EDMC # 47728

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ACCESSION # D19724413 8

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# ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 635505

Proj. ECN

| 2. ECN Category (mark one) | 3. Originator's Name, Organization, MSIN, and Telephone No. | 4. USQ Required? | 5. Date |
|---|---|---|---|
| Supplemental [] <br> Direct Revision [X] <br> Change ECN [] <br> Temporary [] <br> Standby [] <br> Supersedure [] <br> Cancel/Void [] | Jaiduk Jo, Data Assessment and Interpretation, R2-12, 373-9322 | [] Yes [X] No | 07/25/97 |
| | 6. Project Title/No./Work Order No. <br> Tank 241-AN-105 | 7. Bldg./Sys./Fac. No. <br> 241-AN-105 | 8. Approval Designator <br> N/A |
| | 9. Document Numbers Changed by this ECN (includes sheet no. and rev.) <br> HNF-SD-WM-ER-678, Rev. 0-A | 10. Related ECN No(s). <br> ECN-635494 | 11. Related PO No. <br> N/A |

| 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) <br> [X] No (NA Blks. 12b, 12c, 12d) | N/A | N/A <br> Design Authority/Cog. Engineer Signature & Date | N/A <br> Design Authority/Cog. Engineer Signature & Date |

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

This ECN was generated to include additional explanatory text in the best-basis narrative, and to update the comprehensive radionuclide inventory estimates for the tank.

14a. Justification (mark one)

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

14b. Justification Details

Initial release of this document was deficient.

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

See attached distribution.

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A-7900-013-1

# ENGINEERING CHANGE NOTICE



1. ECN (use no. from pg. 1): ECN-635505

| 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 |
|---|---|---|
| N/A | | |

21. Approvals

| | Signature | Date | | Signature | Date |
|---|---|---|---|---|---|
| Design Authority | | | Design Agent | | |
| Cog. Eng. J. Jo | Beth Simpson for J. Jo | 8-21-97 | PE | | |
| Cog. Mgr. K.M. Hall | Kathleen M. Hall | 8/21/97 | QA | | |
| QA | | | Safety | | |
| Safety | | | Design | | |
| Environ. | | | Environ. | | |
| Other | | | Other | | |

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

# Tank Characterization Report for Double-Shell Tank 241-AN-105

Jaiduk Jo
Lockheed Martin Hanford, Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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Key Words: Waste Characterization, Double-Shell Tank, DST, Tank 241-AN-105, 241-AN-105, AN-105, AN Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-AN-105. This report supports the requirements of the Tri-Party Agreement Milestone M-44-10.

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| RECORD OF REVISION | (1) Document Number HNF-SD-WM-ER-678 | Page 1 |
|---|---|---|

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AN-105

CHANGE CONTROL RECORD

| (3) Revision | (4) Description of Change - Replace, Add, and Delete Pages | Authorized for Release (5) Cog. Engr. | (6) Cog. Mgr. Date |
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## 3.0 BEST-BASIS INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, as well as to address regulatory issues. Waste management 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 the wastes into a form that is suitable for long-term storage.

Chemical inventory information generally is derived using two approaches: 1) component inventories are estimated using the results of sample analyses; and 2) component inventories are predicted using a model based on process knowledge and historical information. The most recent model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1997). Not surprisingly, information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization information for the various waste management activities (Hodgson and LeClair 1996). Appendix D contains the complete narrative regarding the derivation of the inventory estimates presented in Tables 3-1 and 3-2.

