventory (Ci)
^{14}C	0.0153	0.29	0.3
^{60}Co	0.00745	0.332	0.34
^{90}Sr	126	725	850
^{90}Y	126	725	850
^{99}Tc	0.0455	2.05	2.09
^{137}Cs	144	745	890
^{154}Eu	0.146	4.93	5.08
^{155}Eu	3.04	1.51	4.55
^{237}Np	3.27 E-04	0.00705	0.00738
^{238}Pu	4.0	0.0105	4.01
^{239}Pu	167	0.32	167
^{240}Pu	29.6	0.0567	29.7
^{241}Am	0.0316	0.368	0.4

HDW = Hanford Defined Waste
[a] Agnew et al. (1997a), decayed to January 1, 1994.

In the next section flowsheet, fuel production, and process history will be used to independently evaluate the credibility of the HDW model-based estimates for this waste.

D3.1 WASTE TYPES

Generally, three different types of wastes were added to tank 241-T-103. The most important from a volume perspective are secondary PUREX coating (CWP2) waste and secondary REDOX coating (CWR) waste. Secondary cesium recovery (CSR) ion exchange waste and possibly salt cake waste (SMMT2) from the 242-T Evaporator may be present (although the waste transaction records do not support the presence of any salt cake wastes in this tank).

D3.2 SECONDARY PUREX AND REDOX COATING WASTES

About 1,945 kL (514 kgal) of secondary PUREX coating (CWP2) waste were received from tank 241-C-102 in 1965, and another 1,881 kL (497 kgal) of CWP2 waste from tanks 241-T-102 and 241-C-102 in 1969. In addition, 1,692 kL (447 kgal) of secondary REDOX coating (CWR) waste were received from tank 241-T-101 in 1969. According to the HDW model, PUREX coating waste makes up about 95 percent of the sludge in tank 241-T-103, with the balance consisting of residual metal waste. Because tank 241-T-103 was a secondary receiver of such waste, the absolute quantities of waste that might have been added to this downstream tank are unknown. Flowsheet values can be used, however, to generate upper bounding estimates for silica, aluminum and nickel, assuming that these wastes were routed directly to tank 241-T-103.

Analysis of the PUREX fuel fabrication and production records and waste transaction records (Agnew et al. 1997b) shows that 781.9 MTU of secondary (aluminum-clad) PUREX coating waste were transferred from tank 241-C-102 to tank 241-T-103 in 1965. Another 792.7 MTU of secondary (aluminum-clad) PUREX coating waste were transferred to tank 241-T-103 in 1969 after about 4 years of residence time in tank 241-T-102. Finally, about 2,119 MTU (215 gal/MTU) of secondary (aluminum-clad) REDOX coating waste were transferred to tank 241-T-103 in 1969 after 5 years of residence in tank 241-T-101 (see the best-basis discussions for tanks 241-T-101 and 241-T-102 [Lambert (1997a), Baldwin et al. (1997)]). The REDOX coating wastes appear to be much more concentrated than the PUREX coating waste (215 gal/MTU for REDOX waste versus 642 gal/MTU for PUREX coating waste because the PUREX coating waste estimate probably includes rinse and wash water). The number of MTU from each source was estimated by allocating the fuel over the volume of coating waste produced each quarter from the PUREX and REDOX processes.

D3.3 SILICA

The aluminum alloy jacket around the fuel typically contains 0.046 kg Si/MTU, while the Al-Si braze metal used in the bonding layer adds another 1.269 kg Si/MTU (Kupfer et al. 1997). Therefore, the upper bounding limit for the PUREX and REDOX coating wastes added to all of the tanks in the cascade should be 4,857 kg of Si (compared to the HDW estimate of 12.2 kg for tank 241-T-103).

