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# ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 657282

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 [] <br> Change ECN [] <br> Temporary [] <br> Standby [] <br> Supersedure [X] <br> Cancel/Void [] | Melvin R. Adams, Data Development and Interpretation, R2-12, 373-6167 | [] Yes [X] No | 03/22/00 |
| | 6. Project Title/No./Work Order No. <br> Tank 241-AN-107 | 7. Bldg./Sys./Fac. No. <br> 241-AN-107 | 8. Approval Designator <br> N/A |
| | 9. Document Numbers Changed by this ECN (includes sheet no. and rev.) <br> WHC-SD-WM-ER-600, Rev. 0-C | 10. Related ECN No(s). <br> ECNs: 612297, 644487, 653798 | 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This hard copy document has been released and superseded by an electronic information database and data currently available via hard copy are now available at the HLAN address: http://pctwins.pnl.gov:9397/twinsproto/default.htm

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14a. Justification (mark one)

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

14b. Justification Details

Electronic access to information and data is superseding hard copy document.

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

See attached distribution.

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

A-7900-013-1

# ENGINEERING CHANGE NOTICE



1. ECN (use no. from pg. 1) ECN-657282

| 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. M. R. Adams | M R Adams | 3/22/00 | PE | | |
| Cog. Mgr. J. G. Field | J G Field | 3/22/00 | 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-107

**M. R. Adams**
CH2M Hill Hanford Group, Inc., Richland, WA 99352
U.S. Department of Energy Contract 8023764-9-K001

EDT/ECN: ECN-657282 UC: 2070
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Key Words: Waste Characterization, Double-Shell Tank, DST, Tank 241-AN-107, Tank AN-107, AN-107, AN Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: N/A

http://pctwins.pnl.gov:9397/twinsproto/default.htm

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Release Approval 3/23/00 Date

DATE: HANFORD RELEASE
STA: 4 ID: 2
MAR 23 2000
Release Stamp

**Approved for Public Release**

| RECORD OF REVISION | (1) Document Number WHC-SD-WM-ER-600 | Page 1 |
|---|---|---|

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AN-107

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 8/14/96 on EDT 617516. | J. Jo | J. G. Kristofzski |
| 0A RS | Incorporate per ECN-612297 | M. J. Kupfer 7-29-97 | K. M. Hodgson 7-29-97 |
| 0B RS | Incorporate per ECN-644487 | M.J. Kupfer 8/5/98 | K.M. Hodgson 8-3-98 |
| 0-C RS | Incorporate per ECN-653798. | A.M. Templeton 3/27/99 | K.M. Hall 3/27/99 |
| 1 RS | Incorporate per ECN-657282 | M. R. Adams | J. G. Field 3/22/00 |

A-7320-005 (08/91) WEF168

**This report prepared especially for Archive TIR on 3/21/00**

**Some of the reports herein may contain data that has not been reviewed or edited. The data will have been reviewed or edited as of the date that a Tank Interpretive Report (TIR) is prepared and approved. The TIR for this tank was approved on March 21, 2000.**

Tank: 241-AN-107

Sampling Events:
- 7AN-95-1
- 7AN-95-10
- 7AN-95-2
- 7AN-95-3
- 7AN-95-4
- 7AN-95-5
- 7AN-95-6
- 7AN-95-7
- 7AN-95-8
- 7AN-95-9
- 7AN-95-FB
- 7AN-98-1
- 7AN-98-10
- 7AN-98-11
- 7AN-98-12
- 7AN-98-13
- 7AN-98-14
- 7AN-98-15
- 7AN-98-16
- 7AN-98-17
- 7AN-98-18
- 7AN-98-2
- 7AN-98-3
- 7AN-98-4
- 7AN-98-5
- 7AN-98-6
- 7AN-98-7
- 7AN-98-8
- 7AN-98-9
- 7AN-98-99

Reports:
- Tank Interpretive Report

Constituent Groups:
- Anions
- Inorganics
- Metals/Nonmetals
- Organics

PCBs
Physical Properties
Radionuclides

**Table of Contents**

Data Dictionary to Reports in this Document ..... 1
Tank Interpretive Report For 241-AN-107 ..... 2
Tank Information Drivers ..... 2
Tank History ..... 10
Tank Comparisons ..... 11
Disposal Implications ..... 11
Scientists Assessment of Data Quality and Quantity ..... 12
Unique Aspects of the Tank ..... 16
Best-Basis Inventory Derivation ..... 16
Overall tank volume ..... 18
Reference List ..... 21

**Data Dictionary to Reports in this Document**

| Report | Field | Description |
|---|---|---|
| Tank Interpretive Report | | Interprets information about the tank answering a series of six questions covering areas such as information drivers, tank history, tank comparisons, disposal implications, data quality and quantity, and unique aspects of the tank. |

## Tank Interpretive Report For 241-AN-107

### Tank Information Drivers

*Question 1: What are the information drivers applicable to this tank? What type of information does each driver require from this tank? (Examples of drivers are Data Quality Objectives, Mid-Level Disposal Logic, RPP Operation and Utilization Plan, test plans and Letters of Instruction.) To what extent have the information and data required in the driving document been satisfied to date by the analytical and interpretive work done on this tank?*

The information drivers for tank 241-AN-107 are the Flammable Gas Data Quality Objective (DQO), Tank Safety Screening DQO, Organic Solvent Safety Issue DQO, Low-Activity Waste (LAW) Feed DQO, Provide Samples to Contractor issue, Confirm Tank T is an Appropriate Feed Source for LAW Feed (Waste Feed Delivery) DQO, Regulatory Compliance Waste Disposal Integration Team (WIT) DQO, Air Emissions DQO, and Dangerous Waste DQO. As of the date this report was prepared, March 1, 2000, the sampling events associated with this tank did not address the issues of the Regulatory Compliance WIT DQO, the Air Emissions DQO, or the Dangerous Waste DQO. These issues are currently being evaluated and will be applied as specified in the interface control documents with the Office of River Protection. The remaining issues are discussed below.

**Flammable Gas DQO:** Does a possibility exist for releasing flammable gases into the headspace of the tank or releasing chemical or radioactive materials into the environment?

The requirements to support the flammable gas issue are documented in the *Data Quality Objective to Support Resolution of the Flammable Gas Safety Issue* (Bauer and Jackson 1998). The Flammable Gas DQO has been extended to apply to all tanks. Analyses and evaluations will change according to program needs until this issue is resolved. Final resolution of the Flammable Gas issue is expected to be completed by September 30, 2001 (Johnson 1997).

In May 1994, a standard hydrogen monitoring system (SHMS) was installed in tank 241-AN-107 to continuously monitor the tank and collect vapor-phase data to support resolution of flammable gas issues. No hydrogen gas release events (GREs) have been documented for tank 241-AN-107 based upon SHMS data (McCain 1999). A GRE is an abrupt increase in the flammable gas concentration within the dome space of a tank, followed by a dissipation of that concentration proportional to the tank vent flow rate.

In December 1994, vapor samples were obtained from tank 241-AN-107 through the ventilation access duct (Tamppari 1994). The samples were collected through flow-through canisters and analyzed in accordance with Carpenter (1994) by the Inorganic Mass Spectrometry Laboratory at Pacific Northwest National Laboratory. The following analytes were detected: argon, carbon dioxide, hydrogen, nitrogen, and oxygen. The most abundant constituents detected were argon, nitrogen, and oxygen. The analytical results are reported in *Gas Species Analyses of Tank Farm Samples* (Goheen 1994) and appear in the *Vapor Data* Standard Report.