Table 3-1. Best-Basis Total Inventory Estimates for Nonradioactive Components in Tank 241-AN-105 as of May 31, 1996. (2 sheets)

| Analyte | Total inventory (kg) | Basis (S, M, or E)[1] |
|---|---|---|
| Al | 156,000 | S |
| Bi | < 281 | S |
| Ca | < 1,100 | S |
| Cl | 40,800 | S |
| TIC as $CO_3$ | 197,000 | S |
| Cr | 6,060 | S |
| F | 4,340 | S |
| Fe | 306 | S |
| K | 25,400 | S |
| La | < 581 | S |
| Mn | < 59.4 | S |
| Na | 1.10E+06 | S |

Table 3-1. Best-Basis Total Inventory Estimates for Nonradioactive Components in Tank 241-AN-105 as of May 31, 1996. (2 sheets)

| Analyte | Total inventory (kg) | Basis (S, M, or E)[1] |
|---|---|---|
| Ni | < 129 | S |
| $NO_2$ | 504,000 | S |
| $NO_3$ | 728,000 | S |
| OH | 214,000 | S |
| Pb | 265 | S |
| $PO_4$ | 20,300 | S |
| Si | 950 | S |
| $SO_4$ | 22,900 | S |
| Sr | < 32.1 | S |
| TOC | 30,000 | S |
| $U_{TOTAL}$ | 242 | S |
| Zr | < 43.5 | S |
| Percent water | 46.6 | S |
| Density, g/mL | 1.56 | S |

Notes:

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

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AN-105 Decayed to January 1, 1994 (Effective May 31, 1996). (3 Sheets)

| Analyte | Total Inventory (Ci) | Basis (S,M or E)[1] | Comment |
|---|---|---|---|
| $^{3}H$ | 1410 | M | |
| $^{14}C$ | 198 | M | |
| $^{59}Ni$ | 11.1 | M | |
| $^{60}Co$ | 124 | S | |
| $^{63}Ni$ | 1090 | M | |
| $^{79}Se$ | 21.9 | M | |
| $^{90}Sr$ | 33,600 | S | |
| $^{90}Y$ | 33,600 | S | based on $^{90}Sr$ |

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AN-105 Decayed to January 1, 1994 (Effective May 31, 1996). (3 Sheets)

| Analyte | Total Inventory (Ci) | Basis (S,M or E)[1] | Comment |
|---|---|---|---|
| $^{93m}Nb$ | 77.6 | M | |
| $^{93}Zr$ | 106 | M | |
| $^{99}Tc$ | 1,170 | S | |
| $^{106}Ru$ | 0.056 | M | |
| $^{113m}Cd$ | 552 | M | |
| $^{125}Sb$ | 1330 | M | |
| $^{126}Sn$ | 33.2 | M | |
| $^{129}I$ | 11.0 | S | |
| $^{134}Cs$ | 208 | M | |
| $^{137m}Ba$ | 794,000 | S | based on $^{137}Cs$ |
| $^{137}Cs$ | 836,000 | S | |
| $^{151}Sm$ | 77200 | M | |
| $^{152}Eu$ | 26.9 | M | |
| $^{154}Eu$ | < 565 | S | |
| $^{155}Eu$ | < 2,260 | S | |
| $^{226}Ra$ | 9.14 E-04 | M | |
| $^{227}Ac$ | 0.00565 | M | |
| $^{228}Ra$ | 2.03 | M | |
| $^{229}Th$ | 0.0471 | M | |
| $^{231}Pa$ | 0.0249 | M | |
| $^{232}Th$ | 0.212 | M | |
| $^{232}U$ | 6.32 | M | |
| $^{233}U$ | 24.2 | M | |
| $^{234}U$ | 5.5 | M | |
| $^{235}U$ | 0.216 | M | |
| $^{236}U$ | 0.249 | M | |
| $^{237}Np$ | 25.8 | S | |
| $^{238}Pu$ | 11.8 | M | |
| $^{238}U$ | 6.53 | M | |
| $^{239/240}Pu$ | 6.43 | S | |
| $^{241}Am$ | 10.1 | S | |

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AN-105 Decayed to January 1, 1994 (Effective May 31, 1996). (3 Sheets)

| Analyte | Total Inventory (Ci) | Basis (S,M or E)[1] | Comment |
|---|---|---|---|
| $^{241}Pu$ | 920 | M | |
| $^{242}Cm$ | 0.987 | M | |
| $^{242}Pu$ | 0.00457 | M | |
| $^{243}Am$ | 0.0188 | M | |
| $^{243/244}Cm$ | < 4.27 | S | |