Tank 241-T-102 may be the best comparison case for tank 241-T-103 because tank 241-T-102 was also secondary receiver of Al-clad coating waste. If coating waste had been sent directly to tank 241-T-102, the sludge layers in this tank would contain about 1,102 kg of Si. However, as a secondary receiver, only 417 kg of Si were actually found in tank 241-T-102 waste. Based on this comparison, the sludge layers in tank 241-T-103 should contain about 389 kg of Si (per 781.9 MTU) from the 1965 PUREX coating waste and an indeterminate amount of Si from other coating wastes, compared to 12.2 kg of Si predicted by the HDW model.

D3.4 ALUMINUM AND NICKEL

Other components were also contained in the PUREX and REDOX coating wastes, including 173,970 kg of Al and 1,736 kg of Ni (47.1 kg of Al and 0.47 kg of Ni per MTU, Kupfer et al. 1997). Aluminum-clad fuels produced after 1959 contained about 1 percent Ni in the Al alloy jacket (Kupfer et al. 1997).

Most of the Al is present as sodium aluminate in the coating waste. If this waste is stored in a receiver tank for an extended amount of time (4 to 5 years), the aluminum tends to precipitate because of the atmospheric absorption of CO_2. This pattern seems to characterize the behavior of tanks 241-C-102 and 241-T-102, where 90 percent of the aluminum would be expected to transfer as soluble sodium aluminate to tank 241-T-102, and based on samples, all of this aluminum precipitated over the 5 year period that secondary coating wastes were stored in this tank.

This example is important because it shows, based on the residence time in the primary receiver tanks, that most aluminum had already precipitated from the PUREX and REDOX coating wastes added to this tank in 1969, but not from the PUREX coating waste added in 1965. From the 1965 PUREX coating waste receipts, it appears that perhaps 90 percent of the aluminum in this waste, or 33,000 kg of aluminum in 781.9 MTU of PUREX coating waste, could have precipitated in tank 241-T-103, based on the observed separation factors developed from tank 241-C-102 and 241-T-102 analytical data (from the best-basis estimates for these tanks [Lambert (1997b), Baldwin et al. (1997)]). This projected inventory is equivalent to 95,300 kg of $Al(OH)_3$ or 68 percent of the estimated sludge mass in this tank, which seems high but not totally unreasonable. By comparison, the HDW model predicts 10,400 kg of aluminum in this tank, which appears low based on the amount of aluminum expected in the 1965 PUREX coating waste received in 241-T-103.

Based on similar comparisons for Ni, approximately 98 percent of the Ni settled in the primary receiver tank (241-C-102) rather than in the secondary receiver (241-T-102). This value was derived from the best basis inventory estimates for these tank (using flowsheet estimates and sample data for tanks 241-C-102 and 241-T-102). On this basis, only 7.3 kg of Ni are expected to be found in the tank 241-T-103 sludge, compared to the HDW model prediction of 6 kg of Ni. For a minor component, these values are in excellent agreement.

D3.5 COMMON SLUDGE LAYERS

Common sludge layers in other tanks can also be used to estimate the composition of tank 241-T-103 waste. Tank 241-T-103 received secondary PUREX coating waste, while tanks 241-C-102 and 241-C-105 received primary coating wastes of similar composition from the PUREX process. Tank 241-C-104 also received PUREX coating waste, but this waste only represents 56 percent of the total sludge inventory in this tank. As for the other tanks, PUREX coating waste is thought to represent about 90 percent of the sludge in tank 241-C-105 and 85 percent of the sludge in tank 241-C-102. This assumption is reasonable

because in 1965, PUREX coating wastes were stored in tank 241-C-102 only for a short period of time (several months at most) before being transferred to tank 241-T-103. In this respect, tank 241-T-103 was essentially a primary receiver of such waste in 1965. The following estimates were produced by multiplying the mass of each component (in the 241-C-102/241-C-105 waste) by the volume of coating waste sent to tank 241-T-103 (1,950 kL [514 kgal]) divided by the volume of coating waste sent to tanks 241-C-102 (49,370 kL [13,044 kgal]) or 241-C-105 (11,930 kL [3,151 kgal]) (Kupfer et al. 1997). These estimates are based on the analysis of tank 241-C-102 and 241-C-105 sludges, and are summarized in Table D3-3, together with the HDW model predictions for tank 241-T-103.