**Safety Screening DQO:** Does the waste pose or contribute to any recognized potential safety problems?

*Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995) identifies the data needed to screen the waste in tank 241-AN-107 for potential safety problems. These potential safety problems are exothermic conditions in the waste, flammable gases in the waste and/or tank headspace, and criticality conditions in the waste.

The safety screening DQO has established a decision limit of a change in enthalpy of 480 J/g (dry weight basis) for exothermic reactions detected during the differential scanning calorimetry (DSC) analysis. All the samples except one duplicate exhibited exothermic reactions greater than the decision limit. The maximum value was 1340 J/g (dry weight) for the duplicate on sample S96T000697 (Esch 1996). These high results were expected based on the knowledge of the presence of a high concentration of total organic carbon (TOC) in this tank.

Because the DSC results exceeded the decision limit, TOC was analyzed. All TOC samples exceeded the decision limit of 30,000 μg C/g (dry weight); the highest sample-duplicate mean result on a dry weight basis was 88,700 μg C/g for sample S96T000723. The highest upper limit on a 95 percent confidence interval on the mean for the TOC analysis was 91,300 μg C/g on a dry weight basis for sample S96T000746 (Esch 1996). However, because the tank's contents have a moisture content greater than the criterion of 17 weight percent (measured > 40 percent water) an exothermic reaction is not expected.

The safety screening DQO limit for criticality is 38.7 μCi/g for the sludge and 61.5 μCi/mL for the supernatant, and is assessed from the total alpha activity. Concentrations in all samples were well below these limits, with the maximum saltcake value being 1.58 μCi/g and the maximum supernatant value being 1.15 μCi/mL. Additionally, as required by the DQO, upper limits to a one-sided 95 percent confidence interval on the mean were calculated. All upper limits were well below the criticality decision limits, with a maximum value of 3.44 μCi/g. The data show that criticality is not a concern with this tank.

The DQO notification limit for flammable gas concentration is 25 percent of the lower flammability limit (LFL). Combustible gas meter readings taken at the time of the 1996 sampling revealed the concentration of flammable gases to be 0 percent of the LFL. (The pre-check results can be found with other headspace vapor measurements in the *IH Sniff Data* Standard Report.)

This tank was sufficiently sampled to satisfy the requirements of safety screening (Reynolds et al. 1999). It does not pose or contribute to any recognized safety problem.

**Organic Solvent Safety Issue DQO:** Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?

The data required to support the organic solvent screening issue are documented in the *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997). The DQO requires tank headspace samples be analyzed for total non-methane organic compounds. The

purpose of this assessment is to ensure that an organic solvent pool fire or ignition of organic solvent cannot occur.

No vapor samples have been taken from tank 241-AN-107 to estimate the organic pool size. However, the organic program has determined that even if an organic solvent pool does exist, the consequence of a fire or ignition of organic solvents is below risk evaluation guidelines for all tanks (Brown et al. 1998). The organic solvent issue is expected to be closed for all tanks in fiscal year 2000.

**LAW Feed DQO:** Do the samples taken from tank 241-AN-107 and the subsequent laboratory analysis meet the needs of the *Low-Activity Waste Feed Data Quality Objectives* (LAW Feed DQO) (Wiemers and Miller 1997)?

Tank 241-AN-107 was sampled and analyzed in support of privatization based on the requirements documented in Wiemers and Miller (1997). The purpose of the LAW Feed DQO (Wiemers and Miller 1997) was to address technical issues pertinent to pretreatment, immobilization, and balance-of-plant for LAW processing. Waste was to be characterized to determine whether it fell within the defined process design envelope. Data collected in support of this DQO were to be used primarily for planning activities of the privatization contractors as specified in the privatization request for proposals.

Grab samples were collected from tank 241-AN-107 in April 1998. The samples were subsampled, composited, and analyzed in accordance with the *Tank 241-AN-107 Privatization Grab Sampling and Analysis Plan* (TSAP) (Jo 1998) and the *Low-Activity Waste Feed Data Quality Objective* (Wiemers and Miller 1997). Composites were prepared by combining all of the liquid for the supernate composite and all of the solid collected from centrifugation of the samples for the centrifuged solid composite. Though analyses were only requested on three subsamples, additional subsamples were prepared so that smaller volumes could be handled. Analyses were performed on nine subsamples (three sets of three samples) for the supernate composite and six subsamples (two sets of three samples) for the centrifuged solid composite to reduce the radiological exposure to personnel and still provide enough material to perform all the required analyses. However, each requested analysis was performed on only three of the subsamples (one sample from each set).

The 222-S Laboratory performed the analyses according to the requirements of the LAW Feed DQO (Wiemers and Miller 1997). Esch (1999a and 1999b) reports the results from these analyses. The following statistical calculations were performed on these data as directed by Kinzer (1999):

- the mean concentration ($\hat{\mu}$) of the composite subsample results,
- the standard deviation of the mean $SD(\hat{\mu}) = S/\sqrt{n}$, and
- the relative standard deviation (RSD) associated with the mean ($RSD(\hat{\mu}) = (SD(\hat{\mu})/\hat{\mu}) \times 100$). Both $SD(\hat{\mu})$ and $RSD(\hat{\mu}) = (SD(\hat{\mu})/\hat{\mu}) \times 100$ represent the random variability associated with the analytical measurements.

The mean, the SD of the mean, and the RSD on the mean are reported in Table 1-1. Table 1-2 provides a comparison of the ratio of each analyte to sodium with the Envelope C contract limits. The Envelope C contract limits are reported as a ratio of moles of analyte to moles of sodium. The

LAW Feed DQO (Wiemers and Miller 1997) establishes a sensitivity boundary around the envelope limits of ± 30%. For tank 241-AN-107, all constituents analyzed met the Envelope C contract limits for LAW except Am-241 and transuranic (TRU) content. The concentration ratios to sodium were 125.35% for Am-241 and 170.46% for TRU. As seen in Table 1-2, three analytes (TOC [furnace oxidation]: 85.98%, TOC [persulfate]: 78.45%, and total alpha: 98.70%) fell within the sensitivity boundary of ±30% of the contract envelope limit. Statistical studies (Nguyen et al. 1999) of the chemical characteristics of tank 241-AN-107 indicated that TOC, $^{60}$Co, and TRU had a degree of probability of exceeding Envelope C limits.

The current data needed to support DOE Waste Processing and Disposal (WP&D) are documented in the *Low-Activity Waste and High-Level Waste Feed Processing Data Quality Objectives* (Patello et al. 1999). The WP&D DQO replaces the LAW Feed DQO and imposes additional sampling, compositing, and analytical requirements that address the Privatization Contract's allowance for entrained solids to be processed as LAW, high-level waste (HLW), or returned to tank farms. Additionally, the DQO accommodates the LAW and HLW treatment scenario, allowing for liquids separated from HLW feed to be treated as LAW feed. Further sampling and analysis of tank 241-AN-107 may be required to meet the new WP&D DQO requirements.

