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ENGINEERING CHANGE NOTICE

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Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [X] Cancel/Void []	M. R. Adams, Data Development and Interpretation, R2-12, 373-6167	[] Yes [X] No	09/07/00
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Tank 241-AN-102	241-AN-102	N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	HNF-SD-WM-ER-545, Rev. 2	ECNs: 635339, 640361, 644477, and 654990	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) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

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

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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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ENGINEERING CHANGE NOTICE	Page 2 of 2	1. ECN (use no. from pg. 1) ECN-657297

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	8/7/00	PE		
Cog. Mgr. J. G. Field	J G Field	8/7/00	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-102

M. R. Adams
CH2M HILL Hanford Group, Inc., Richland, WA 99352
Office of River Protection Contract DE-AC06-99RL14047

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-545	Page 1

(2) Title
Tank Characterization Report for Double-Shell Tank 241-AN-102

CHANGE CONTROL RECORD

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This report prepared especially for Archive TCR on 9/7/00

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 September 7, 2000.

Tank: 241-AN-102

Sampling Events:

102-AN-1
102-AN-2
102-AN-3A
102-AN-3B
102-AN-4
2AN-95-1
2AN-95-2
2AN-95-3
2AN-95-4A
2AN-95-5A
2AN-95-6
2AN-98-1
2AN-98-10
2AN-98-11
2AN-98-12
2AN-98-13
2AN-98-14
2AN-98-15
2AN-98-17
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2AN-98-34
2AN-98-35
2AN-98-37
2AN-98-38
2AN-98-4

2AN-98-40
2AN-98-47
2AN-98-5
2AN-98-55
2AN-98-6
2AN-98-67
2AN-98-7
2AN-98-8

Reports:
Tank Interpretive Report

Constituent Groups:
Anions
Inorganics
Metals/Nonmetals
Organics
PCBs
Physical Properties
Radionuclides

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Data Dictionary to Reports in this Document

Report	Field	Description
Tank Interpretive Report		Interprets information about the tank answering a series of seven 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-102

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-102 include the Tank Safety Screening Data Quality Objective (DQO), Organic Solvent Safety Issue DQO, Low-Activity Waste (LAW) Feed DQO, Confirm Tank T is an Appropriate Feed Source for LAW Feed (Waste Feed Delivery) DQO, Interface Control Document-23 (ICD-23) issue, Dangerous Waste DQO, and Air Emissions DQO. As of the date this report was prepared, August 1, 2000, the sampling events associated with this tank did not address the issues of the Dangerous Waste DQO. Negotiations are ongoing between the Department of Energy (DOE) and regulatory agencies on the extent and timing of sampling and analysis in support of this DQO (Adams et al. 2000). The AN Tank Farm ventilation system exhaust was vapor sampled in 2000 to address the Air Emissions DQO. The samples are still being analyzed. If something of interest is found in the samples, sampling of individual tanks in the farm may be conducted. The remaining issues are discussed below.

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

The data needed to screen the waste in tank 241-AN-102 for potential safety problems are documented in *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). These potential safety problems are exothermic conditions in the waste, flammable gases in the tank headspace, and criticality conditions in the waste. Each condition is addressed separately below. Only the 1994/1995 grab sample data were used to address the safety screening issue (Esch 1996). The 1990 and 1998 sampling events were not performed for safety screening purposes.

The first requirement outlined in the safety screening DQO (Dukelow et al. 1995) is to ensure there are not sufficient exothermic constituents (organic or ferrocyanide) in tank 241-AN-102 to pose a safety hazard. The safety screening DQO required the waste sample profile be tested to determine whether the energetics exceeded the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry weight basis.

Results obtained using differential scanning calorimetry (DSC) indicated that 12 of the 14 grab samples obtained in 1994/1995 from tank 241-AN-102 had mean exothermic reactions (on a dry-weight basis) exceeding the safety screening DQO limit. The maximum dry weight exotherm observed was 1,200 J/g, while the maximum upper limit to a 95 percent confidence interval on the mean was 1,501 J/g (both from sample 2AN-95-2).

Total organic carbon (TOC) analyses were performed as secondary analyses when the DSC notification limit was exceeded. The organic safety program has established a dry-weight TOC

concentration limit of 4.5 weight percent, or 45,000 μg C/g. Results for three out of the ten samples analyzed for TOC were above this limit. Six of the ten samples had an upper limit to a one-sided 95 percent confidence interval on the mean exceeding the threshold, with the highest being 57,900 μg C/g (from sample 2AN-95-4A).

The high concentration of TOC was expected based on the tank's process history. The tank was a receiver of concentrated complexant waste, which contains elevated levels of organic complexants. Although the elevated levels of TOC found in the waste are capable of producing exothermic reactions under laboratory conditions, they do not present a safety concern in the waste because of the high water contents of both the saltcake and supernatant. As calculated in the Best-Basis Inventory (see Question #8), the saltcake had an average water content of 42.1 weight percent, while the mean water content for the supernatant was 48.4 weight percent. Both of these results were well above 17 weight percent, which is the amount required to prevent propagating reactions regardless of TOC content (Turner et al. 1995).

Headspace measurements using a combustible gas meter were taken from riser 21 before obtaining the December 1995 grab samples. Flammable gas was not detected in the headspace (0 percent of the lower flammability limit [LFL]) during the measurements. The safety screening limit for flammable gas concentration is 25 percent of the LFL. Therefore, flammability is not a concern for this tank. The headspace measurements are presented in the *IH Sniff Data* Standard Report.

The potential for criticality can be assessed from the total alpha activity data from the 1994/1995 grab samples. The safety screening decision threshold is 1 g/L, or 61.5 μCi/mL for the supernatant (based on the specific activity of ^{239}Pu). The overall supernatant mean was 0.163 μCi/mL, well below the decision threshold. The upper limit to a 95 percent confidence interval on the mean for each sample/duplicate pair was also below the DQO decision threshold, with the highest value being 0.290 μCi/mL. For the saltcake, the 1 g/L decision threshold was converted to 41.0 μCi/g using the mean saltcake density of 1.5 g/mL and the specific activity of ^{239}Pu. The overall saltcake mean was 0.296 μCi/g, well below the limit. Because the saltcake was analyzed as centrifuged fractions, the 95 percent confidence interval limits on the mean were determined on the centrifuged solids and centrifuged liquid results. The highest upper limits to a one-sided 95 percent confidence interval on the mean for the centrifuged solids and centrifuged liquid were 1.414 μCi/g and 0.296 μCi/mL, respectively, indicating that the potential for a criticality event is extremely low. Therefore, criticality is not a concern for this tank.

A formal review of the sampling and analytical data for tank 241-AN-102 was performed to determine if the safety screening DQO requirements were met. This review is documented in *Evaluation of Tank Data for Safety Screening* (Reynolds et al. 1999). Reynolds et al. (1999) concluded that "the sampling and analysis performed in this tank were consistent with the requirements of the Safety Screening DQO." Therefore, tank 241-AN-102 requires no additional sampling and analysis under the safety screening DQO.

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 safety screening issue are documented in *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997). The organic solvents DQO requires tank headspace samples be analyzed for total nonmethane organic compounds. The purpose of this assessment is to ensure that an organic solvent pool fire or ignition of organic solvents cannot occur.

No vapor samples have been taken 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 the tanks (Brown et al. 1998). Consequently, vapor samples are not required for this tank. The organic solvent issue is expected to be closed for all tanks in fiscal year 2000.

Low-Activity Waste Feed DQO: Do the samples taken from tank 241-AN-102 and the subsequent laboratory analysis meet the needs of the *Low-Activity Waste Feed Data Quality Objectives* (Wiemers and Miller 1997)?

The February 1998 sampling and analysis were performed to meet the requirements of the *Low-Activity Waste Feed Data Quality Objectives* (Wiemers and Miller 1997). Since completion of the analyses, the low-activity waste feed DQO has been revised several times. The current version is the *Low-Activity Waste and High-Level Waste Feed Processing Data Quality Objectives* (Patello et al. 1999). However, because the sampling and analysis were performed to meet the requirements of Wiemers and Miller (1997), this assessment is based on the requirements of that DQO.

The purpose of the low-activity waste feed DQO is to address technical issues pertinent to pretreatment, immobilization, and balance-of-plant for low-activity waste processing. Waste will be characterized to determine whether it falls within the defined process design envelope. Data collected in support of this DQO will be used primarily for planning activities of the waste treatment plant contractors as specified in the privatization request for proposals.