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

# APPENDIX D

# EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR TANK 241-AN-105

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# APPENDIX D

# EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR TANK 241-AN-105

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-AN-105 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 composition information for the waste in tank 241-AN-105 is as follows:

- Steen (1997) and Appendix B of this report provides characterization results from the June 1996 core sampling event.
- A feed projection document that supported grout treatment facility studies provides estimates of the waste in tank 241-AN-105 based on 242-A Evaporator slurry product data (Hendrickson 1994).
- The HDW model document (Agnew et al. 1997) provides tank content estimates in terms of component concentrations and inventories. A complete list of data sources used in this evaluation is provided at the end of this section.

A complete list of data sources used in this evaluation is provided at the end of this section.

## D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

There have been no transfers (with the exception of a small amount of flush water) into or out of tank 241-AN-105 since 1985. The HDW model provides composition estimates for the waste in tank 241-AN-105 as of January 1, 1994. Sample-based inventories derived from the June 1996 core samples and inventories generated by the HDW model (Agnew et al. 1997), are compared in Tables D2-1 and D2-2. (The chemical species are reported without charge

designation per the best-basis inventory convention). A tank volume of 4,270 kL (1,129 kgal) was used to generate the sample-based and HDW inventories. The sample based densities are 1.42 g/mL for the liquid and 1.59 g/mL for the salt slurry. The sample based bulk density is 1.56 g/mL. The HDW model bulk density is 1.88 g/mL. The sample-based inventories were taken from the inventory tables in Section B3.4.3. The liquid comprises 60 percent of the total volume; the salt slurry occupies 40 percent. The inventories that included the less than values (those having a "w" extension) but excluded the outliers ("ed") were used in this assessment.

Table D2-1. Sampling and Hanford Defined Waste Model Inventory Estimates for Nonradioactive Components in Double-Shell Tank 241-AN 105 (2 sheets)

| Analyte | June 1996 Inventory based on segment data from both core samples (kg) | June 1996 Inventory based on composite of core 152 (kg) | HDW Model Inventory (kg) | Inventory based on Evaporator post-run data[1] (kg) |
|---|---|---|---|---|
| Al | 168,000 | 145,000 | 271,000 | 201,000 |
| Bi | 196 | < 242 | 1,670 | NR |
| Ca | < 1,880 | 2,860 | 9,560 | NR |
| Cl | 40,100 | 41,500 | 54,800 | 36,400 |
| $CO_3$ | NR | 197,000 | 234,000 | 93,000 |
| Cr | 7,250 | 4,780 | 35,600 | 2,890 |
| F | 5,760 | 2,900 | 8,720 | NR |
| Fe | < 263 | 349 | 3,730 | 47.1 |
| Hg | NR | NR | 11.8 | NR |
| K | 26,100 | 24,700 | 17,800 | 26,200 |
| La | < 144 | < 131 | 11.8 | NR |
| Mn | < 71.8 | < 47.1 | 2,200 | NR |
| Na | 1.13E+06 | 1.07E+06 | 2.02E+06 | 1.18E+06 |
| Ni | < 141 | 116 | 2,660 | NR |
| $NO_2$ | 485,000 | 523,000 | 609,000 | 513,000 |
| $NO_3$ | 712,000 | 744,000 | 1.88E+06 | 826,000 |