Table D3-3. Comparison of Common Sludge Layer Derived Estimates for PUREX Coating Waste and Hanford Defined Waste Derived Estimates for the Sludge Composition in Tank 241-T-103. (2 Sheets)

Analyte	Estimated inventory based on tank 241-C-102[a] (kg)	Estimated inventory based on tank 241-C-105[b] (kg)	HDW estimates for tank 241-T-103[c] (kg)
Al	3,080	2,496	10,400
Bi	133	27	0.2
Cr	28	54	40.9
Fe	463	428	1,670
Pb	45	38	4,340
Mg	149	143	NR
Mn	79.9	100	1.82
Ni	344	87	6
NO_3	2,140	894	3,210
NO_2	699	NR	1,250
PO_4	1,462	420	157
Si	1,870	1,607	12.2
Na	4,300	4,475	3,750
SO_4	181	< 885	216
U	118	410	4,230
Zn	478	0.7	NR
Zr	284	34	0.013

Table D3-3. Comparison of Common Sludge Layer Derived Estimates for PUREX Coating Waste and Hanford Defined Waste Derived Estimates for the Sludge Composition in Tank 241-T-103. (2 Sheets)

Analyte	Estimated inventory based on tank 241-C-102[a] (kg)	Estimated inventory based on tank 241-C-105[b] (kg)	HDW estimates for tank 241-T-103[c] (kg)
Sludge Volume, kL	54.35[d] kL	54.39[d] kL	68.1 kL

HDW = Hanford Defined Waste

[a]Common sludge layer estimate based on tank 241-C-102 sludge composition multiplied by fraction of 1965 PUREX coating waste routed to tank 241-T-103 (1,950 kL [514 kgal]) divided by volume routed to tank 241-C-102 (49,370 kL [13,044 kgal]). Tank 241-C-102 composition estimates referenced in Weiss and Schull (1988a).

[b]Common sludge layer estimate based on tank 241-C-105 sludge composition multiplied by fraction of 1965 PUREX coating waste routed to tank 241-T-103 (1,950 kL [514 kgal]) divided by volume routed to tank 241-C-105 (11,930 kL [3,151 kgal]). Tank 241-C-105 composition estimates referenced in Weiss and Schull (1988b).

[c]HDW based inventory estimate from Table D3-1.

[d]Sludge volume estimates based on fraction of PUREX coating waste sludge in tanks 241-C-102 and 241-C-105 (1,380 kL [364.5 kgal] and 333 kL [88.1 kgal], respectively) multiplied by the volume of coating wastes sent to tank 241-T-103 in 1965 divided by the volume sent to tanks 241-C-102 and 241-C-105.

The common sludge layer derived estimates for Al, Fe, NO_3, NO_2, Pb and U are generally lower than the HDW model predictions for this waste. The low aluminum inventory fraction in tanks 241-C-102 and 241-C-105 is expected because coating wastes were typically transferred to other tanks before most of the aluminum had a chance to precipitate in these primary receivers. This table also shows that large quantities of Fe were probably added from another source, possibly from the cesium recovery (CSR) ion exchange wastes added to tanks 241-T-101, 241-T-102 and 241-T-103 from 1972 to 1976.

The HDW model predictions for Cr, Na and SO_4 are in good agreement with estimates derived from tanks 241-C-102 and 241-C-105 wastes. HDW model predictions for U are likely to be more reasonable than estimates from tanks 241-C-102 and 241-C-105 because of the residual metal waste left in tank 241-T-103 after the 1957 sluicing campaign. The Zr estimates for tank 241-C-102 are also likely to be high because of the Zirflex waste added to this tank but not to tank 241-T-103.

The sludge volume estimates derived from various sources in Table D3-3 are also in reasonable agreement, except for the added volume of sludge from the secondary PUREX and REDOX coating wastes introduced to this tank in 1969. The total volume of waste

(102 kL [27 kgal]) is approximately twice the projected amount from PUREX coating waste added in 1965 (54.4 kL [14 kgal]).