Supernatant grab samples were obtained from tank 241-AN-102 in February 1998, as directed by the *Tank 241-AN-102 Privatization Grab Sampling and Analysis Plan* (SAP) (Jo 1998a). The 222-S Laboratory performed the analysis of the grab samples according to the requirements of Wiemers and Miller (1997). Table 6 in Esch (1998a) provides a comparison of the supernatant results to the Envelope C contract limits. It was determined that all constituents analyzed met the Envelope C contract limits identified in Wiemers and Miller (1997) for low-activity waste. Only one analyte (SO_4; 84.87%) fell within the sensitivity boundary of $\pm$30% of the envelope limit. Solubility screening tests were also performed on the February 1998 grab samples, as directed by Jo (1998a), according to the requirements of Wiemers and Miller (1997). These results are presented in Person (1998a), as well as Esch (1998a).

If the current DQO, *Low-Activity Waste and High-Level Waste Feed Processing Data Quality Objectives* (Patello et al. 1999), is applied to tank 241-AN-102, further analysis of the archived samples from this sampling event may be required. Patello et al. (1999) imposes control limits on

constituents not required by Wiemers and Miller (1997) (e.g., ^{60}Co, ^{154}Eu, and ^{155}Eu). Other differences may also exist that could require additional sampling and/or analysis.

Waste Feed Delivery DQO: Does the waste feed meet specifications as a feed source for low-activity waste treatment?

The 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). Since the 1998 grab sampling of tank 241-AN-102 took place before the release of Nguyen (1999), these activities were performed to the requirements of a previous version of this DQO (Certa 1998). Therefore, this assessment is based on the requirements of Certa (1998).

Five samples taken from tank 241-AN-102 in February 1998 were reserved for future analysis by the Retrieval Program to meet the needs of this DQO. These samples (2AN-98-2, 2AN-98-9, 2AN-98-16, 2AN-98-23, and 2AN-98-30) were placed into archive at the 222-S Laboratory. The requirements of this DQO have not been met as no analyses have as yet been performed for waste feed delivery purposes.

ICD-23 Issue: Have the required samples been provided to the waste treatment plant contractor?

The Waste Disposal Division and Waste Integration Team identified the need for tank waste samples to be provided to the Privatization Contractor for process validation work before the commencement of hot operations (Gasper 1998). It was determined that fifteen liters of waste were to be collected from tank 241-AN-102 and shipped to the contractor (Pauly 1998). Fifteen 500-mL grab samples were obtained from tank 241-AN-102 during July 1998 in accordance with the *Letter of Instruction Supporting Privatization Phase 1B PAS-1 Shipment* (LOI 1) (Seidel 1998). Fifteen additional 500-mL grab samples were taken in August 1998 to meet the requirements of the *Request for Grab Samples from Tank 241-AN-102* (LOI 2) (Jo 1998b). Representative samples of tank 241-AN-102 waste collected in 1998 were analyzed by the 222-S Laboratory to meet the shipping requirements of the LOIs, and the results were reported in Esch (1998b). Then the waste was packaged and shipped to the waste treatment contractor, thus meeting the needs of this issue.

An additional 10 L of supernatant and 1,000 g of solids were obtained in late July and early August of 2000 for ICD-23 (BNFL 2000 and Short 1999) as directed by Hulse (2000). This material is scheduled to be shipped to the Pacific Northwest National Laboratory beginning in October 2000, and will be used to perform steps one and two of the Privatization Regulatory DQO (Hulse 2000).

Bounding Concentration Limits

Analytical results from the 1998 grab sampling events were screened against current bounding concentrations used to develop the authorization source term. These bounding concentrations are listed in Tables 4-1 and 4-2 of Section 18 of *River Protection Project Process Engineering Desk Instruction and Guidance Manual* (Adams 2000). Both the liquid and solids results were compared against the applicable double-shell tank bounding concentrations. No results exceeded any of the bounding concentration values.

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 value calculated using the best-basis total inventory estimates (see *Best Basis Inventory Estimate [Radioactive]* Standard Report) was 10,700 W (36,500 Btu/hr), as shown in Table 1-1. As a comparison, the heat-load estimate based on the tank process history was 11,000 W (37,500 Btu/hr) (Agnew et al. 1997a), while the heat load estimate listed in Kummerer (1995) was 12,000 W (41,000 Btu/hr) based on radionuclide data. All of these estimates are well below the design specification limit of 20,500 W (70,000 Btu/hr) for the AN Tank Farm (Fowler 2000).

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

Radionuclide	Waste Inventory[1]	Specific Activity	Heat Load
Strontium-90	4.30E+05 Ci	0.00669 W/Ci	2,880 W
Cesium-137	1.66E+06 Ci	0.00472 W/Ci	7,840 W
Total			10,700 W

Note:

[1]Obtained from *Best Basis Inventory Estimate (Radioactive)* 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, and contains seven 4,391-kL (1,160-kgal) tanks. These tanks were designed for a maximum fluid temperature of 177 °C (350 °F) (Leach and Stahl 1997), and consist of a reinforced concrete shell with two (inner and outer) carbon steel liners on the bottom and sides. The AN Tank Farm does not use a cascade system between tanks. Twenty-two risers provide access to the tank, while 37 risers provide access to the annulus between the two tank liners. 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.

A small amount of water for hydrotesting was received by tank 241-AN-102 in 1981. Dilute, non-complexed waste from tank 241-SY-102 was received during the second and third quarters of 1982. Water was added to tank 241-AN-102 intermittently from the second quarter of 1982 until the third quarter of 1983.

During the third quarter of 1982, most of the waste in tank 241-AN-102 was transferred to the 242-A Evaporator feed tank (tank 241-AW-102). Tank 241-AN-102 then received non-complexed waste processed in the 242-A Evaporator (Agnew et al. 1997b). Most of this waste was removed during the second quarter of 1983, leaving approximately 125 kL (33 kgal) of waste in tank 241-AN-102. Between the fourth quarter of 1983 and the first quarter of 1984, the tank was filled with evaporator feed from tanks 241-SY-102, 241-AY-102, 241-AW-105, and 241-AN-101. Most of this waste was removed in the second quarter of 1984 for an evaporator campaign, leaving a heel of approximately 129 kL (34 kgal) in tank 241-AN-102. By the fourth quarter of 1984, tank 241-AN-102 was nearly filled with concentrated complexant waste (from a previous 242-A Evaporator campaign) from tank 241-AW-101 (Agnew et al. 1997b). Since then, tank

241-AN-102 has received only small amounts of miscellaneous waste from the Plutonium-Uranium Extraction (PUREX) Plant and waste water. Minor fluctuations (primarily losses) in the waste level have been recorded since the last waste transfer in 1992. These variations are not a result of waste transfers; they are attributed to evaporation.

As of July 19, 2000, tank 241-AN-102 contains a total of 3,993 kL (1,055 kgal) of waste, which is categorized as concentrated complexant (CC) waste by Hanlon (2000). This waste volume is based on the AutoENRAF surface-level data from July 19, 2000 (CHG 2000a). Based on past solids-level measurements (as described in detail in Question #8), 337 kL (89 kgal) of solids are expected to reside in the tank. Agnew et al. (1997a) characterizes this waste as A2 salt slurry, which is defined as waste from 242-A Evaporator campaigns from 1981 through 1988. By subtraction, the supernatant volume is 3,656 kL (966 kgal).

Tank 241-AN-102 is listed as sound and is actively ventilated. It is not on the Watch List. It is scheduled as a source tank for low-activity waste for Phase I of the vitrification effort.

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-102 is one of seven double-shell tanks that contain CC waste (Hanlon 2000). The others that contain CC waste are tanks 241-AN-106, 241-AN-107, 241-AP-103, 241-AP-104, 241-SY-101, and 241-SY-103. Of these tanks, tank 241-AN-107 is often considered most similar to tank 241-AN-102. A comparison between the 1998 analytical results from tanks 241-AN-102 and 241-AN-107 was performed for the tank 241-AN-107 Tank Interpretive Report (TIR) (CHG 2000b). The comparison showed that the 1998 results from these two tanks compared well.

The solids in tank 241-AN-102 are characterized as A2 salt slurry by Agnew et al. (1997a). Other tanks in the AN Tank Farm that contain A2 salt slurry include 241-AN-103, 241-AN-104, 241-AN-105, and 241-AN-107. A2 salt slurry is waste that was concentrated in the 242-A Evaporator from 1981 through 1988. Because of the general nature of this waste type, variability in analyte concentrations between tanks that contain A2 salt slurry is not uncommon. However, based on the comparison discussed previously, it appears that good agreement was observed between the 1998 results from tanks 241-AN-102 and 241-AN-107.