Table D2-1. Sampling and Hanford Defined Waste Model Inventory Estimates for Nonradioactive Components in Double-Shell Tank 241-AN 105 (2 sheets)

| Analyte | June 1996 Inventory based on segment data from both core samples (kg) | June 1996 Inventory based on composite of core 152 (kg) | HDW Model Inventory (kg) | Inventory based on Evaporator post-run data[1] (kg) |
|---|---|---|---|---|
| OH | NR | 214,000 | 997,000 | 264,000 |
| Pb | 266 | < 264 | 1,540 | NR |
| $PO_4$ | 23,700 | 16,800 | 74,700 | 8,110 |
| Si | 920 | 980 | 13,600 | NR |
| $SO_4$ | 24,100 | 21,700 | 159,000 | 28,000 |
| Sr | 26.6 | < 24.2 | 0 | NR |
| TOC | NR | 30,000 | 109,000 | 14,400 |
| U | NR | 242 | 13,800 | NR |
| Zr | < 46.4 | < 40.7 | 149 | NR |
| % water | 46.6 | 46.6 | 17.2 | NR |
| density, g/mL | 1.56 | 1.56 | 1.88 | 1.50 |

Notes:

NR = not reported

[1]Hendrickson 1994.

Table D2-2. Sampling and Hanford Defined Waste Model Inventory Estimates for Radioactive Components in Double-Shell Tank 241-AN-105. (Decayed to January 1, 1994)

| Analyte | June 1996 inventory based on segment data from both core samples (Ci) | June 1996 inventory based on composite of core 152 (Ci) | HDW model inventory (Ci) | Inventory based on evaporator post-run data[1] |
|---|---|---|---|---|
| $^{60}Co$ | NR | < 124 | 253 | NR |
| $^{90}Sr$ | NR | 33,600 | 665,000 | 13,800 |
| $^{90}Y$ | NR | 33,600 | 665,000 | NR |
| $^{99}Tc$ | NR | 1,174 | 1,500 | NR |
| $^{129}I$ | NR | 11.0 | 2.89 | NR |
| $^{137}Cs$ | NR | 848,000 | 1.48E+06 | 215,000 |
| $^{137}mBa$ | NR | 805,000 | 1.41E+06 | NR |
| $^{154}Eu$ | NR | < 565 | 4,020 | NR |
| $^{155}Eu$ | NR | < 2,250 | 1,660 | NR |
| $^{237}Np$ | NR | < 25.8 | 5.28 | NR |
| $^{239/240}Pu$ | NR | < 6.42 | 359 | 44.1 |
| $^{241}Am$ | NR | 10.1 | 429 | NR |
| $^{244}Cm$ | NR | < 4.27 | 0.92 | NR |

Note:

[1]Hendrickson 1994.

The HDW model estimates for tank 241-AN-105 were derived by combining the supernatant streams that were believed to have been concentrated in the 242-A evaporator and then sent to tank 241-AN-105. This part of the HDW model is called the supernatant mixing model (SMM). The compositions of the supernatants are derived largely from bulk compositions of process waste streams that left the various processing facilities. To obtain the supernatant fractions, these bulk compositions are multiplied by solubility factors determined from the highest concentrations found among supernatant sample analyses. The higher inventories HDW model inventories for tank 241-AN-105 and other DST supernatants and slurries, when compared to their respective laboratory sample results, appear to be due to overestimation of the solubility of waste constituents in the process waste streams.

The periods in which tank 241-AN-105 received DSSF from the 242-A Evaporator and other waste tanks are accurately known (See Table A3-1, Appendix A). Slurry product concentration data from 242-A Evaporator post run documents can be obtained for each batch of feed processed. This data combined with the fill history of tank 241-AN-105 can be used to estimate the composition of tank 241-AN-105. This can serve as a check against the sample-based and HDW model inventories.

In 1994, an analysis of the DSSF in tanks 241-AN-104 and 241-AN-105 was performed (Hendrickson 1994). The results for tank 241-AN-105 are shown in column 5 of Tables D2-1 and D2-2. This table demonstrates close agreement between 242-A evaporator slurry data and the June 1996 core samples for all major components including Na, $OH^-$, $NO_2^-$, and $NO_3^-$. For K, and $SO_4^{2-}$, components present in lower concentrations, the June 1996 sample inventories and the inventories calculated from evaporator data are essentially the same. Al, $Cl^-$, Cr, Fe, $PO_4^{3-}$, TOC, $^{90}Sr$, and $^{239/240}Pu$ inventories determined from the evaporator post-run data are also in closer agreement to the June 1996 data than the HDW model.