Table 1-1. Variance Components for Tank 241-AN-107 Supernatant Composite Means.[1]

| Constituent | Analysis Method[2] | Mean | Units | SD(mean) | %RSD (mean) |
|---|---|---|---|---|---|
| Aluminum | ICP:A | 3.18E+02 | ug/mL | 2.16E+01 | 6.80 |
| Barium | ICP:A | <2.53E+01 | ug/mL | n/a | n/a |
| Cadmium | ICP:A | 6.47E+01 | ug/mL | 3.32E+00 | 5.13 |
| Calcium | ICP:A | 5.83E+02 | ug/mL | 2.41E+01 | 4.14 |
| Chloride | IC | 2.04E+03 | ug/mL | 8.40E+01 | 4.12 |
| Chromium | ICP:A | 1.64E+02 | ug/mL | 7.16E+00 | 4.38 |
| Fluoride | IC | 4.12E+03 | ug/mL | 2.31E+02 | 5.61 |
| Hydroxide | OH Direct | <1.25E+03 | ug/mL | n/a | n/a |
| Iron | ICP:A | 1.68E+03 | ug/mL | 7.21E+01 | 4.29 |
| Lanthanum | ICP:A | 3.39E+01 | ug/mL | 1.61E+00 | 4.74 |
| Lead | ICP:A | 3.91E+02 | ug/mL | 1.95E+01 | 4.98 |
| Mercury | AA CLP (Hg) | <3.47E+00 | ug/mL | n/a | n/a |
| Nickel | ICP:A | 5.29E+02 | ug/mL | 2.57E+01 | 4.85 |
| Nitrate | IC | 2.37E+05 | ug/mL | 1.02E+04 | 4.30 |
| Nitrite | IC | 6.83E+04 | ug/mL | 3.05E+03 | 4.46 |
| Phosphate | IC | 3.33E+03 | ug/mL | 4.66E+02 | 14.00 |
| Potassium | ICP:A | 1.84E+03 | ug/mL | 7.87E+01 | 4.28 |
| Sodium | ICP:A | 1.83E+05 | ug/mL | 6.99E+03 | 3.82 |
| Sulfate | IC | 9.28E+03 | ug/mL | 3.09E+02 | 3.33 |
| Total inorganic carbon | TIC/TOC | 1.59E+04 | ug/mL | 7.97E+02 | 5.02 |
| Total organic carbon | Furnace Oxidation | 4.11E+04 | ug/mL | 1.55E+03 | 3.78 |
| Total organic carbon | TIC/TOC | 3.75E+04 | ug/mL | 1.44E+03 | 3.85 |
| U-total | ICP/MS:A | 1.16E+02[3] | ug/mL | 8.89E+00 | 7.64 |
| Gross alpha | Proportional | 6.37E-01 | uCi/mL | 7.90% | 2 |

Table 1-1. Variance Components for Tank 241-AN-107 Supernatant Composite Means.[1]

| Constituent | Analysis Method[2] | Mean | Units | SD(mean) | %RSD (mean) |
|---|---|---|---|---|---|
| | Count | | | | |
| Neptunium-237 | TIOA-TTA | 7.19E-05 | uCi/mL | 2.08E-06 | 2.89 |
| Plutonium-239 | ICP/MS:A | <7.83E-02 | uCi/mL | n/a | n/a |
| Plutonium-240 | ICP/MS:A | <5.78E-02 | uCi/mL | n/a | n/a |
| Americium-241 | AEA | 8.09E-01 | uCi/mL | 2.25E-02 | 2.78 |
| Atomic Mass Unit 242 | ICP/MS:A | <2.38E-03 | uCi/mL | n/a | n/a |
| Curium-243/244 | AEA | <5.68E-02 | uCi/mL | n/a | n/a |
| Atomic Mass Unit 243 | ICP/MS:A | <1.55E-01 | uCi/mL | n/a | n/a |
| TRU | Alpha Rad | <1.10E+00 [4] | uCi/mL | n/a | n/a |
| Cesium-137 | GEA | 3.64E+02 | uCi/mL | 1.20E+00 | 0.33 |
| Strontium-89/90 | Sr89/90 | 9.82E+01 | uCi/mL | 8.07E-01 | 0.82 |
| Technetium-99 | Tc99 | 7.03E-02 | uCi/mL | 2.197E-02 | 31.12 |

Notes:

n/a = not applicable
SD(mean) = standard deviation of the mean
RSD(mean) = relative standard deviation associated with the mean

[1]Means based on 1998 samples reported in Esch (1999a and 1999b).
[2]Analysis methods are identified in *Analytical Methods and Procedures* Standard Report.
[3]Derived by summing results for the individual uranium isotopes as measured by ICP/MS and atomic mass unit (AMU)-238, which is assumed to be U-238. Approximately 96 percent of this total is from a detected result (AMU-238); the remainder is a sum of detection limits.
[4]TRU is derived by summing Np-237, Pu-239, Pu-240, Am-241, Cm-243/244, and Am-243.

Table 1-2. Comparison of Tank 241-AN-107 Supernatant Results to Envelope C Contract Limits.[1] (2 sheets)

| Analyte | Average (ug/mL) | Average (M) | Ratio (Avg/ Na) | Envelope Limit[2] (moles analyte/moles Na) | Found Analyte/Env. Spec. [(Avg/Na)/Env. Spec.] |
|---|---|---|---|---|---|
| Al | 3.18E+02 | 1.18E-02 | 1.48E-03 | 1.9E-01 | 0.78% |
| Ba | 2.53E+01[3] | 1.84E-04 | 2.31E-05 | 1.0E-04 | 23.14% |
| Ca | 5.83E+02 | 1.45E-02 | 1.83E-03 | 4.0E-02 | 4.57% |
| Cd | 6.47E+01 | 5.76E-04 | 7.23E-05 | 4.0E-03 | 1.81% |
| Cl | 2.04E+03 | 5.75E-02 | 7.23E-03 | 3.7E-02 | 19.54% |
| Cr | 1.64E+02 | 3.15E-03 | 3.96E-04 | 6.9E-03 | 5.74% |
| F | 4.12E+03 | 2.17E-01 | 2.72E-02 | 9.1E-02 | 29.94% |
| Fe | 1.68E+03 | 3.01E-02 | 3.78E-03 | 1.0E-02 | 37.79% |
| Hg | 3.47E+00[3] | 1.73E-05 | 2.17E-06 | 1.4E-05 | 15.52% |
| K | 1.84E+03 | 4.71E-02 | 5.91E-03 | 1.8E-01 | 3.28% |
| La | 3.39E+01 | 2.44E-04 | 3.07E-05 | 8.3E-05 | 36.94% |
| Na | 1.83E+05 | 7.96E+00 | 1 | 1 | 100.00% |
| Ni | 5.29E+02 | 9.01E-03 | 1.13E-03 | 3.0E-03 | 37.74% |
| NO2 | 6.83E+04 | 1.48E+00 | 1.87E-01 | 3.8E-01 | 49.08% |
| NO3 | 2.37E+05 | 3.82E+00 | 4.80E-01 | 8.0E-01 | 60.02% |
| OH | 1.25E+03[3] | 7.35E-02 | 9.23E-03 | 7.0E-01 | 1.32% |
| Pb | 3.91E+02 | 1.89E-03 | 2.37E-04 | 6.8E-04 | 34.86% |
| PO4 | 3.33E+03 | 3.51E-02 | 4.40E-03 | 3.8E-02 | 11.59% |
| SO4 | 9.28E+03 | 9.66E-02 | 1.21E-02 | 2.0E-02 | 60.68% |
| TIC (P) | 1.59E+04 | 1.32E+00 | 1.66E-01 | 3.0E-01 | 55.43% |
| TOC (F)[4] | 4.11E+04 | 3.42E+00 | 4.30E-01 | 5.0E-01 | 85.98% |
| TOC (P)[5] | 3.75E+04 | 3.12E+00 | 3.92E-01 | 5.0E-01 | 78.45% |
| U ICP/MS | 1.16E+02 | 4.87E-04 | 6.12E-05 | 1.2E-03 | 5.10% |