Tanks 241-AN-102 and 241-AN-107 may also be similar in that their wastes may display the phenomenon of caustic depletion. Both tanks currently have a hydroxide concentration below that required by the corrosion specifications. Caustic depletion is well documented for tank 241-AN-107. For tank 241-AN-102, the issue is currently under review (see Question #4). Any lessons learned during remediation of the caustic shortage problem in tank 241-AN-107 can be applied to resolving the same problem in tank 241-AN-102.

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-102 has been selected as a Phase I source tank for vitrification. According to *Tank Farm Contractor Operation and Utilization Plan* (Kirkbride et al. 2000), the tank will provide low-activity waste feed for Envelope C.

Given what is known about the waste types and behaviors in tank 241-AN-102, there should be little difficulty in retrieving the waste in the tank. The following discussion provides information regarding issues that are of interest from a waste retrieval/processing point-of-view.

The concentration of hydroxide and the issue of caustic depletion are currently under review for tank 241-AN-102. The tank's hydroxide concentration is slightly below the tank farm corrosion specification, which, based on the nitrate and nitrite results, is 0.3 M. The low hydroxide concentration may be indicative of caustic depletion. A review of the historical hydroxide data is inconclusive as to a downward trend over the years. Before this issue can be fully addressed, more data points are needed. The reason caustic depletion is important for waste retrieval is because the waste in tank 241-AN-102 will be staged for another seven and a half years before processing (according to low-activity waste feed delivery Case 3S6E [Kirkbride et al. 2000]), and the depletion of hydroxide during this time could potentially cause stress corrosion cracking in the tank's primary steel liner. Kirkbride et al. (2000) assumed that a 0.5 M caustic addition will be made to the tank in October 2001.

Caustic demand studies were performed in 1996 on the 1994 and 1995 grab samples. A solids composite and a supernatant liquid composite were created for the studies according to Herting (1995). The results (as reported in [Herting 1996]) demonstrated that the tank samples had very little buffering capacity. Herting (1996) also noted that a small amount of solids precipitated at a hydroxide concentration of 2 M in both the solids and supernatant samples. The supernatant liquid composite at 3 M formed approximately 50 percent centrifuged solids. The solids were assumed to be sodium carbonate, and corresponding decreases in the solution total inorganic carbon (TIC) concentrations were observed. The same behavior has been observed in similar samples from tank 241-AN-107. Further discussion of these results is available in Herting (1996).

At the same time as the caustic demand studies, tests were performed on two solids grab samples from 1994 and 1995 to measure the soluble species in the solids. The tests were performed by subjecting the solids samples to a water wash. Herting (1996) reports that most of the solids were water soluble in both samples. The samples contained about 5 percent total solids after the water wash. Most of these solids appear to be carbonate, sulfate, and oxalate, though the data were not consistent enough to draw firm conclusions. The total weight percent of typically insoluble sludge analytes, including aluminum, iron, and chromium, was less than one percent of the total solids sample weight.

Solubility screening tests were performed on material obtained during February 1998. The tests, performed according to Person (1998b), were done on composites comprised of drainable liquid and

centrifuged solids. The composites were made to match the highest solids/liquid mass ratio observed in the grab samples. The intent of the tests was to gain information about the species present in the solids, and to determine what dissolves upon dilution with inhibited water. The results indicated that as the amount of diluent was increased, there was a corresponding decrease in the weight percent solids in the composite. It was determined that TIC (present as carbonate), phosphorus (present as phosphate), and sulfur (present as sulfate) were soluble, while TOC (present as oxalate) was quite insoluble. (Person [1998a] noted that the solubility of sodium oxalate is very dependent on ionic strength, and was unlikely to dissolve very much at the dilution ratios used in the tests.) Other insoluble species were chromium, iron, and silicon. Aluminum was mostly insoluble. More detail regarding these results can be found in Person (1998a) (which is included as Attachment 2 in Esch [1998a]).

Archived material from 1998 was sent to BNFL, Inc. (the privatization contractor at the time) as required by ICD-23. BNFL, Inc. sent this material off-site for analysis. At the time of preparation of this TIR, the final results from the analysis have not been released. A draft copy of the data report presents results for supernatant and solids samples after dilution to 6.4 M sodium.

Mixing of the supernatant is planned for most of the low-activity waste feed staging tanks in order to achieve homogeneity before transfer to the waste treatment plant. This mixing step may possibly be eliminated for tank 241-AN-102 because the results of a homogeneity check on samples from the February 1998 grab sampling event revealed that supernatant liquid is already homogeneous (Esch 1998a).

Finally, the pumpability of the waste should be evaluated before retrieval commences. Tank temperatures average between 30 and 35 °C (86 and 95 °F). Person (1998a) raised the possibility that some of the solids seen in the supernatant samples may have precipitated as a result of cooling. A slight cooling trend in the waste may also be contributing to the formation of suspended solids in the lower regions of the tank (see Question #8 for more detail). As mentioned earlier, the solubility screening study (Person 1998a) revealed that the weight percent solids decreased as the amount of diluent increased. Therefore, the problem of precipitating solids during pumping may be alleviated through dilution.

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 River Protection Program (RPP): Safety Screening, Organic Solvent Safety Issue, and the ICD-23 Issue. No additional sampling or analyses are necessary to satisfy current safety issue requirements for this

tank. Further action may be identified to address the latest revision of the low-activity waste feed DQO (the one in effect at the time of the February 1998 grab samples has been superseded by Patello et al. [1999]), the Waste Feed Delivery DQO (Nguyen [1999] has superseded the one in effect at the time of sampling, Certa [1998]), and the Dangerous Waste DQO. The Air Emissions DQO evaluation is currently underway. Any further action is dependent on the results from vapor sampling of the AN Tank Farm ventilation system exhaust.

The following discussion provides a qualitative assessment of the field sampling. No problems were observed while taking the 1998 supernatant grab samples. However, several problems were noted while collecting the 1998 saltcake samples. These sampling problems are discussed below.

The intended saltcake grab samples from the February 1998 sampling event were taken from an elevation of 127 cm (50 in.) rather than 25 cm (10 in.) as specified in the sampling and analysis plan (Jo 1998a). Consequently, supernatant was primarily obtained instead of saltcake. This caused a change in the analytical procedure, as there was insufficient solids to provide enough material to prepare a solids composite using representative fractions of solids from each tank level sampled. Instead, the centrifuged solids composite was prepared by combining all of the solids collected.

Only two of the three July 1998 saltcake grab samples were taken at the requested elevation of 36 cm (14 in.); the third sample was taken at an elevation of 38 cm (15 in.). The first two samples had 66 and 72 percent solids, respectively; while the third sample contained 12 percent solids. Because the appearance of the solids was identical between the three grab samples, the laboratory analyzed just one sample (the 12 percent solid sample) rather than all three as requested by Jo (1998b).

No problems were noted during the October 1994 and February 1995 sampling events, and recoveries were good. During the November/December 1995 sampling event, it was discovered that the two samples expected to contain saltcake actually contained supernatant. The samples were retaken, with satisfactory results.

There is little information regarding the 1990 core sampling. No problems with this event were recorded in Douglas (1996). Based on the length of material obtained in each of the three segments, sample recoveries ranged from 79 to 100 percent.

Data Quality

The usual quality control (QC) assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. Sample and duplicate pairs with one or more QC results outside the specified criteria were identified by footnotes in the tables in the *Analytical Results* Standard Report.

The standard and spike recovery results provide an estimate of analysis accuracy. If a standard or spike recovery is above or below the given criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the relative percent difference (RPD), which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100.

The vast majority of QC results were within the required boundaries. Small discrepancies noted in the data packages and footnoted in the *Analytical Results* Standard Report should not impact the data validity or use. The QC results are summarized by sampling event in the following sections.

July/August 1998 Grab Sampling Event. The grab samples taken from tank 241-AN-102 in July and August 1998 were analyzed at the 222-S Laboratory. Other than the few instances noted below, the quality control criteria associated with these samples met the minimum requirements stated in the *222-S Laboratory Quality Assurance Plan* (LABQAPP) (Markel 1998).

The standard recoveries met the minimum recoveries stated in LABQAPP (Markel 1998). Spike recoveries for all analytes except aluminum met the specified limits. The aluminum spike recovery failure was because of the high concentration of analyte in the sample. A post-digestion spike analysis was performed for the solid samples and a spike analysis on a higher dilution was performed for the supernatant samples. These additional spike analyses had recoveries that were within the LABQAPP limits.

The RPD for AMU-238 from sample S98T002900 (centrifuged solid) was greater than 20 percent. A reanalysis was performed with no improvement of the RPD. The reanalysis results were consistent with the original and are the only results reported. The high RPD for AMU-238 may be attributed to analyte specific problems such as inhomogeneity of the saltcake. No repreparation or further reanalysis was performed.