## D3.0 COMPONENT INVENTORY EVALUATION

The evaluation of the core sample data in Appendix B noted that the relative percent differences (RPD) between the samples and duplicates, and spike recoveries for a number of analytes during individual segment analyses were outside the specified ranges (See Section B2.0). These discrepancies were attributed to the heterogeneity of the waste. Another factor for analytes such as $^{241}Am$, Ca, Li, Fe, Zr, Si, Mn, and Ni, whose RPDs were outside the required range is that their segment concentrations were at or near the detection limits. In Table D3-1, inventories for the supernatant and salt slurry portions based on the means of the segment data for both cores and the Core 152 composite are shown. Core 152 was taken from riser 12A near the center of the tank and Core 153 was taken from riser 7B twenty feet southwest of the center.

Table D3-1. Comparison of June 1996 Core Sample-based Inventories.

| Analyte | Segment based supernatant inventory (kg) | Segment based salt slurry inventory (kg) | Segment based total inventory (kg) | Core 152 composite supernatant inventory (kg) | Core 152 composite salt slurry inventory (kg) | Core 152 composite total inventory (kg) |
|---|---|---|---|---|---|---|
| Al | 107,000 | 59,600 | 168,000 | 91,500 | 53,300 | 144,500 |
| Bi | NR | 196 | 196 | < 134 | < 97.7 | < 232 |
| Ca | < 154 | 1,730 | 1,880 | 2,250 | 606 | 2,860 |
| Cl | 26,200 | 13,900 | 40,100 | 26,100 | 15,350 | 41,500 |
| $CO_3$ | NR | NR | NR | 28,100 | 169,000 | 197,000 |
| Cr | 576 | 6,670 | 7,250 | 573 | 4,300 | 4,780 |
| F | 752 | 5,010 | 5,760 | < 138 | 2,760 | 2,900 |
| Fe | < 77.1 | 186 | 263 | 163 | 148 | 311 |
| K | 16,800 | 9,300 | 26,100 | 16,700 | 8,040 | 24,700 |
| La | < 77.1 | < 66.7 | < 144 | < 77.1 | < 54.02 | < 131 |
| Mn | < 15.1 | 56.7 | < 71.8 | < 15.4 | 31.7 | < 47.1 |
| Na | 633,000 | 493,000 | 1.13E+06 | 655,000 | 418,000 | 1.07E+06 |
| Ni | < 30.7 | 110[a] | 141 | < 30.7 | 85.6 | 116 |
| $NO_2$ | 313,000 | 172,000 | 485,000 | 334,000 | 189,000 | 523,000 |
| $NO_3$ | 412,000 | 300,000 | 712,000 | 429,000 | 315,000 | 744,000 |
| OH | NR | NR | NR | 150,000 | 64,000 | 214,000 |
| Pb | 138 | 128 | 266 | < 154 | < 110 | < 264 |
| $PO_4$ | 1,930 | 21,800 | 23,700 | 2,670 | 14,100 | 16,800 |
| Si | 559 | 361 | 920 | 425 | 555 | 980 |
| $SO_4$ | 7,190 | 16,900 | 24,100 | 2,480 | 19,200 | 21,700 |
| Sr | NR | 26.6 | 26.6 | < 13.4 | < 10.1 | < 24.2 |
| TOC | NR | NR | NR | 15,600 | 14,400 | 30,000 |
| U | NR | NR | NR | 9.13 | 233 | 242 |
| Zr | < 15.6 | 30.8 | < 46.4 | < 15.4 | 25.3 | < 40.7 |

Note:

[a]Based on acid digest. Ni concentrations from fusion analyses are biased from Ni in the fusion crucible.