Table 1-2. Comparison of Tank 241-AN-107 Supernatant Results to Envelope C Contract Limits.[1]

| Analyte | Average uCi/mL | Average Bq/L | Ratio (Avg/ Na) | Envelope Limit[2] (Bq analyte/ moles Na) | Found Analyte/Env. Spec. [(Avg/Na)/Env. Spec.] |
|---|---|---|---|---|---|
| Total Alpha | 6.37E-01 | 2.36E+07 | 2.96E+06 | 3.00E+06 | 98.70% |
| Np-237 | 7.19E-05 | 2.66E+03 | 3.34E+02 | n/a | n/a |
| Pu-239 | 7.83E-02[3] | 2.90E+06 | 3.64E+05 | n/a | n/a |
| Pu-240 | 5.78E-02[3] | 2.14E+06 | 2.69E+05 | n/a | n/a |
| Am-241 | 8.09E-01 | 2.99E+07 | 3.76E+06 | 3.00E+06 | 125.35% |
| Pu-242 | 2.38E-03[3] | 8.81E+04 | 1.11E+04 | n/a | n/a |
| Cm-243/244 | 5.68E-02[3] | 2.10E+06 | 2.64E+05 | n/a | n/a |
| Am-243[6] | 9.82E-02[3] | 3.63E+06 | 4.56E+05 | n/a | n/a |
| TRU[7] | 1.10E+00[3] | 4.07E+07 | 5.11E+06 | 3.0E+06 | 170.46% |
| Cs-137 | 3.64E+02 | 1.35E+10 | 1.69E+09 | 4.3E+09 | 39.35% |
| Sr-90 | 9.82E+01 | 3.63E+09 | 4.56E+08 | 8.1E+08 | 56.49% |
| Tc-99 | 7.03E-02 | 2.60E+06 | 3.27E+05 | 7.1E+06 | 4.60% |

Notes:

n/a = not applicable

[1]Means based on 1998 sample results reported in Esch (1999a and 1999b). Mean concentrations were reported previously. See Table 1-1 for additional notes.
[2]Envelope specifications as reported in Wiemers and Miller (1997).
[3]Mean concentrations based on non-detected values.
[4]TOC (F) = Total Organic Carbon by furnace oxidation method.
[5]TOC (P) = Total Organic Carbon by persulfate method.
[6]Am-243 = AMU-243 (by ICP/MS) - Cm-243/244 (by separation AEA).
[7]TRU = Sum of Np-237, Pu-239, Pu-240, Am-241, Cm-243/244, Am-243 results.

**Provide Samples to Contractor issue:** Have the required samples been provided to the Privatization Contractor?

The Waste Disposal Division and the Regulatory Compliance Waste Integration Team (WIT) identified the need for tank waste samples to be provided to the Privatization Contractor for process validation work prior to the commencement of hot operations. An estimated quantity of 1.5 to 2 liters of sample material was needed from tank 241-AN-107 (BNFL 1998). A shipment of 2 liters of tank 241-AN-107 sample material was made to BNFL in September 1998, fulfilling the requirements of this issue.

**Waste Feed Delivery DQO:** Does the waste feed meet specifications as a feed source for tank waste privatization?

The current data required to support waste feed delivery for Phase I low-activity waste are documented in *Data Quality Objectives for TWRS Privatization Phase I: Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X* (Nguyen 1999). However, sampling and analysis were performed to meet the requirements of a previous version of this DQO (Certa 1998).

Tank 241-AN-107 has been identified as one of the first tanks scheduled for retrieval for low-level waste pretreatment and immobilization. Measurements of physical and rheological properties of the waste are needed to confirm that the waste can be effectively mixed and supernate transferred to the Privatization Contractor. These properties are viscosity, specific gravity, and volume percent solids. Measurements were conducted on samples from tank 241-AN-107, as directed by Garfield (1999), to determine the rheological properties of these samples. These measurements were conducted over a range of operating conditions (i.e., temperature and dilution) to provide Waste Feed Delivery with information that will assist with the evaluation and/or design of waste transfer systems. Mean viscosity results ranged from 6.3 to 14.0 cP at varying temperatures and dilutions. Density results ranged from 1.30 to 1.36 g/mL with varying dilutions. Percent solids by volume ranged from 0 to 24% at varying temperatures and dilutions. Note that the limits specified in the DQO are 10 cP, 1.5 g/mL, and 30% for viscosity, specific gravity, and percent solids, respectively. These results are reported in *Results for Tank 241-AN-107 Retrieval Testing* (O'Rourke 1999) and *Analytical Results: Rheology* Standard Report, thus satisfying the rheology testing requirements of this DQO.

Laboratory tests were conducted to study the dilution of this waste since retrieval of the tank waste will require dilution to dissolve solids. The solids solubility screening tests were performed on dissolution composites in accordance with the *Test Plan for Tank 241-AN-107 Solubility Screening Tests* (Person 1998). The solids solubility screening tests were directed by the *Tank 241-AN-107 Privatization Grab Sampling and Analysis Plan* (Jo 1998) in accordance with Certa (1998). The results of these studies satisfied the Waste Feed Delivery DQO requirements in effect at the time of sampling (Certa 1998) and are documented in *Solubility Screening Tests for Tank 241-AN-107* (Person 1999).

**Bounding Concentration Limits:**

Sample results from tank 241-AN-107 were screened against current bounding concentrations limits used to develop the authorization source term, Tables 4-1 and 4-2 in HNF-SD-PROC 021 Rev. 3, Section 18.0 (Adams 1999). Liquid sample results from one cobalt-60, one europium-154, three cadmium, eleven neodymium, and eleven total organic carbon were found to exceed the bounding concentration limits. Since the analytical data does represent tank waste and there appears to be no quality assurance problems with the data, notifications were made for further study concerning those sample results exceeding the bounding concentration limits.

**Heat Load Estimate:**

A factor in assessing tank safety is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. The heat load estimate for tank 241-AN-107 based on the process history was 7,500 W (25,600 Btu/hr) (Agnew et al. 1997a). The heat load estimate derived from the tank radionuclide content was 7,910 W (27,000 Btu/hr) (Kummerer 1995). The heat load estimated from the best-basis inventory is 11,720 W (39,990 Btu/hr), as shown in Table 1-3. All of these estimates are below the 20,500 W (70,000 Btu/hr) operating specification limit for double-shell tanks (Fowler 1999).