While it is not certain what the balance consists of, the waste transaction records strongly suggest that the additional solids were probably derived from the PUREX and REDOX coating wastes sent to this tank in 1969. Most of the cesium recovery (CSR) ion exchange waste consists of soluble components that were probably transferred with most of the remaining supernatant to tanks 241-U-107, 241-S-110 and 241-T-101 in 1974

D3.6 BISMUTH PHOSPHATE METAL WASTE

Hanford sluicing records show that most of the metal waste was removed from tank 241-T-103 in 1953 and 1956 (Rodenhizer 1987). A small residual heel of 4 kL (1 kgal) of metal waste is thought to have been left after the 1956 sluicing campaign (Agnew et al. 1997b, Anderson 1990). Based on known composition of tank 241-T-101 metal waste (1.53 g moles of uranium/kg of metal waste) and assumed density of 1.74 kg/L, about 2,400 kg of uranium would be expected in this heel (compared to the HDW model prediction of 4,230 kg of uranium) (GE 1951, Agnew et al. 1997b). This heel is also expected to have about 319 kg of PO_4 and 759 to 1,740 kg of CO_3 (0.51 g moles of PO_4/kg of metal waste and 1.92 to 4.4 g moles of CO_3/kg of metal waste sludge) (GE 1951). The estimates for PO_4 and CO_2 are generally consistent with the HDW model predictions (157 kg of PO_4 and 1,830 kg of CO_3), while the estimate for U is about one-half the amount predicted by the HDW model.

The sluicing records from this era show that 81,800 kg of uranium were left in the tank 241-T-101, 241-T-102 and 241-T-103 cascade after the last sluicing campaign (declassified information from McDonald [1959]). If this information is correct, the residual metal waste heel could be as high as 43 kL (11.3 kgal) in tank 241-T-103, with corresponding inventories of 27,200 kg of uranium, 5,280 to 12,100 kg of CO_3 and 2,150 kg of PO_4. During the metal waste sluicing campaign, metal wastes from tanks 241-T-101 and 241-T-102 were typically sluiced to tank 241-T-103. In view of the high uranium inventory that might be present in this, the third tank of a three tank cascade, the HDW model predictions for uranium, CO_3 and PO_4 will be used as the best basis estimates for this waste.

D3.7 CESIUM AND STRONTIUM

Tank 241-T-103 has an estimated heat load of 1,075 BTU/h or 315 watts (Kummerer 1995). This heat load corresponds to 66,800 Ci of ^{137}Cs or 47,100 Ci of ^{90}Sr, values that are well above the HDW model predictions for this tank (890 Ci of ^{137}Cs and 850 Ci of ^{90}Sr, decayed to January 1, 1994). In addition to other sources of cesium and strontium, a significant fraction of cesium may have been added from tank 241-T-101 during the third and fourth quarters of 1972 (via the Redox supernatant from tanks 241-SX-114 and 241-SX-105). Due to the absence of sample data, the best basis ^{137}Cs and ^{90}Sr estimates will

be projected from the thermal modelling results, using the radionuclide ratios provided in the HDW model. Based on this assessment, 28,400 Ci of ^{137}Cs and 27,100 Ci of ^{90}Sr are assumed to be present in this waste. These values correspond to the hypothetical heat load characteristics of this waste.

D3.8 BEST-BASIS INVENTORY ESTIMATE

The Al inventory estimate developed from the fuel and waste transfer records and from the PUREX coating waste transferred to tank 241-T-103 in 1965 (33,000 kg of Al) appears to be more reasonable than the HDW model prediction for this tank (10,400 kg). Similarly, the upper bounding estimates for Si corrected for the separation factor developed for tanks 241-C-102 and 241-T-102 (389 kg of Si), seems to be a better value than the HDW model prediction (12.2 kg).