The RPD for the required inductively coupled plasma (ICP) analyte (aluminum) was within the LABQAPP limits. Results for other non-requested ICP analytes determined from the same acid preparation were evaluated to determine whether the digestion was satisfactory. Many analytes had acceptable RPDs (<20 percent). However, five analytes were noted to have elevated RPDs (chromium, iron, manganese, silicon, and zirconium). When the results were compared to those previously reported (Esch 1998b), it appeared that the saltcake may be non-homogeneous for these analytes in particular. Other detected analyte results were consistent with previously reported results.

Contamination was detected in the preparation blanks for Al and ^{137}Cs, and in the method blank for ^{90}Sr. However, the detected concentrations were less than 5 percent of the concentrations reported for the samples. Therefore, the contamination was considered insignificant, and no repreparation or reanalysis was requested.

In summary, the vast majority of QC results were within the boundaries specified in the LOIs (Seidel 1998 and Jo 1998b). The discrepancies mentioned here and footnoted in the data summary tables should not impact data validity or use.

February 1998 Grab Sampling Event. The data from the February 1998 sampling event do not appear in the *Analytical Results* Standard Report. This is because the data are in the altered section of the Tank Characterization Database (TCD) as they provided a baseline for the solubility screening studies. The baseline data will be available in the unaltered section of TCD in the near future. A review of the QC data on the unaltered samples from the February 1998 sampling event is provided here because the data were used in developing the BBI. The review of the QC data is limited to those analytes identified in Table 5 of Esch (1998a) as Group 1 or Group 2 analytes. All other ICP

results are considered "opportunistic" and do not have specified QC acceptance criteria. Therefore, any anomalies for these results are not discussed in this report.

The analytes are divided into Group 1 and Group 2, as required by the low-activity waste feed DQO (Wiemers and Miller 1997). The low-activity waste feed DQO requires repreparation and/or reanalysis only for Group 1 analytes that fail to meet the QC criteria specified in the SAP (Jo 1998a). Group 2 analytes that fail to meet the specified QC criteria do not require reanalysis. In addition, repreparation and/or reanalysis of Group 1 analytes were only required if the reported results were within the sensitivity bounds as defined in Table 6 of Esch (1998a).

The standard recoveries for all of the required analytes met the requirements stated in the SAP (Jo 1998a), except for Si and ^{237}Np. Because the ^{237}Np recovery (129.4 percent) was within the method control limits of 70 to 130 percent, no reanalysis was requested. For Si, the centrifuged solid composite and the solids from the solubility screening standard recoveries were outside the limits of 80 to 120 percent recovery stated in the SAP (Jo 1998a). Because of problems obtaining consistent results for Si from acid digested samples, the acceptance limits for the digested standard were set at a fixed administrative range of 50 to 500 percent recovery. In both cases, the low recovery was within these limits. Because this analyte is not included in the envelope limits, no repreparation or reanalysis was requested.

Spike recovery results were outside of the requested limits of 75 to 125 percent recovery for several of the required analytes: Al, K, Na, P, Si, and S. For all of the analytes but Si, the failure was because of the high concentration of analyte in the sample. With analyte concentrations higher than 1,000 μg/mL, it is difficult to add sufficient spike to perform a meaningful analysis. A post-digestion spike analysis was performed for the solid samples, and a spike analysis on a higher dilution was performed for the supernatant samples. For all analytes, these additional spike recoveries were within the requested limits. The cause for the low spike recoveries for the Si analysis is unknown. However, because this analyte is not included in the contract envelope limit, repreparation and reanalysis were not required.

The spike recovery result for Na on the first analysis of the supernatant composite was outside of the limits of 75 to 125 percent recovery. However, the spike recovery on the higher dilution of the sample was acceptable. The serial dilution results were obtained from the data collected on the first analysis. They indicate that the accuracy of the analysis was acceptable. Therefore, when the samples were reanalyzed to improve the precision, an additional spike analysis was not requested. As a result, the spike recovery for the Na is reported as "n/a" (not available) in Esch (1998a). The results from the first analysis are included with the raw data.

The RPDs associated with the February 1998 grab samples met the requirements specified in the SAP (Jo 1998a) for all analytes except Na, ^{3}H, ^{154}Eu, ^{14}C, and ^{79}Se. The high RPD for one ^{14}C subsample (56.8 percent) may have been caused by a leak in the CO_2 collection system for the duplicate aliquot, resulting in low analyte recovery. Because ^{14}C, ^{154}Eu, and ^{79}Se were not included in the envelope limit, no reanalysis was required on these analytes.

Relative percent differences greater than 20 percent were reported for all three ^{3}H subsamples. The elevated RPDs were probably caused by contamination from the high concentration of Cs in the samples. The three samples were reanalyzed several times, but only the last set of results was

included in this document. Even with the bias, only one result was more than ten times higher than the detection limit and no further reanalysis was requested. With this method, it is difficult to avoid contamination from Cs, especially with the high concentration found in these samples.

Other than ^{3}H, the only other reanalysis requested was for a high RPD for Na on two of the three supernatant composite subsamples. The RPDs for the first analysis were approximately 8 percent. Because the Na results are used to evaluate the envelope criteria for all of the Group 1 analytes, the SAP requires an RPD of ≤ 5 percent. The reported RPDs for the reanalysis were all < 3 percent.

Contamination was detected in the method or preparation blanks for the following analytes: total alpha, total beta, Al, Na, Si, Cl, NO_3, ^{90}Sr, ^{137}Cs, and ^{79}Se. However, all of the detected concentrations were less than 5 percent of the concentration reported for those analytes in the samples. Therefore, the contamination was considered insignificant, and no repreparation or reanalysis was requested.

It was difficult for the laboratory to meet the minimum reportable quantities specified by the low-activity waste feed DQO (Wiemers and Miller 1997) for a number of analytes because of dilutions that were required during the sample preparations and analyses.

Large dilutions of the inductively coupled plasma/mass spectrometry (ICP/MS) samples were required to reduce the concentrations of dissolved solids. Sample aliquots were diluted to achieve a sodium concentration of at most 5 μg/mL. Concentrations higher than this would affect the analysis because of reduced ionization efficiencies and material buildup on the sample or skimmer cones at the interface to the mass spectrometer. Even though the detection limits did not meet the minimum reportable quantity (MRQ) requirements, the sum of the "less than" values used for the determination of the transuranic (TRU) isotopes met the envelope criteria. The TRU value was at 50.93% of the contract envelope limit.

The minimum detectable activities reported for ^{155}Eu were more than a factor of 10 higher than the minimum reportable quantities requested in the low-activity waste feed DQO (Wiemers and Miller 1997). However, since a smaller dilution could not be analyzed because of the high cesium concentration in the samples, no reanalysis was requested.

The results for all analytes were below the Envelope C contract limits. Sulfate (SO_4) was the only analyte that fell within the sensitivity boundary (84.87 percent).

In summary, the vast majority of QC results were within the boundaries specified in the SAP (Jo 1998a). The discrepancies mentioned here and footnoted in the data summary tables should not impact data validity or use.

1994/1995 Grab Sampling Event. All the pertinent QC tests were conducted on the grab samples analyzed in 1996 from the December 1995, November 1995, February 1995, and October 1994 grab sampling events that were subjected to the safety screening evaluation. The specific criteria for the QC checks on these grab samples were provided in the SAP (Jo 1996). Only limited QC information was available for the grab samples analyzed in 1994. One standard was run in conjunction with each analyte.

All standard recoveries were within the defined criteria. Fluoride, nitrate, and nitrite each had 1 out of 3 matrix spikes above the QC limits, while total alpha activity had 2 of 12 spikes below the QC limit (including reruns). Low total alpha activity spike recoveries are common because of difficulties in preparing the sample mount, which can cause self-shielding. For total alpha activity, 1 out of 14 RPDs were outside the criterion, while TOC had 1 out of 10 RPDs exceed the criterion. Nine of the 21 samples with exothermic reactions had RPDs above the criterion. This was not unusual given the small sample sizes (8 to 60 mg) and possible sample heterogeneity problems. Manganese and potassium had 2 out of 3 RPDs outside the criterion, while iron had 1 out of 3 outside the limits. Finally, none of the samples exceeded the criteria for preparation blanks; therefore, contamination was not a problem for any of the analytes.