Table 1-3. Heat Load Estimate Based on the Best-Basis Inventory.

| Radionuclide | Waste Inventory[1] (Ci) | Specific Activity (W/Ci) | Heat Load (W) |
|---|---|---|---|
| $^{90}Sr$ | 6.23E+05 | 0.00669 | 4,168 |
| $^{137}Cs$ | 1.6E+06 | 0.00472 | 7,552 |
| Total | | | 11,720 |

Note:

[1]See *Best-Basis Inventory Estimate (Radioactive Components)* Standard Report.

## Tank History

*Question 2: What is known about the history of this tank as it relates to waste behavior?*

The AN Tank Farm was built between 1980 and 1981 in the 200 East area. This tank farm consists of seven 4,391 kL (1,160 kgal) tanks. These tanks were designed for boiling waste with a maximum fluid temperature of 177 °C (350 °F). The 241-AN Tank Farm does not use a cascade system between tanks. Tank 241-AN-107 is a double-shell tank constructed of a reinforced concrete shell with two (inner and outer) carbon steel liners on the bottom and sides. Tank 241-AN-107 has 22 risers that provide access to the tank, 21 air-lift circulator risers, and 37 risers that provide access to the annulus. Additional tank descriptive material is contained in the *Tank Plan View, Tank Profile View, and Riser Configuration Table* Standard Reports. The only risers discussed in these three reports are the 22 primary tank access risers.

Tank 241-AN-107 entered service in 1981. Water was initially added to the tank in the third quarter of 1981. A second addition of water in the second quarter of 1982 completed the testing phase for the tank. Dilute non-complexed waste was transferred into tank 241-AN-107 from tank 241-AN-102 during the second quarter of 1983. Another transfer of waste occurred during the fourth quarter of 1983 with an addition of concentrated complexant waste from tank 241-AZ-102. Records indicate that a portion of the waste transferred could have had a small amount of non-complexed concentrate waste originating from plutonium-extraction (PUREX) miscellaneous streams.

Tank 241-AN-107 received 30 kL (8 kgal) of an unknown waste type in the third quarter of 1984. The tank did not receive or transfer any more waste, though several unknown losses and gains were

noted in the historical records (Agnew et al. 1997b). Surveillance data indicate average losses of approximately 4,000 gal/yr (CHG 2000). These losses are most likely because of evaporation.

Tank 241-AN-107 has an operating capacity of 4,391 kL (1,160 kgal), and presently contains an estimated 3,948 kL (1,043 kgal) of concentrated complexant (CC) waste. This waste volume was derived from surface level measurements (CHG 2000). The tank is estimated to contain 935 kL (247 kgal) of saltcake and 3,016 kL (796 kgal) of supernatant. (See Table 7-1 for Best-Basis Inventory Source Data.)

Tank 241-AN-107 is listed as sound and is actively ventilated. Tank 241-AN-107 is one of the first double-shell tanks scheduled for waste retrieval at Hanford. The tank is currently scheduled to be retrieved during fiscal year 2005 (Kirkbride et al. 1999).

## Tank Comparisons

*Question 3: What other tanks have similar waste types and waste behaviors, and how does knowledge of the similar tanks contribute to the understanding of this tank?*

Tank 241-AN-107 is one of six double-shell tanks that are categorized as containing concentrated complexant (CC) waste. The other tanks that contain CC waste are tanks 241-AN-102, 241-AN-106, 241-AW-106, 241-SY-101, and 241-SY-103. Analytical data from tank 241-AN-102 were used for comparison with the tank 241-AN-107 analytical concentrations. These comparisons showed good agreement between the 1998 analytical results for tank 241-AN-107 and the analytical data for tank 241-AN-102.

The entire contents of tank 241-AN-107 are Supernatant Mixing Model type A2 (SMMA2) waste from 242-A evaporator campaigns. Tanks 241-AN-102, 241-AN-103, 241-AN-104, and 241-AN-105 also contain SMMA2 waste and contribute to an understanding of the waste in tank 241-AN-107 (Agnew et al. 1997a).

## Disposal Implications

*Question 4: Given what is known about the waste properties and waste behaviors in this tank, what are the implications of the waste properties and behaviors to the waste retrieval/processing methodologies and equipment selection?*

Tank 241-AN-107 has been selected as a Phase I source tank for LAW feed for vitrification. Given what is known about the waste types and behaviors in tank 241-AN-107, there should be little difficulty in retrieving this waste as no critical retrieval concerns were identified. However, tank 241-AN-107 does have a history of consumption or depletion of hydroxide.

The present condition of hydroxide is not a general corrosion problem, but caustic depletion in the tank waste can potentially cause stress corrosion cracking. A plan has been developed (Carothers 1992) whereby the hydroxide concentration will be adjusted to the point at which corrosion stress cracking can be avoided. The plan calls for the addition of 19 M sodium hydroxide to the tank waste, in two phases. The first phase will add caustic to the supernatant only, with no mixing of the

sludge layer. This will protect the majority of the tank surface, since most of the waste is supernatant. The second phase will uniformly mix the tank contents, including the saltcake, during the caustic addition.

In 1999, an ultrasonic test of tank 241-AN-107's primary liner showed that there was no excessive uniform corrosion, pitting, or stress corrosion cracking observed in the section of the tank evaluated. This test consisted of two 15 inch vertical sections separated by 6 inches. The measurements were made from upper to lower knuckle. This represents about 1% of tank 241-AN-107's surface. Approximately 1/8$^{th}$ of the tank's lower knuckle was also examined and found to be fine (Lysher 1999).

A sample of the waste in tank 241-AN-107 was acquired in order to study the effects of hydroxide addition to the waste (Washington 1990). It was noted that alpha-emitting radionuclides (plutonium/americium) tended to precipitate after caustic addition. Total alpha was found to decrease in the supernatant samples. Analysis of the solids in the samples using an acid digestion accounted for the decreased total alpha activity in the supernatant. Some evidence was noted that the levels in the supernatant for TOC and carbonate also decreased after caustic addition.

Other than the caustic depletion issue discussed above, there should be little difficulty encountered during the retrieval of supernatant from tank 241-AN-107. The flammable gas concentrations are low (0 percent of the lower flammability limit). The presence of organic vapors in tank 241-AN-107 is considered small in a steady state condition. The vapor in the headspace of the tank measured 9.6 ppm using a hand held organic vapor monitor prior to the February 1996 grab sampling event. Sample results showed that the tank waste has low total alpha concentrations greatly alleviating criticality concerns during retrieval and processing.

All analytical results indicate the feasibility of successful retrieval and disposal of the waste. However, the caustic depletion issue warrants further monitoring. Exothermic reactions were detected during DSC analyses, therefore, it is important the waste not be allowed to dry out during retrieval. Also, because of the high TOC content in the waste, measures must be taken to ensure that the moisture in the tank remains within the safety limits.

## Scientists Assessment of Data Quality and Quantity

*Question 5: Given the current state of understanding of the waste in this tank on the one hand and the information drivers on the other; should additional tank data be sought via sampling/analysis from a strictly technical point-of-view? Can the waste behavior in this tank be adequately understood by other means (eg. archive samples, tank grouping studies, modeling) without additional sampling and analysis? If so, what characteristics of the tank waste lend themselves to a non-sample alternative? Is the quality of the data from this tank adequate from a field sampling and analytical laboratory point-of-view? Are there any clarifications or explanations needed for the data tables and figures?*

### Sampling and Analysis

The following DQOs and waste issues have been addressed for this tank and accepted by the Project Hanford Management Contract River Protection Project (RPP): Flammable Gas, Safety Screening,

Organic Solvent, Provide Samples to Contractor issue, and Waste Feed Delivery. No additional sampling or analyses are necessary to satisfy current safety issue requirements for this tank. Further action may be identified to address the LAW Feed DQO, Regulatory Compliance WIT DQO, Air Emissions DQO, and Dangerous Waste DQO.