For major components (Al, Na, $NO_2^-$, $NO_3^-$), the RPDs between the total inventories are less than 15 percent. For analytes with RPDs < 20 percent, an average of the results in columns 4 and 7 are assumed to be appropriate for the best basis inventory. Generally, the mean concentrations from the segment data should be more accurate than the single core composite data because these means are based on concentrations taken from both cores. Reconciliation for analytes with RPDs > 20 percent are provided in the list below.

**1. Calcium (Ca)**

The RPD for the two total inventories is 41 percent. From Table B2-38, Ca liquid concentrations in all of the segments from both cores are below the detection limit (<42.3 $\mu$g/g). The Ca liquid concentration in the Core 152 composite is 618 $\mu$g/g. This number may be in error and may be a result of solids being present in the sample and included in the acid digestion. The < 154 kg value from the segment-based inventory is used for the best basis.

The salt slurry inventory for Ca in the segment-based sample is 2.85 times higher than the composite-based inventory. Table B2-31 for the solids acid digest results suggests horizontal heterogeneity between Core 152 and Core 153. An average of the salt slurry inventories in Table D3-1 is used in the best-basis inventory.

**2. Fluoride (F)**

The RPD for the two total inventories is 49 percent. Concentrations for F from the segment data vary considerably from segment to segment for both cores. An average of the segment-based data and the core 152 composite is used to determine the best-basis inventory.

**3. Manganese (Mn)**

The RPD for the two total inventories is 42 percent. The calculated inventories are < 71.8 kg and < 47.1 kg. Both cores show wide variation in Mn concentrations in the salt slurry segment concentrations. An average of the segment-based data and the core 152 composite is used to determine the best-basis inventory.

**4. Phosphate ($PO_4^{3-}$)**

The RPD for $PO_4^{3-}$ for the two total inventories is 34 percent. Table B2-59 shows that Core 153 contained higher $PO_4$ concentrations than Core 152, implying horizontal heterogeneity. An average of the segment-based data and the core 152 composite is used to determine the best-basis inventory.

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

Inventories based on the June 1996 sampling event should serve as the basis for the best estimate inventory to tank 241-AN-105 for the following reasons:

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

2. Estimates based on 242-A Evaporator product sample data agrees with the June 1996 data.

3. The HDW model estimate overestimates slurry and supernatant inventories due to solubility assumptions that are biased high.

Best-basis inventory estimates for tank 241-AN-105 are presented in Tables D4-1 and D4-2. Radionuclide values are decayed to January 1, 1994. 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.

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. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AN-105 Supernatant as of May 31, 1996. (2 sheets)

| Analyte | Supernatant inventory (kg) | Basis (S, M, or E)[1] | Comments |
|---|---|---|---|
| Al | 99,200 | S | |
| Bi | < 134 | S | |
| Ca | < 154 | S | |
| Cl | 26,100 | S | |
| TIC as $CO_3$ | 28,100 | S | Core composite data. |
| Cr | 573 | S | |
| F | < 445 | S | RPD > 20 percent |
| Fe | 120 | S | Segment-based < 77.1 |
| K | 16,700 | S | |
| La | < 77.1 | S | |
| Mn | < 15.2 | S | |
| Na | 644,000 | S | |
| Ni | < 30.7 | S | |
| $NO_2$ | 323,000 | S | |
| $NO_3$ | 420,500 | S | |
| OH | 150,000 | S | Core composite data. |
| Pb | < 146 | S | Composite < 154 |
| $PO_4$ | 2,300 | S | |
| Si | 492 | S | |
| $SO_4$ | 4,840 | S | |
| Sr | < 13.4 | S | |
| TOC | 15,600 | S | Core composite data. |
| $U_{TOTAL}$ | 9.13 | S | Core composite data. |
| Zr | < 15.5 | S | |
| Percent water | 51.9 | S | |
| Density, g/mL | 1.42 | S | |

Notes:

[1]S = Sample-based, M = Hanford defined waste model-based, E = Engineering assessment-based.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AN-105 Supernatant as of May 31, 1996. (Decayed to January 1, 1994) (2 sheets)

| Analyte | Supernatant inventory (Ci) | Basis (S, M, or E)[1] |
|---|---|---|
| $^{60}Co$ | < 0.050 | S |
| $^{90}Sr$ | 112 | S |
| $^{90}Y$ | 112 | S |
| $^{99}Tc$ | 701 | S |
| $^{129}I$ | 0.685 | S |
| $^{137}Cs$ | 1,290 | S |
| $^{137m}Ba$ | 1,230 | S |
| $^{154}Eu$ | < 250 | S |
| $^{155}Eu$ | < 835 | S |
| $^{237}Np$ | < 0.0566 | S |
| $^{239/240}Pu$ | 0.0953 | S |
| $^{241}Am$ | 0.100 | S |
| $^{243/244}Cm$ | 0.110 | S |

Notes:

[1]S = Sample-based, M = Hanford defined waste model-based, E = Engineering assessment-based

Table D4-3. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AN-105 Salt Slurry as of May 31, 1996.

| Analyte | Salt Slurry inventory (kg) | Basis (S, M, or E)[1] | Comment |
|---|---|---|---|
| Al | 56,500 | S | |
| Bi | < 147 | S | |
| Ca | 942 | S | |
| Cl | 14,620 | S | |
| TIC as $CO_3$ | 169,000 | S | Core composite data. |
| Cr | 5,490 | S | |
| F | 3,890 | S | |
| Fe | 186 | S | |
| K | 8,670 | S | |
| La | < 60.4 | S | |
| Mn | 44.2 | S | |
| Na | 456,000 | S | |
| Ni | 97.8 | S | |
| $NO_2$ | 181,000 | S | |
| $NO_3$ | 308,000 | S | |
| OH | 64,000 | S | Core composite data. |
| Pb | < 119 | S | |
| $PO_4$ | 18,000 | S | |
| Si | 458 | S | |
| $SO_4$ | 18,000 | S | |
| Sr | < 18.7 | S | Core composite data. |
| TOC | 14,400 | S | Core composite data. |
| $U_{TOTAL}$ | 233 | S | Core composite data. |
| Percent water | 44.7 | S | |
| Density, g/mL | 1.59 | S | |
| Zr | 28.1 | S | |

Notes:

[1]S = Sample-based, M = Hanford defined waste model-based, E = Engineering assessment-based.

Table D4-4. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AN-105 Salt Slurry as of May 31, 1996. (Decayed to January 1, 1994)

| Analyte | Salt slurry inventory (Ci) | Basis (S, M, or E)[1] |
|---|---|---|
| $^{60}Co$ | 124 | S |
| $^{90}Sr$ | 33,500 | S |
| $^{90}Y$ | 33,500 | S |
| $^{99}Tc$ | 473 | S |
| $^{129}I$ | 10.3 | S |
| $^{137}Cs$ | 835,000 | S |
| $^{137m}Ba$ | 793,000 | S |
| $^{154}Eu$ | < 315 | S |
| $^{155}Eu$ | < 1,420 | S |
| $^{237}Np$ | < 29.9 | S |
| $^{239/240}Pu$ | 6.33 | S |
| $^{241}Am$ | 9.97 | S |
| $^{243/244}Cm$ | < 4.16 | S |

Notes:

[1]S = Sample-based, M = Hanford defined waste model-based, E = Engineering assessment-based.