The only QC check performed in conjunction with the 1994 analyses was one standard for each analyte. Because no tank characterization plan governed this sampling event, no specific criterion was given to evaluate the standards. However, to maintain consistency, the same criteria applied to the other grab samples were applied to these samples (80 to 120 percent recovery for all analytes except DSC and the thermogravimetric analysis [TGA], which were 90 to 110 percent recovery). None of the standards conducted on the 1994 supernatant analytes violated the QC limits.

In summary, practically all of the QC results associated with the 1994/1995 analyses were within the boundaries specified in the SAP (Jo 1996). The few discrepancies observed should not impact either the validity or the use of the data.

1990 Core Sampling Event. No QC information was provided in the Pacific Northwest National Laboratory source documents used to compile the final report (Douglas 1996) for the 1990 core sampling event. Because there is no way to assess the reliability of the analytical results, the data from this sampling event should be used with caution.

Clarification and Explanation of Data Tables and Figures

Description of Tank Standard Report: The 1990 core sampling event is not listed in the sampling events on this standard report because the data are not in the Tank Characterization Database. The dates of this sampling event were June 20 through June 27, 1990 (Stanton 2000).

Subsampling Scheme and Sample Description Standard Report: Blanks are present in the "Weight" column of this standard report because sample weights were unavailable for some of the tank 241-AN-102 grab samples. All of the supernatant grab samples from 1994 and 1995 did not have sample weights. Likewise, the three samples analyzed from the July/August 1998 sampling event did not have sample weights. Sample weights were also unavailable for samples 2AN-98-17 and 2AN-98-30 from the February 1998 sampling event.

Sample Breakdown Diagrams Standard Report: Two sample breakdown diagrams exist for the February 1998 liquid composite (sample S98T002181) because the analysis of cyanide, antimony, and thallium were requested after issuance of the original final data package. Also, no sample breakdown diagrams appear for the 1990 core sample or the original analyses on the October 1994 grab samples because none were included in the data sources for these sampling events. The TOC analyses on samples S95T003982, S95T003983, S95T003984, S95T004133, S95T004135, S95T004137, and S95T004139 from the 1994/1995 sampling events are not reflected in the sample breakdown diagrams.

Core Profile Standard Report: No core profile is available for the 1990 core sampling event.

Average Monthly Tank Surface Level Standard Report: The slow but steady decrease in the tank surface level over the years is a result of evaporation instead of transfers from the tank. The small jump in level shown in early 2000 was caused by a rebaselining from the FIC gauge to the ENRAF gauge.

Analytical Results Standard Report: Only data in the unaltered section of the TCD appears in this standard report. Consequently, the data from the February 1998 sampling event and the original analyses on the October 1994 grab samples do not appear. The February 1998 data are in the altered section of TCD, while the original October 1994 data are included in the historical database. In the future, the February 1998 data will be available in the unaltered section of TCD.

QC Limits Used When Generating Analytical Results Report for Tank 241-AN-102 Standard Report: The QC limits varied between the grab sampling events. This standard report is configured so that only one set of specific QC limits for each analytical method can be entered. Consequently, the most stringent QC limits used in analysis of any of the grab samples were entered into this standard report. Usually, the 1996 QC limits were more stringent than the 1998 QC limits. This may have caused some 1998 data to be incorrectly flagged as having QC problems. Also, the default QC limits in the standard report are automatically generated and are programmed to always appear, regardless if they are applicable to tank 241-AN-102. Note that this standard report is scheduled to be eliminated in early fiscal year 2001, and instead, the QC flags will be placed directly into TCD.

Unique Aspects of the Tank

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

The waste in tank 241-AN-102 is relatively unique in several aspects. First, the waste is concentrated complexant waste, which is a fairly rare waste type. Secondly, the waste may be caustic deficient. Finally, the makeup of the supernatant and saltcake in the interface region are such that it is difficult to pinpoint where one ends and the other begins. All of these unique conditions are discussed in other areas of this report. Question #3 discusses concentrated complexant waste, Question #4 addresses the caustic deficient nature of the waste, and Question #8 provides detail regarding the difficulty in definitively determining the solids level in the tank.

Means and Confidence Intervals

Question 7: What statistical model was used to generate the means and confidence intervals? What data was included in the calculations?

Solid Data

An analysis of variance (ANOVA) model was fit to the replicate data from the solid portion of the laboratory samples. Mean analyte concentrations and 95 percent confidence intervals on the mean were estimated using results from the ANOVA. One variance component was used in the calculations. It represents concentration differences between analytical replicates.

The model is:

$$Y_i = \mu + A_i,$$

$$i=1, 2, \ldots, n;$$

where

Y_i	=	concentration from the ith analytical result
μ	=	the mean
A_i	=	the analytical error
n	=	the number of analytical results.

The variables A_i are assumed to be uncorrelated and normally distributed with means zero and variance $\sigma^2(A)$. The estimate of μ is the sample mean, and the estimate of $\sigma^2(A)$ is the sample variance.

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used for non-detected results. For analytes with a majority of results below the detection limit, a simple average is reported.

The lower and upper limits, LL(95%) and UL(95%), of a two-sided 95 percent confidence interval on the mean were calculated using:

$$\text{LL(95\%)}: \hat{\mu} - t_{(df,\ 0.025)} \times \hat{\sigma}(\hat{\mu})$$
$$\text{UL(95\%)}: \hat{\mu} + t_{(df,\ 0.025)} \times \hat{\sigma}(\hat{\mu}).$$

In these equations, $\hat{\mu}$ is the estimate of the mean concentration, $\hat{\sigma}(\hat{\mu})$ is the estimate of the standard deviation of the mean, and $t_{(df,\ 0.025)}$ is the quantile from Student's *t* distribution with degrees of freedom (*df*). The *df* are the number of observations minus one. In cases where the lower limit of the confidence interval was negative, it was reported as zero.

Two sets of means were calculated for the solid data resulting from the 1998 sampling events of tank 241-AN-102: July/August 1998 solid sample means and February 1998 solid and dissolution composite means. The means for each of the data sets are listed separately in the *Means and Confidence Intervals* Standard Report. Because the 1990 core data were not in TCD, no statistical means were performed on the data. Refer to Question #8 for a description of the method used to derive saltcake means using the 1990 data.

The July 1998 solid sample was centrifuged, and the means provided in the standard report are for the centrifuged solid sample.

A centrifuged solids composite was formed using solids obtained from centrifugation of the February 1998 grab samples. Five dissolution composites were also created. These composites were designed to match the grab sample with the highest observed solid to liquid mass ratio and, therefore, may be biased. Only two of the composites were left undiluted. The means from these two composites and the centrifuged solids composite were combined to derive a single mean (called the "February 1998 grab liquid composites mean").

Liquid Data

Four sets of means were calculated for the liquid data from the various grab sampling events. These means are the July/August 1998 liquid sample means, the February 1998 supernatant and dissolution composite means, the February 1998 liquid sample means, and the 1994/1995 liquid means.

A ANOVA model was fit to the data from the liquid portion of the laboratory samples. Mean analyte concentrations and 95 percent confidence intervals on the mean were estimated using results from the ANOVA. Two variance components were estimated and used in the computations. The variance components represent concentration differences between laboratory samples and between analytical replicates.

The model is:

$$Y_{ij} = \mu + L_i + A_{ij},$$

$$i=1,2,\ldots,a;\ j=1,2,\ldots,n_i;$$

where

Y_{ij} = concentration from the jth analytical result from the ith riser

μ = the mean

L_i = the effect of the ith laboratory sample

A_{ij} = the analytical error

a = the number of laboratory samples

n_i = the number of analytical results from the ith laboratory sample.

The variable L_i is a random effect. This variable and A_{ij} are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(L)$, and $\sigma^2(A)$, respectively.

The restricted maximum likelihood method (REML) was used to estimate the mean concentration and standard deviation of the mean for all analytes that had 50 percent or more of their reported values greater than the detection limit. The mean concentrations and standard deviations of the mean were used to calculate the 95 percent confidence intervals. The following table gives the estimate of the mean, degrees of freedom, and confidence interval on the mean.

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used for non-detected results. For analytes with a majority of results below the detection limit, a simple average is reported.

The lower and upper limits, LL(95%) and UL(95%), of a two-sided 95 percent confidence interval on the mean were calculated using:

$$\text{LL}(95\%): \hat{\mu} - t_{(df,\ 0.025)} \times \hat{\sigma}(\hat{\mu})$$

$$\text{UL}(95\%): \hat{\mu} + t_{(df,\ 0.025)} \times \hat{\sigma}(\hat{\mu}).$$

In these equations, $\hat{\mu}$ is the REML estimate of the mean concentration, $\hat{\sigma}(\hat{\mu})$ is the REML estimate of the standard deviation of the mean, and $t_{(df,\ 0.025)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom are the number of laboratory samples with data minus one. In cases where the lower limit of the confidence interval was negative, it was reported as zero.