More sampling and analysis may be necessary to meet the additional requirements of the recently issued *Low-Activity Waste and High-Level Waste Feed Processing Data Quality Objectives* (Patello et al. 1999). Given the schedule for Phase I retrieval, this additional analytical/physical information has a high priority.

Finally, to date, no sampling has been performed to address the issues of the Regulatory Compliance WIT DQO (Wiemers et al. 1998), Air Emissions DQO (Mulkey and Markillie 1995), or Dangerous Waste DQO (Mulkey 1996). These activities will be scheduled as needed to meet the Retrieval Program's requirements.

**Data Quality**

Samples obtained in the 1996 and 1998 grab sampling events were collected and analyzed with approved and recognized sampling and laboratory procedures and in accordance with Jo (1996) and Jo (1998). The laboratory procedures for the grab sample analyses can be found in the Standard Report *Analytical Methods and Procedures*. Quality Control (QC) parameters assessed in conjunction with tank 241-AN-107 samples included standard recoveries, spike recoveries, duplicate analyses, and blanks. Appropriate QC footnotes were applied to data outside QC parameter limits. Analytical results and data quality are discussed in Esch (1996) and Esch (1999a and 1999b).

For the safety-screening samples analyzed in 1996, all of the standard and spike recoveries were within QC limits and none of the samples exceeded the criterion for preparation blanks; thus, contamination was not a problem for any of the analyses. The relative percent differences (RPDs) associated with all the 1996 saltcake samples analyzed for total alpha activity exceeded the limits. These high RPDs were attributed to the non-homogeneity of the solids. During the separation of the solid and liquid phases of the saltcake samples, it was noted that all of the saltcake samples had very dark particulates in the bottom of the jar. After transferring the suspended solids, some of these pieces remained in the sample bottles. The pieces looked similar to corroded pieces of metal. Any of this material that may have been transferred into the centrifuge cones would create a non-homogeneous sample, which would result in large differences between sample and duplicate results. In addition to the total alpha RPDs exceeding limits, one supernatant DSC sample/duplicate pair was outside the criteria. All thermogravimetric analysis (TGA) and TOC RPDs were within the limits (Esch 1996).

The 1998 analysis of tank 241-AN-107 grab samples was performed in accordance with the TSAP (Jo 1998) and the LAW DQO (Wiemers and Miller 1997). A discussion of QC failures for non-opportunistic analytes as reported in Esch (1999a and 1999b) is provided below:

Contamination was detected in the method and preparation blanks for a number of different methods and analytes. However, since in each case the amount detected in the blank was less than 5% of the sample results, the contamination was considered insignificant.

Only a few analytes failed to meet precision requirements. Two carbon-14 subsamples had RPDs greater than 20%. The results were approximately twenty times higher than the detection limit, so the cause for the high RPD is unknown. However, since this analyte is not included in the envelope limit, no reanalysis was required. The RPDs for all IC analytes were less than 20% except phosphate (34.6%). This high RPD might be due to a relatively low concentration of phosphate due to the large sample dilution required for the high nitrate concentration.

Standard and spike recoveries were also acceptable for most analytes. During the graphite furnace atomic absorption analysis, the thallium matrix spike recovery was outside the specified QC limits (41.8%). The post-digestion spike analysis also had a low recovery (43.5%). These low recoveries can be attributed to the high concentration of chloride in the samples.

The spike recovery for fluoride was reported as a negative number for one sample during the IC analysis. The most likely cause for the spike failure is the interference from small organic acids. Upon close examination of the chromatograms, two peaks from organic acids can be seen that elute within the integration window for fluoride. Therefore, the results reported for fluoride are biased high. Fluoride was not within the sensitive boundary and no reanalysis was required.

One of the total inorganic carbon (TIC) samples had a high spike recovery (126%). The spike failure was attributed to the high concentration of carbon in the samples; results for both TOC and TIC were greater than 10,000 μg/mL. With concentrations this high, it is difficult to add sufficient spike standard and a smaller sample size cannot be used in order to attain a meaningful spike analysis. The standard recovery for $^{237}$Np was outside of the limits of 80% - 120% recovery. The low recovery (71%) was within the range determined by statistical evaluation of historical data, so the results were considered acceptable.

During the polychlorinated biphenyl (PCB) analysis of the first supernate composite subsample, the duplicate aliquot was inadvertently brought to dryness during sample preparation and the aliquot was unable to be analyzed. There was insufficient sample to analyze a matrix spike duplicate.

The matrix spike recovery obtained during the PCB analysis of the supernate sample was low (39.4%). Since the surrogates for the matrix spike aliquots were good, there is an indication of either a low bias matrix effect, or a syringe error. There were no PCBs observed in these samples. Hence, the low spike recovery has no significant effect on the sample results, especially since the laboratory control standard (LCS) recovery was good.

Low surrogate recoveries were obtained for the supernate composite analysis. Although one surrogate was not consistently low, the decachlorobiphenyl (DCB) had more failures than the tetrachloro-m-xylene (TCX). Standard, blank, and field blank recoveries were also low for DCB. The DCB failures may have been due to problems with sample handling. The TCX recoveries were low for only two of the subsamples. No aliquot extract had both surrogates fail. The surrogates for this method are only for advisory use, and one low surrogate does not necessarily mean the aroclor results are biased. Since at least one of the two surrogate recoveries was acceptable for each aliquot analyzed, and PCBs are not included in the envelope limit, no reanalysis was requested.

During the inductively coupled plasma-mass spectrometry (ICP/MS) analysis it was difficult to meet the minimum reportable quantities (MRQ) specified in the LAW DQO because of the large dilution

required to achieve a sodium concentration of at most 5 μg/mL. Concentrations higher than this will affect the analysis because of reduced ionization efficiencies and material buildup on the sample or skimmer cones at the interface to the mass spectrometer.

All of the Group 1 ICP analytes were less than 50% of the contract envelope limits. Therefore, the LAW DQO did not require any re-preparation or reanalysis for QC failures. High RPDs were reported for aluminum and silicon. The poor precision for silicon was attributed to possible leaching from glassware. Difficulty in pipetting the liquid from the samples may have affected the aluminum precision. The standard recoveries for all of the required analytes were acceptable, except for silicon in the acid digested standards. The recovery for the standard was outside the 80% - 120% limit stated in the TSAP. Because of problems obtaining consistent results for silicon from acid digested samples, the acceptance limits have been set at a fixed administrative range of 50% - 500% recovery. The high recovery was within these limits. Since this analyte is not included in the envelope limits, no reanalysis was requested.