Other values in the HDW model, specifically those developed for CO_3, Fe, Cr, PO_4, Na, SO_4 and U, are consistent with other sources of information, including common sludge layers from other tanks, flowsheet estimates for B-Plant wastes or historical sluicing records for this tank. Waste volume estimates from various sources, including common sludge layer tanks such as 241-C-102 and 241-C-105, are also in general agreement with the waste volume predicted by the HDW model. Finally, the HDW model predictions for ^{137}Cs and ^{90}Sr are much lower than the values derived from the thermal modelling results for this tank. Better estimates were developed from the thermal modeling results using the fractional ratio of ^{90}Sr and ^{137}Cs in the HDW model prediction. The best-basis inventory estimates are summarized in Tables D3-4 and D3-5, using the HDW model predictions for most components, flowsheet and common sludge layer derived estimates for Al, Ni and Si, common sludge layer derived estimates for Mn and Pb, and thermal modeling results and the HDW model radionuclide ratios for ^{137}Cs and ^{90}Sr. The HDW model was used to predict all of the remaining radionuclides in this waste.

Table D3-4. Best-Basis Estimates for Nonradioactive Components in Tank 241-T-103. (2 Sheets)

Analyte	Best-basis tank inventory (kg)	Source
Al	33,000	1965 PUREX coating waste[a]
Bi	27	tank 241-C-105[b]
Ca	846	HDW
Cl	57.8	HDW
CO_3	1,830	HDW
Cr	40.9	HDW
F	0.9	HDW

Table D3-4. Best-Basis Estimates for Nonradioactive Components in Tank 241-T-103. (2 Sheets)

Analyte	Best-basis tank inventory (kg)	Source
Fe	1,670	HDW
Hg	76.3	HDW
K	15.9	HDW
La	0	HDW
Mn	80	tank 241-C-102[c]
Ni	7.3	1965 PUREX coating waste[a]
NO_3	3,210	HDW
NO_2	1,250	HDW
Pb	45	tank 241-C-102[c]
PO_4	157	HDW
Si	389	1965 PUREX coating waste[a]
Na	3,750	HDW
Sr	0	HDW
SO_4	216	HDW
TOC	57	HDW
U	4,230	HDW
Zr	0.013	HDW

HDW = Hanford Defined Waste, Agnew et al. (1997a)
NR = Not reported
PUREX = Plutonium-uranium extraction
[a] GE (1951)
[b] Weiss and Schull (1988b)
[c] Weiss and Schull (1988a).

Table D3-5. Best-Basis Estimates for Radioactive Components in Tank 241-T-103. (2 Sheets)

Radionuclide	Best-basis sludge inventory, Ci	Source
^{14}C	0.3	HDW
^{60}Co	0.34	HDW

Table D3-5. Best-Basis Estimates for Radioactive Components in Tank 241-T-103. (2 Sheets)

Radionuclide	Best-basis sludge inventory, Ci	Source
^{90}Sr	27,100	thermal model[a]
^{90}Y	27,100	based on ^{90}Sr
^{99}Tc	2.09	HDW
^{137}Cs	28,400	thermal model[a]
^{154}Eu	5.08	HDW
^{155}Eu	4.55	HDW
^{237}Np	0.00738	HDW
^{238}Pu	4.01	HDW
^{239}Pu	167	HDW
^{240}Pu	29.7	HDW
^{241}Am	0.4	HDW

HDW = Hanford Defined Waste, Agnew et al. (1997a), decayed to January 1, 1994

[a] Kummerer (1995).

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

Chemical and radionuclide inventory estimates are derived from one of three sources of information: (1) sample analyses and sample derived inventory estimates, (2) component inventories predicted by the HDW model based on process knowledge and historical tank transfer information, or (3) a tank-specific process estimate based on process flowsheets, reactor fuel data, essential materials records, or comparable sludge layers and sample information from other tanks.

An effort is currently underway to provide waste inventory estimates that will serve as the standard characterization data for various waste management activities. As part of this effort, a survey and analysis of various sources of information relating to the chemical and radionuclide component inventories in tank 241-T-103 was performed, including the following:

1. Component inventory estimates provided by the HDW model (Agnew et al. 1997a).

2. Evaluation of upper bounding estimates for secondary (Al-clad) PUREX and REDOX coating wastes (CWP2 and CWR, respectively), based on process flowsheets, fuel and waste transaction records for this tank.