When calculating the July/August 1998 means in the *Means and Confidence Intervals* Standard Report, three liquid samples were used. Two of the samples were uncentrifuged supernatant samples (one each from July and August), while the third was the centrifuged liquid portion of the July solid sample discussed earlier (note that this sample contained only 12 percent solids).

As with the solids means from February 1998, only the results from the two undiluted solubility screening composites were included in the mean calculation. Data from these two composites were combined with data from the supernatant composites to derive one liquid composite mean (called the "February 1998 supernatant and dissolution composite mean"). When calculating means for the liquids, data from one of the undiluted dissolution composites (from which analytical samples S98T002286 and S98T002286D were taken) were excluded from the mean calculation. This data was excluded because of questions regarding its validity. Without exception, data from this composite were substantially different from that of the other undiluted dissolution composite. The reason for the inconsistencies could not be definitively determined. Unexpectedly, only a limited amount of material from the composite in question was available for analysis. It was hypothesized that some spillage of the composite may have occurred (Esch 1998a), which could account for the data problems. Because of the severe data inconsistencies, the chemist that performed the dissolution studies concluded that the results from the questionable dissolution composite should be discarded (Esch 1998a). Therefore, they were not used in the mean calculations.

It should be noted that each of the liquid composite types (supernatant and dissolution) may contain biases. The supernatant composites were centrifuged before analysis, likely biasing the results by removing the solids. Conversely, the dissolution composites were created to match the grab sample with the highest observed solid to liquid mass ratio and, therefore, may also be biased.

Although they were not used in deriving any of the best-basis inventories, the *Means and Confidence Intervals* Standard Report also includes a table of means from the four homogeneity check samples from February 1998. This is the February 1998 "Liquid Sample Data" means table shown in the standard report.

The 1994/1995 means that appear in the *Means and Confidence Intervals* Standard Report are a combination of data from the October 1994, February 1995, November 1995, and December 1995 sampling events. Note that the October 1994 supernatant data resides in the historical section of TCD and, therefore, will not be displayed in the *Analytical Results* Standard Report. These data were originally reported in Herting (1994). As directed by Herting (1994), the primary results for chloride, fluoride, nitrite, phosphate, and sulfate from sample 102-AN-1 were omitted from any mean calculations because of questions regarding the validity of the numbers. All of the results in question were higher than the other results from the October 1994 samples. Also removed from the mean calculations were the fluoride results from samples 2AN-95-1 (S95T003867) and 2AN-95-2 (S95T003868). These results were small less-thans, while the remaining liquid fluoride data were detected results that were at least an order of magnitude higher.

Best-Basis Inventory Derivation

Question 8: 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 BBI is an on-going effort. Because of concerns regarding the saltcake sodium and anion concentrations in the previous BBI for tank 241-AN-102, a re-evaluation of the BBI 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-102 liquid grab samples from the October 1994, February 1995, and November/December 1995 sampling events (see *Means and Confidence Intervals* Standard Report).

- Statistical means based on the supernatant and centrifuged liquid portions of grab samples taken in February 1998 from tank 241-AN-102 (see *Means and Confidence Intervals* Standard Report).

- Statistical means based on the supernatant and centrifuged liquid portions of grab samples taken in July and August 1998 from tank 241-AN-102 (see *Means and Confidence Intervals* Standard Report).

- Reconstituted saltcake means based on data from centrifuged solids and liquid fractions from a 1990 tank 241-AN-102 core sample.

- Reconstituted saltcake means based on the centrifuged solids data from the 1990 core, and an average of the liquid means from the 1994/1995, February 1998, and July/August 1998 sampling events, along with results from the 1996 study (Herting 1996) of centrifuged liquid portions from the 1994/1995 solids grab samples.

- Calculated saltcake concentrations based on analysis of various portions of the 1994/1995 solids samples, as reported in *Tank 241-AN-102 Caustic Demand and Sludge Characterization* (Herting 1996).

- Best-Basis Inventory templates for the following waste types: A1 saltcake solids and A1 saltcake liquid.

Table 8-1 represents how the available information was used to derive best-basis inventories for tank 241-AN-102.

Table 8-1. Tank 241-AN-102 Best-Basis Inventory Source Data.

Waste Phase	Waste Type	Applicable Concentration Data	Associated Density	Associated Volume
Supernatant	Concentrated complexant waste	Combined supernatant means	1.43 g/mL	3,656 kL (966 kgal)
		A1 saltcake liquid template	1.60 g/mL	
Saltcake	A2 salt slurry (solids)	Reconstituted concentrations using the calculated IL means and the 1990 core centrifuged solids (see Table 8-3)	1.56 g/mL	337 kL (89 kgal)
		Reconstituted concentrations based on centrifuged fractions of the 1990 core (see Table 8-4)	1.5 g/mL	
		A1 saltcake solids template	1.58 g/mL	
		Calculated concentrations based on 1994/95 solids grab samples	1.53 g/mL	
Total tank				3,993 kL (1,055 kgal)[1]

Notes:

A1 saltcake = waste from 242-A Evaporator campaigns from 1976 through 1980
IL = interstitial liquid

[1]Volume as of 7/19/00.

Tank 241-AN-102 has two waste phases: supernatant and saltcake. The waste types listed in Table 8-1 were taken from process knowledge and the Hanford Defined Waste (HDW) model (Agnew et al. 1997a).

The total waste volume of 3,993 kL (1,055 kgal) is based on the AutoENRAF surface-level gauge reading on July 19, 2000. CHG (2000c) and the July 2000 version of the Hanlon report will be updated to reflect this volume. There has been a slow but steady decline in the waste volume over the years as a result of evaporation.

The saltcake volume in tank 241-AN-102 is open to interpretation. Previous BBIs have used 337 kL (89 kgal), which was based on an average of three solids-level measurements taken in 1989. Since

that time, much additional information on the solids level has been obtained, but no clear conclusion can be drawn from the data.

From the many grab samples taken, an appreciable amount of solids was first observed in samples taken at 180 in. from the tank bottom. (See the *Tank 241-AN-102 Subsampling Scheme and Sample Description* Standard Report for a description of the grab samples.) Note that all sampling elevations mentioned in the following discussion are referenced from the bottom of the tank. Two of seven samples taken through riser 20 from 180 in. in February 1998 contained 13.1 and 6 percent settled solids, respectively (see the *241-AN-102 Tank Plan View* Standard Report for riser locations). Samples taken at 122 in. through riser 21 in November/December 1995 had only a trace amount of solids. Two of five samples taken from riser 20 at 101 in. in February 1998 had 6 and 5 percent settled solids, respectively, while the remainder had no solids or only a trace of solids. In riser 22, an appreciable amount of solids did not appear in the samples until a February 1995 sample taken at 69 in. The sample contained 18.8 percent settled solids. The 1990 core (taken through riser 10) consisted of three 19-in. segments from the bottom of the tank (i.e., the bottom 57 in. of waste were sampled). A majority of the core was described as a flowing slurry, which implies that solids are present up to at least 57 in. Fourteen samples were taken at 50 in. through riser 20 in February 1998; the settled solids content of these samples ranged from <1.7 percent to 22 percent, with an average of 12 percent. No grab samples have been taken between 50 in. and 18 in. From 18 in. and lower, all but one sample contained at least 61.5 percent settled solids.

Measurements of the solids level were made in 1989 and 1998. The three solids-level measurements in 1989 were 39.25 in., 32.25 in., and 26.0 in. from risers 20, 3, and 1, respectively. Following the February 1998 sampling event, a zipcord was deployed through riser 20 to measure the solids level. At 42 in. from the tank bottom, it was recorded in the work package that the waste had a thick consistency (LMHC 1998). The consistency continued to get thicker, and at 30 in., the zipcord became completely slack, characteristic of a hard saltcake layer.

All of this information seems to indicate that the lower region of waste in tank 241-AN-102 is a slurry in which the entrained solids content increases according to depth. Above 180 in., there is little, if any, entrained solids. Between 180 in. and 69 in., six out of 20 samples contained measurable solids. This reveals that entrained solids are beginning to appear in the waste in this region. It is possible that a scattering or upwelling of solids is present only in the vicinity of riser 20, as all 6 samples with solids in the 180-in. to 69-in. range were taken from this riser. Below 69 in., the grab samples generally showed an increase in amount of entrained solids with increasing depth.