Several ICP analytes had spike recovery results outside the requested limits (aluminum, sodium, phosphorus, and silicon). The probable cause for the silicon spike failure was discussed previously. Failures for aluminum and sodium were due to the high concentration of analyte in the sample. With analyte concentrations higher than 1000 μg/mL, it is difficult to add sufficient spike material to perform a meaningful analysis. The cause for the low spike recovery for phosphorus is unknown. Post-digestion spike analyses for all these analytes had acceptable recoveries. In addition to matrix spike and post-digestion spike analyses, serial dilution analyses were performed for aluminum, sodium, and phosphorus. The accuracy of these analyses was acceptable.

During the original 1998 ICP analysis, the standards for tin, tantalum, thorium, tungsten, and yttrium were inadvertently omitted from the laboratory control standard and the matrix spike samples. Three new subsamples of the original supernate composite were digested, with the additional standards and spikes included, and the ICP analyses were re-run. The results were reported in a revision to the original data package (Esch 1999b). The standard recoveries for all analytes were within the QC limits. The RPDs for all samples were less than 20%, with the exception of silicon in one sample. For this sample, the sample and duplicate results were less than 4 times the detection limit and the RPD was 52.3%. The precision of the analysis is reduced as the result approaches the detection limit. Since a reanalysis was not likely to improve the results, no additional re-preparation or reanalysis was requested.

For the ICP re-analysis, spike recovery results were outside the requested limits for boron, iron, potassium sodium, and sulfur. With the exception of boron, the spike failures were due to the high concentration of analyte in the sample. Non-uniform leaching from the glassware used during the acid digestion might have caused the spike failure for boron. The post-digestion spike analyses performed for these analytes all had acceptable recoveries (between 94% and 104%).

Because the detection limits for the ICP/MS analysis did not meet the MRQ requirements, the sum of the "less than" values used for the determination of the transuranic (TRU) isotopes did not meet the envelope criteria. The TRU content was reported in Esch (1999a) at 402.25% of the contract envelope limit. It appears that Esch used an incorrect specific activity for Am-243 (1.996) during unit conversion. In Table 1-2 of this TIR, the ratio of Envelope C analytes to the contract limit were re-calculated. A specific activity of 0.199 Ci/g was used for Am-243. Though the TRU

concentration still exceeded the contract limits (170.46%), it was much less than that reported by Esch (1999a). Again, this is because the detection limits did not meet the MRQ limits. A more accurate evaluation of the TRU content can be obtained by using the results from the total alpha activity analysis.

Esch (1999a) also reports the total alpha concentration also exceeded the Envelope C contract limits (102.62%). (Note: due to differences in rounding, Table 1-2 of this TIR reports the total alpha at 98.7% of the contract limits.) Sample results indicate that $^{241}$Am is the major isotope contributing to the alpha activity in this tank. However, the results for total alpha are lower than the $^{241}$Am results. The lower activity is probably due to solids on the sample mount causing self-absorption.

The vast majority of QC results were within the boundaries specified in the sampling and analysis plans. Small discrepancies noted in the analytical reports and footnoted in the *Analytical Results* Standard Report should not impact the data validity or use.

**Clarifications for Data Tables and Figures**

The 241-AN-107 Historical Tank Content Estimate (HTCE) Surface Level figure shows a sharp level drop during the third quarter of 1988. This drop is caused by an error in the surface level data used to generate the figure and does not represent any real transfer of waste. The slow decrease in the tank waste surface level is caused by evaporation of water from the tank at the rate of about 4 kgal/yr. (approximately 1.5 inches/yr.).

## Unique Aspects of the Tank

*Question 6: What are unique chemical, physical, historical, operational or other characteristics of this tank or its contents?*

There are no exceptional unique chemical, physical, historical, operational or other characteristics of tank 241-AN-107. The waste types in this tank are relatively well defined and understood, and can be found in a number of other tanks. While not unique, one characteristic worth noting is that tank 241-AN-107 contains concentrated complexant waste. For this reason, waste from tank 241-AN-107 should only be mixed with other CC waste unless the requirements documented in Fowler (1999) have been met.

## Best-Basis Inventory Derivation

*Question 7: What is the source data used to derive this tank's Best-Basis inventories by mass (kg) and activity (Ci) for the standard list of 25 chemicals and 46 radionuclides?*

The Best-Basis Inventory (BBI) effort involves developing and maintaining waste tank inventories comprising 25 chemical and 46 radionuclide components in the 177 Hanford Site underground storage tanks. These best-basis inventories provide waste composition data necessary as part of the

RPP process flowsheet modeling work, safety analyses, risk assessments, and system design for waste retrieval, treatment, and disposal operations.

Development and maintenance of the best-basis inventory is an on-going effort. Since new sample data were recently made available for double-shell tank 241-AN-107, a re-evaluation of the best-basis inventory was performed and is documented in the following text. The following information was used in this evaluation:

- Statistical means based on the tank 241-AN-107 liquid grab samples from the April 1998 analyses (see *Means and Confidence Intervals* Standard Report). These means were supplemented with data from liquid grab samples taken in February 1996 to support safety screening efforts (Esch 1996), data from liquid grab samples taken in July 1996 to support Privatization (Esch 1997), and data from liquid grab samples taken in February 1993 to assess the tank's caustic demand (Herting 1994).

- Statistical means based on the tank 241-AN-107 solid grab samples from the April 1998 analyses (see *Means and Confidence Intervals* Standard Report). These means were averaged with data from solid grab samples taken in May 1994 to support mitigation of the low-caustic condition of the tank (Herting 1994).

- Statistical means based on the tank 241-AN-102 sludge core samples from the May 1990 analyses (Douglas 1996).

- BBI templates for the following waste types: SMMA1 saltcake liquid and SMMA1 saltcake solids. The templates are based on sample data and supplemented with Hanford Defined Waste (HDW) model document (Agnew et al. 1997a), where sample data are not available.

Table 7-1 summarizes how the best-basis inventories for tank 241-AN-107 were derived. Two waste phases were identified for the tank: supernatant and saltcake. Note that at the time the samples were taken, the solids in tank 241-AN-107 were identified as sludge. However, following an evaluation of the analytical results that revealed high concentrations of sodium in the waste, the waste phase designation was changed to saltcake. Inventories were computed for each phase separately and then summed to obtain the overall tank inventory.

Agnew et al. (1997a) identifies the waste in the tank as supernatant mixing model (SMM) composite liquids and SMMA2 solids. The SMMA2 waste type designated in Agnew et al. (1997a) is the saltcake supernatant resulting from the second 242-A Evaporator campaign (1981-1988). It is a mixture of concentrated supernatant coming from the 242-A Evaporator that is a blend of other waste types. Upon cooling some saltcake precipitates. The complexed concentrate waste includes high concentrations of organic compounds coming from B Plant cesium and strontium recovery campaigns.