3. Analysis of CWP2 sludge based on common sludge layers in tanks 241-C-102 and 241-C-105, together with waste transaction records for these tanks.

4. Analysis of residual metal waste based on the composition of tank 241-T-101 MW (GE 1951).

5. Evaluation of the estimated thermal loads provided by the HDW estimates for ^{90}Sr and ^{137}Cs relative to thermal modelling results for this tank.

Based on this analysis, a best-basis inventory was developed. The waste in tank 241-T-103 primarily consists of secondary (Al-clad) PUREX coating (CWP2) waste, secondary REDOX coating (CWR) waste, secondary cesium recovery (CSR) ion exchange waste and a small amount of residual metal waste (MW) from the $BiPO_4$ process. The best-basis inventory for tank 241-T-103 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) for the most current inventory values.

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. (1997a).

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

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

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-T-103 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	33,000	E	Based on 1965 PUREX coating waste and tanks 241-C-102 and 241-T-102
Bi	27	E	Based on tank 241-C-105
Ca	846	M	
Cl	57.8	M	
TIC as CO_3	1,830	M	
Cr	40.9	M	
F	0.9	M	
Fe	1,670	M	
Hg	76.3	M	
K	15.9	M	
La	0	M	
Mn	80	E	Based on tank 241-C-102
Na	3,750	M	
Ni	7.3	E	Based on 1965 PUREX coating waste and tanks 241-C-102 and 241-T-102
NO_2	1,250	M	
NO_3	3,210	M	
OH_{TOTAL}	66,300	C	Based on charge balance
Pb	45	E	Based on tank 241-C-102
P as PO_4	157	M	
Si	389	E	Based on 1965 PUREX coating waste and tanks 241-C-102 and 241-T-102
S as SO_4	216	M	
Sr	0	M	
TOC	57	M	
U_{TOTAL}	4,230	M	

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-T-103 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Zr	0.013	M	

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

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-103 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	1.7	M	
^{14}C	0.304	M	
^{59}Ni	0.0164	M	
^{60}Co	0.34	M	
^{63}Ni	1.62	M	
^{79}Se	0.0238	M	
^{90}Sr	27,100	E	Based on thermal model and HDW model radionuclide ratio
^{90}Y	27,100	E	Based on ^{90}Sr estimate
^{93m}Nb	0.0836	M	
^{93}Zr	0.117	M	
^{99}Tc	2.09	M	
^{106}Ru	6.78 E-05	M	
^{113m}Cd	0.651	M	
^{125}Sb	1.49	M	
^{126}Sn	0.0359	M	
^{129}I	0.00404	M	
^{134}Cs	0.00826	M	
^{137m}Ba	26,900	E	Based on ^{137}Cs estimate
^{137}Cs	28,400	E	Based on thermal model and HDW model radionuclide ratio
^{151}Sm	83.8	M	
^{152}Eu	0.0681	M	
^{154}Eu	5.08	M	
^{155}Eu	4.55	M	
^{226}Ra	1.36 E-06	M	
^{227}Ac	0.0106	M	
^{228}Ra	0.00348	M	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-T-103 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{229}Th	0.00157	M	
^{231}Pa	0.0157	M	
^{232}Th	1.68 E-04	M	
^{232}U	0.179	M	
^{233}U	0.697	M	
^{234}U	1.46	M	
^{235}U	0.0618	M	
^{236}U	0.0315	M	
^{237}Np	0.00738	M	
^{238}Pu	4.01	M	
^{238}U	1.41	M	
^{239}Pu	167	M	
^{240}Pu	29.7	M	
^{241}Am	0.400	M	
^{241}Pu	321	M	
^{242}Cm	0.00167	M	
^{242}Pu	9.05 E-04	M	
^{243}Am	1.51 E-05	M	
^{243}Cm	1.20 E-04	M	
^{244}Cm	0.00116	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based
NR = Not reported.

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D5.0 APPENDIX D REFERENCES

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