As seen from the above discussion, determining the point at which the supernatant ends and the saltcake begins is extremely difficult. For BBI purposes, the previous volume of 337 kL (89 kgal) (based on an average solids level of 32.5 in.) has been retained. Two pieces of information strongly support this volume: first, the observation during the 1998 solids-level measurement that the zipcord went completely slack at 30 in.; and second, a portion of the 1990 core beginning at approximately 31 in. appeared more solid-like, as it partially held its shape upon extrusion.

It should be noted that no changes to the process history have occurred since 1984 that would affect the solids layer. However, new solids may have been and may continue to be generated as a result of caustic depletion and the degradation of organic complexants, as well as waste cooling. As the hydroxide concentration decreases, the change in pH can cause new precipitates to form, especially

aluminum compounds. As organic complexants degrade over time, insoluble degradation products may form. The increased concentration of TOC in the samples obtained at 50 in. relative to the samples taken lower may indicate that a portion of these solids is from organic complexant degradation. Tank 241-AN-102 waste temperatures have generally displayed a slow but steady cooling trend over the years. As the waste cools, solids may precipitate out of solution.

The supernatant volume was calculated by subtracting the saltcake volume from the total volume, yielding a result of 3,656 kL (966 kgal).

A separate interstitial liquid (IL) inventory was not determined for this tank because of observations made during extrusion of the 1990 core. Although it was obvious that the saltcake contained a substantial amount of liquid, very little liquid drained from the core. Instead, the vast majority of the waste phase "flowed". The solids were really more characteristic of a salt slurry instead of a traditional saltcake. For this reason, the average in-tank saltcake drainable porosity of 0.25 from Field and Vladimiroff (1999) was not applied as is normally done. Instead, an estimate of the volume of interstitial liquid present was derived using the weight fractions of the centrifuged solids and liquids. These weight fractions (0.554 for the centrifuged solids and 0.446 for the centrifuged liquid) were the same that were used when reconstituting means for the saltcake layer. The centrifuged solids weight fraction was converted to a volume fraction using the density of the saltcake (1.56 g/mL) and the density of the centrifuged solids (1.7 g/mL) as shown in the following equation (note that c.s. = centrifuged solids and s.c. = saltcake):

$$\frac{55.4\,g\ c.s.}{100\,g\ s.c.} * \frac{1.56\,g\ s.c.}{mL\ s.c.} * \frac{mL\ c.s.}{1.7\,g\ c.s.} = \frac{0.508\ mL\ c.s.}{mL\ s.c.}$$

The volume fraction of the centrifuged liquid was determined by difference (1 - 0.508) to be 0.492. Multiplying the saltcake volume by this number yielded an interstitial liquid volume of 167 kL (44 kgal).

A. Derivation of Supernatant Characterization Vectors.

The previous BBI for tank 241-AN-102 primarily used three sample-based vectors to characterize the supernatant. These three vectors were: (1) means based on the 1994/1995 supernatant grab samples; (2) means based on the February 1998 supernatant and dissolution composites; and (3) means based on the July/August 1998 supernatant samples and the decanted liquid from the solids samples. In the previous BBI, the 1994/1995 supernatant grab sample means were the preferred vector, followed by the February 1998 composite means. The July/August 1998 data were used for only one analyte, total uranium.

A comparison of the three sample-based supernatant vectors revealed that they displayed remarkable consistency. This was not unexpected, as a homogeneity check performed on the February 1998 samples found that the supernatant was homogeneous from top to bottom (Esch 1998a). Because of the excellent agreement between the vectors, the decision was made for this update to average the three vectors. The BBIM tool performed the averaging.

Prior to averaging, each vector was adjusted for evaporation that had occurred between the sampling date and the effective date of this BBI, July 19, 2000. The adjustments were made using multipliers,

which were simply the result of the volume at the sampling date divided by the effective date volume. The multipliers for the 1994/1995, February 1998, and July/August 1998 vectors were 1.027 (992 kgal/966 kgal), 1.014 (980 kgal/966 kgal), and 1.012 (978 kgal/966 kgal), respectively.

The average of the three sample-based supernatant vectors was the preferred vector for characterizing the supernatant. The A1 saltcake liquid template was used for deriving inventories when data were unavailable from the sample-based average vector, or when the template had a smaller value than a sample-based less-than value. Although the waste in tank 241-AN-102 was categorized as A2 salt slurry by Agnew et al. (1997a), a composition for A2 salt slurry was not derived by Agnew et al. (1997a). Consequently, the assumption was made that A2 salt slurry was similar to A1 saltcake (both waste types were produced by the 242-A Evaporator, although over different time spans), and the A1 saltcake liquid template was used to represent the A2 salt slurry liquid in the tank. The A1 saltcake liquid template was based on sample data from tanks containing this waste type supplemented with HDW model data (Agnew et al. 1997a) where sample data were not available. A more detailed description of template data is found in Tran (1999). The template data were scaled to the sample data using the weight percent water (48.4) and density (1.44) from the sample-based average vector, which yielded a multiplier of 0.786.

The three-vector average density and percent water were calculated in a different manner than the other analytes. The method used for calculating these analytes was the same as that used for the saltcake interstitial liquid. This method is detailed in the introduction to Table 8-2 in Section B.

Exceptions to the data hierarchy described above were made for several analytes. For total uranium, the July/August 1998 value (20.9 μg/mL) was selected to represent the supernatant layer instead of the three-vector average because the results from the other two supernatant vectors were much higher less-thans. It should be noted that this 20.9 μg/mL value was derived from the measured ^{238}U result by assuming that ^{238}U comprises approximately 99 percent of total uranium (i.e., the ^{238}U value was divided by 0.99 to derive total uranium). (Because of enrichment with ^{235}U, the fuel in N Reactor was approximately 98.75 to 99.0 percent ^{238}U. Ninety-nine percent was selected as the nominal value.) Also note that ^{238}U was reported as atomic mass unit (AMU)-238 by the laboratory. However, according to best-basis convention, the AMU-238 value was assumed to be ^{238}U. The other exceptions were for Sb, Tl, and ^{60}Co. For Sb and Tl, the February 1998 values were selected because the July/August 1998 numbers were large less-thans, which skewed the three-vector average. Similarly, the 1994/1995 ^{60}Co mean was selected because the July/August 1998 value was a large less-than.

Analyses were performed on the liquid in the samples from the July/August 1998 sampling event that were sent to the original waste treatment plant contractor. However, for the same reasons described above for the solids, no data from these analyses were used to derive inventories.

B. Derivation of Saltcake Characterization Vectors.

As presented in Table 8-1, four vectors are available for characterizing the saltcake. These four vectors are: (1) calculated concentrations based on the centrifuged solids from the 1990 core and the supernatant characterization data; (2) calculated concentrations based on the centrifuged solids and liquid from the 1990 core; (3) the A1 saltcake solids template; and (4) calculated concentrations

based on data from solids grab samples from 1994 and 1995. The following discussion provides detail on the derivation of each of these vectors.

Reconstituted Concentrations Using the Calculated IL Means and the 1990 Core Centrifuged Solids. The 1990 core consisted of three segments taken from the bottom of the tank. Before analysis, the segments were centrifuged, and the centrifuged fractions were analyzed separately. In order to accurately represent the saltcake phase, means for the centrifuged fractions had to be combined based on weighting factors.

Upon evaluation of the data, concerns were raised regarding the centrifuged liquid results. The anion data were extremely low for a saturated solution. The nitrate, nitrite, sulfate, and total inorganic carbon means were only 40,900, 13,800, 4,320, and 2,760 μg/mL, respectively. In comparison, the supernatant nitrate means ranged from 225,000 to 233,000 μg/mL, the nitrite means ranged from 82,700 to 93,000 μg/mL, the sulfate means ranged from 14,300 to 15,500 μg/mL, and the total inorganic carbon means ranged from 13,200 to 14,000 μg/mL. In addition, the centrifuged liquid results did not reflect the elevated levels of organic carbon expected from the tank's process history. The centrifuged liquid mean was 4,440 μg/mL, while the supernatant means ranged from 25,400 to 30,000 μg/mL. Consequently, for this vector, an alternative method for deriving mean concentrations for the interstitial liquid was used.

The alternative method for deriving interstitial liquid concentrations used an average of means from four sources of data. The first three, which included means from the 1994/1995 supernatant grab samples, means from the February 1998 supernatant and dissolution composites, and means from the July/August 1998 supernatant and decanted saltcake liquid samples, were used to characterize the supernatant as described later. These means are reported in the *Means and Confidence Intervals* Standard Report. The fourth source was from a 1996 analysis of the centrifuged liquid from two saltcake samples from the 1994/1995 sampling events. These data are reported in Herting (1996).