Table 7-1. Tank 241-AN-107 Best Basis Inventory Source Data.

| Waste Phase | Waste Type | Applicable Concentration Data | Associated Density | Associated Volume[1] |
|---|---|---|---|---|
| Supernatant | SMMA2 | AN-107 1998 Grab Liquid Composite Mean | 1.37[1] | 3,013 kL (796 kgal) |
| | | AN-107 1998 Grab Liquid Means | 1.37[1] | |
| | | AN-107 1996 Grab Liquid Means | 1.37 | |
| | | AN-107 1996 Liquid Grab – Privatization Means | 1.38 | |
| | | AN-107 1994 Grab Supernatant Average Conc. | 1.39 | |
| | | SMMA1 Saltcake Liquid Template | 1.60 | |
| Saltcake | SMMA2 (solids) | AN-107 1998 Grab Solids Composite | 1.59[2] | 935 kL (247 kgal) |
| | | AN-107 1994 Grab Solids Calculated Means | 1.49[2] | |
| | | AN-102 1990 Core Calculated Sludge Conc. | 1.5 | |
| | | SMMA1 Saltcake Solids Template | 1.58 | |
| Total tank | Overall tank volume | | | 3,948 kL (1,043 kgal)[3] |

Notes:

[1]The liquid density data from the 1998 event were questionable (Esch 1999a). The 1998 density was assumed to be the same as the density that was measured for 1996 safety screening sampling event (Esch 1996).
[2]The two tank 241-AN-107 grab solids means (1994 and 1998) were averaged to calculate the inventory for the saltcake phase; therefore, the density used to calculate the inventory was also an average (1.55667 g/mL).
[3]The HDW model volume for tank 241-AN-107 is 4,012 kL (1,060 kgal) with a density of 1.58 g/mL.

Since Agnew did not estimate the waste composition for SMMA2 saltcake, it was assumed that the SMMA1 saltcake composition was similar. Therefore, the SMMA1 saltcake waste type templates were used for the supernatant and saltcake phases, rather than the HDW model data for the total tank inventory.

Waste phase volumes for tank 241-AN-107 were derived from recent surface level measurements (CHG 2000) and a 1996 solids level measurement. As of February 29, 2000, the surface level in the tank was 379.2 inches, which equals a total waste volume of 3,948 kL (1,043 kgal). The surface level measurement is based on manual food instrument corporation (FIC) readings and manual tape measurements, which agree closely (CHG 2000). The current saltcake volume for tank 241-AN-

107 is 935 kL (247 kgal). The saltcake volume is based on solids level measurements taken March 1, 1996. The supernatant volume of 3,013 kL (796 kgal) was calculated by subtracting the saltcake volume from the total waste volume. These are the volumes currently reported in Hanlon (1999).

All densities used in the best-basis inventory calculations were either analytically determined or an average of analytical and HDW values, and the values reported in Table 7-1 are means. Because density results were considered suspect on the 1998 analyses (because of poor separation during centrifugation), densities for these samples were based on the density means for the 1996 grab liquid samples (Esch 1996).

The waste phases in Table 7-1 were characterized by grab sample analytical data and process history. Five sample-based concentration vectors were available for the supernatant: 1998 grab liquid composite means, 1998 grab liquid means, 1996 grab liquid means, 1996 liquid grab - privatization means, and 1994 grab supernatant average concentrations. Where possible, the 1998 grab liquid means were used to derive the best-basis inventory for this waste phase. Where the 1998 grab liquid means were not available for the supernatant, the 1998 grab liquid composite means were used. The only sample result used from the 1996 grab liquid means was the mean density. Mercury was the only mean used from the 1996 liquid grab - privatization samples, as this value was a lower, non-detected value than that reported with the 1998 grab liquid composite means. The 1994 grab supernatant average concentration vector was used for the plutonium-239/240 value, since this analyte was not reported with the 1998 or 1996 means.

Values from the SMMA1 saltcake liquid waste type template were used for the radionuclides that did not have analytical data. This template is based on sampling data from tanks that contain SMMA1 waste, which is assumed to be similar to the SMMA2 waste type in tank 241-AN-107. Where sample data are not available, the template is supplemented with HDW model data. A multiplier is used to scale the template vector to the sample data using the sample weight percent water and density. The A1 saltcake liquid template multiplier of 0.725 was calculated using 1996 grab liquid mean density of 1.37 g/mL and 1996 grab liquid mean weight percent water of 50%. The A1 saltcake solid template multiplier of 0.879 was calculated using the average density and weight percent water from the 1994 solids and 1998 grab solids composite means (i.e., density of 1.56 g/mL and weight percent water of 45.6%). A more detailed description of template data is found in Tran (1999).

Three sample-based concentrations vectors were available for the saltcake: tank 241-AN-107 1998 grab solids composite means, tank 241-AN-107 1994 grab solids means, and tank 241-AN-102 1990 core calculated sludge concentrations. During the 1998 analysis, the samples were centrifuged and composites were prepared by combining all of the liquid for the supernate composite and all of the solid collected from centrifugation of the samples for the centrifuged solid composite. The results for these analyses are reported in the *Means and Confidence Intervals* Standard Report as liquid tank composite data and solid tank composite data, respectively. The 1998 grab solids composite means used for best-basis purposes were calculated by re-combining the centrifuged solids and centrifuged liquid results using weight percent solid and liquid fractions (81.8% solid and 18.2% liquid).

The 1994 grab solids means were also manipulated, but in this case the weight percent solids and liquids were adjusted to discount the supernatant fraction that had been analyzed with the solids. Two solids samples were collected from tank 241-AN-107 and noted to contain 77% and 87% settles solids, respectively (Herting 1994). However, the supernatant was not discarded from the samples

but homogenized with the solids, and after the samples underwent centrifugation, analyzed as centrifuged liquid. This resulted in a bias low for the concentration of the centrifuged liquid. The reported weight percent solids was 49% for the first sample and 52.2% for the second. Calculations were performed to discount the supernatant fraction of the samples, resulting in a corrected weight percent solid for each sample. The corrected weight percent solids were 62.39% and 59.28%, respectively. Using these corrected weight percents, the centrifuged liquid and solid portions for the 1994 grab solids samples were re-combined to be more representative of the solids as they exist in the tank, with interstitial liquid rather than supernatant. The two samples were then averaged together to represent the 1994 grab solids means.

The 1998 and 1994 grab samples were taken at different depths and represent different regions of the saltcake in the tank. The two 1994 solid samples were taken at depths of 627 inches and 652 inches (Esch 1999a), whereas the three 1998 solid samples were all taken at a depth of 608 inches (Herting 1994). The variability in analytical results between the data sets indicates two different regions in the saltcake. To best represent the different waste types in the saltcake, the two concentration vectors were averaged.

Since technetium-99 was not analyzed for in the solid phase for tank 241-AN-107, a concentration vector from tank 241-AN-102 was used. The waste in tank 241-AN-107 is CC waste. This is the same waste type that is found in tank 241-AN-102, which has concentrations above the detection limit for technetium-99. For this reason, the technetium-99 concentration for tank 241-AN-107 was assumed to be the same as that reported for tank 241-AN-102 (Douglas 1996).

For the radionuclides that did not have analytical data, values from the SMMA1 saltcake solids waste type template were used.

All inventory calculations were performed using the Best-Basis Inventory Maintenance (BBIM) Tool. The updated best-basis inventory values for tank 241-AN-107 can be found in the *Best-Basis Inventory (Non-Radionuclides)* and *Best Basis Inventory (Radionuclides)* Standard Reports. Discussions of unique data treatments are provided below by analyte.

**Total Hydroxide**. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997a).

**Technetium-99**. The AN-107 1998 grab liquid composite technetium-99 value used to determine the inventory in the supernatant phase was determined by inductively coupled plasma - mass spectroscopy. The mass spectroscopy technique is more reliable than liquid scintillation as it is less susceptible to chemical interference.

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