Table D4-5. Best-Basis Total Inventory Estimates for Nonradioactive Components in Tank 241-AN-105 as of May 31, 1996. (2 sheets)

| Analyte | Total inventory (kg) | Basis (S, M, or E)[1] |
|---|---|---|
| Al | 156,000 | S |
| Bi | < 281 | S |
| Ca | < 1,100 | S |
| Cl | 40,800 | S |
| TIC as $CO_3$ | 197,000 | S |
| Cr | 6,060 | S |

Table D4-5. Best-Basis Total Inventory Estimates for Nonradioactive Components in Tank 241-AN-105 as of May 31, 1996. (2 sheets)

| Analyte | Total inventory (kg) | Basis (S, M, or E)[1] |
|---|---|---|
| F | 4,340 | S |
| Fe | 306 | S |
| K | 25,400 | S |
| La | < 581 | S |
| Mn | < 59.4 | S |
| Na | 1.10E+06 | S |
| Ni | < 129 | S |
| $NO_2$ | 504,000 | S |
| $NO_3$ | 728,000 | S |
| OH | 214,000 | S |
| Pb | 265 | S |
| $PO_4$ | 20,300 | S |
| Si | 950 | S |
| $SO_4$ | 22,900 | S |
| Sr | < 32.1 | S |
| TOC | 30,000 | S |
| $U_{TOTAL}$ | 242 | S |
| Zr | < 43.5 | S |
| Percent water | 46.6 | S |
| Density, g/mL | 1.56 | S |

Notes:

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

Table D4-6. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AN-105 Decayed to January 1, 1994 (Effective May 31, 1996). (2 Sheets)

| Analyte | Total Inventory (Ci) | Basis (S,M or E)[1] | Comment |
|---|---|---|---|
| $^{3}H$ | 1410 | M | |
| $^{14}C$ | 198 | M | |
| $^{59}Ni$ | 11.1 | M | |
| $^{60}Co$ | 124 | S | |
| $^{63}Ni$ | 1090 | M | |
| $^{79}Se$ | 21.9 | M | |
| $^{90}Sr$ | 33,600 | S | |
| $^{90}Y$ | 33,600 | S | based on $^{90}Sr$ |
| $^{93m}Nb$ | 77.6 | M | |
| $^{93}Zr$ | 106 | M | |
| $^{99}Tc$ | 1,170 | S | |
| $^{106}Ru$ | 0.056 | M | |
| $^{113m}Cd$ | 552 | M | |
| $^{125}Sb$ | 1330 | M | |
| $^{126}Sn$ | 33.2 | M | |
| $^{129}I$ | 11.0 | S | |
| $^{134}Cs$ | 208 | M | |
| $^{137m}Ba$ | 794,000 | S | based on $^{137}Cs$ |
| $^{137}Cs$ | 836,000 | S | |
| $^{151}Sm$ | 77200 | M | |
| $^{152}Eu$ | 26.9 | M | |
| $^{154}Eu$ | < 565 | S | |
| $^{155}Eu$ | < 2,260 | S | |
| $^{226}Ra$ | 9.14 E-04 | M | |
| $^{227}Ac$ | 0.00565 | M | |
| $^{228}Ra$ | 2.03 | M | |
| $^{229}Th$ | 0.0471 | M | |
| $^{231}Pa$ | 0.0249 | M | |
| $^{232}Th$ | 0.212 | M | |
| $^{232}U$ | 6.32 | M | |
| $^{233}U$ | 24.2 | M | |
| $^{234}U$ | 5.5 | M | |
| $^{235}U$ | 0.216 | M | |

Table D4-6. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-AN-105 Decayed to January 1, 1994 (Effective May 31, 1996). (2 Sheets)

| Analyte | Total Inventory (Ci) | Basis (S,M or E)[1] | Comment |
|---|---|---|---|
| $^{236}U$ | 0.249 | M | |
| $^{237}Np$ | 25.8 | S | |
| $^{238}Pu$ | 11.8 | M | |
| $^{238}U$ | 6.53 | M | |
| $^{239/240}Pu$ | 6.43 | S | |
| $^{241}Am$ | 10.1 | S | |
| $^{241}Pu$ | 920 | M | |
| $^{242}Cm$ | 0.987 | M | |
| $^{242}Pu$ | 0.00457 | M | |
| $^{243}Am$ | 0.0188 | M | |
| $^{243/244}Cm$ | < 4.27 | S | |

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

## D5.0 APPENDIX D REFERENCES

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