Table 8-2 presents the four data sets used to derive means for representing the interstitial liquid in the saltcake. Note that the data in the four data sets as presented in Table 8-2 will not match the source data because the data in the table have been adjusted in order to bring all data sets to a common date. First, each data set was decayed to August 1, 1990, the approximate analysis date of the 1990 core. Then, each data set was back corrected for evaporation that occurred between the sampling date of the 1990 core (selected as June 1, 1990) and the respective grab sampling event. The back correction was performed using multipliers that were derived by dividing the volume at the time of the grab sampling event by the volume at June 1, 1990 (1,019 kgal). The multipliers used were 0.973503 for the 1994/1995 grab samples (calculated from 992 kgal/1,019 kgal), 0.961727 for the February 1998 grab samples (calculated from 980 kgal/1,019 kgal), 0.959764 for the July/August 1998 grab samples (calculated from 978 kgal/1,019 kgal), and 0.973503 for the Herting (1996) data as they were derived from the 1994/1995 grab samples. The density and percent water values were adjusted differently. Density was modified using the following equation:

$$\text{new density} = [(\text{old density} - 1) * \text{multiplier}] + 1$$

where the multiplier is the same multiplier used to adjust the chemical species

In order to adjust the percent water, the pre-adjustment total concentration (sum of the chemical analytes and the percent water) was determined. (The percent water was converted to a μg/mL basis before summing.) After applying the evaporation multiplier, a new sum was calculated for the chemical analytes. This sum was then subtracted from the old total concentration, yielding the adjusted percent water in units of μg/mL, which was converted to a weight percent using the adjusted density. Table 8-2 also shows a conversion to units of μg/g, which was required in order to combine the means with the 1990 centrifuged solids data.

Table 8-2. Mean Derivations for the Four Data Sets Used to Represent the Saltcake Interstitial Liquid(2 pages).

Analyte	Adjusted 1994/1995 Grab Sample Means	Adjusted Feb. 98 Grab Liquid Composites Means	Adjusted July/Aug 98 Liquid Grab Means	Adjusted Herting 1996 Centrifuged Liquid Data	Mean	Mean Converted to a Per Gram Basis
	μg/mL or μCi/mL	μg/mL or μCi/mL	μg/mL or μCi/mL	μg/mL or μCi/mL	μg/mL or μCi/mL	μg/g or μCi/g
Ag		<7.16E+00			<7.16E+00	<5.13E+00
Al	1.47E+04	1.52E+04	1.40E+04	1.48E+04	1.47E+04	1.05E+04
B		4.17E+01		4.58E+01	4.37E+01	3.13E+01
Ba		<2.89E+01			<2.89E+01	<2.07E+01
Ca	4.23E+02	4.95E+02	4.58E+02	4.44E+02	4.55E+02	3.26E+02
Cd		6.38E+01		5.89E+01	6.13E+01	4.39E+01
Ce		<5.78E+01			<5.78E+01	<4.14E+01
Co		<1.15E+01			<1.15E+01	<8.27E+00
Cr	2.89E+02	2.87E+02	2.69E+02	2.87E+02	2.83E+02	2.03E+02
Cu		2.54E+01		2.43E+01	2.49E+01	1.78E+01
Fe	4.96E+01	4.77E+01	4.19E+01	6.96E+01	5.22E+01	3.74E+01
K	3.78E+03	2.27E+03	2.12E+03	2.17E+03	2.58E+03	1.85E+03
La		<2.89E+01	<2.89E+01	1.51E+01	<2.43E+01	<1.74E+01
Mg		<5.78E+01			<5.78E+01	<4.14E+01
Mn	3.81E+01	2.44E+01	2.21E+01	1.85E+01	2.58E+01	1.85E+01
Mo		5.34E+01		5.11E+01	5.22E+01	3.74E+01
Na	2.34E+05	2.12E+05	2.01E+05		2.15E+05	1.54E+05
Nd				3.26E+01	3.26E+01	2.34E+01
Ni	3.71E+02	4.25E+02	3.91E+02	4.09E+02	3.99E+02	2.86E+02
P				1.77E+03	1.77E+03	1.27E+03
Pb		1.77E+02	1.74E+02	1.65E+02	1.72E+02	1.23E+02
Si	<1.97E+01	<2.90E+01	<2.89E+01	6.62E+01	<3.59E+01	<2.58E+01
Sr		<5.78E+00	<5.77E+00	2.76E+00	<4.77E+00	<3.42E+00
U	<1.95E+02	<2.89E+02	2.01E+01		2.01E+01[1]	1.44E+01
Zn		<5.78E+00			<5.78E+00	<4.14E+00
Zr		9.15E+00	8.93E+00		9.04E+00	6.47E+00
Cl-	3.71E+03	4.02E+03		4.24E+03	3.99E+03	2.86E+03
F-	1.81E+03	1.77E+03		<1.29E+02	1.79E+03[2]	1.28E+03
NO_3^-	2.19E+05	2.24E+05		2.38E+05	2.27E+05	1.63E+05

Table 8-2. Mean Derivations for the Four Data Sets Used to Represent the Saltcake Interstitial Liquid(2 pages).

Analyte	Adjusted 1994/1995 Grab Sample Means	Adjusted Feb. 98 Grab Liquid Composites Means	Adjusted July/Aug 98 Liquid Grab Means	Adjusted Herting 1996 Centrifuged Liquid Data	Mean	Mean Converted to a Per Gram Basis
	µg/mL or µCi/mL	µg/mL or µCi/mL	µg/mL or µCi/mL	µg/mL or µCi/mL	µg/mL or µCi/mL	µg/g or µCi/g
NO_2^-	8.05E+04	8.94E+04		8.75E+04	8.58E+04	6.15E+04
PO_4^{3-}	4.80E+03	5.85E+03		5.23E+03	5.29E+03	3.79E+03
SO_4^{2-}	1.39E+04	1.49E+04		1.52E+04	1.47E+04	1.05E+04
NH_3		1.27E+02			1.27E+02	9.09E+01
TIC	1.29E+04	1.35E+04		1.29E+04	1.31E+04	9.35E+03
TOC	2.52E+04	2.44E+04	2.88E+04	2.92E+04	2.69E+04	1.93E+04
^{241}Am	1.35E-01	1.57E-01			1.46E-01	1.05E-01
^{14}C		6.78E-04			6.78E-04	4.85E-04
$^{243/244}Cm$		<1.95E-02			<1.95E-02	<1.39E-02
^{60}Co	2.72E-01	2.92E-01	<5.42E+00	3.28E-01	2.97E-01[3]	2.13E-01
^{137}Cs	3.82E+02	3.68E+02	5.04E+02	3.90E+02	4.11E+02	2.94E+02
^{154}Eu		4.95E-01		5.73E-01	5.34E-01	3.82E-01
^{155}Eu		<4.77E-01		<8.33E-01	<6.55E-01	<4.69E-01
^{3}H		1.10E-03			1.10E-03	7.92E-04
^{237}Np		<2.05E-03			<2.05E-03	<1.47E-03
$^{239/240}Pu$	5.67E-03				5.67E-03	4.06E-03
^{125}Sb		<4.59E+00			<4.59E+00	<3.29E+00
^{79}Se		5.81E-04			5.81E-04	4.16E-04
^{90}Sr	8.15E+01	1.04E+02	1.04E+02	8.70E+01	9.40E+01	6.74E+01
^{99}Tc		1.35E-01			1.35E-01	9.64E-02
Density	1.40E+00	1.41E+00	1.44E+00	1.33E+00	1.40E+00	---
% Water	5.14E+01			5.06E+01	5.10E+01	---

Notes:

[1]Based on the July/August 1998 value only.

[2]Did not use the Herting (1996) value in the mean calculation.

[3]Did not use the July/August 1998 value in the mean calculation.

As mentioned earlier, the combination of the means in µg/g from Table 8-2 with the centrifuged solids data from the 1990 core was done using weighting factors. These weighting factors were based on the weight percent that each fraction represented in the 1990 composite; centrifuged solids constituted 55.4 percent of the composite, while centrifuged liquids comprised the remaining 44.6 percent. Therefore, the total saltcake concentration for each analyte was derived by multiplying the centrifuged solids results by 0.554 and the liquid values from Table 8-2 (in units of µg/g) by 0.446, and then summing the two products. Table 8-3 displays the means for the centrifuged solids and the calculated liquid values, along with the resulting saltcake concentrations.

The sodium value for the 1990 centrifuged solids means in Table 8-3 deserves special note as it is not a sample-based number. The sodium value reported in Douglas (1996) for the centrifuged solids was 322,000 μg/g. Because the value was so high, charge and mass balances were performed on the data. The charge balance was extremely poor, as the anionic species measured balanced only approximately 60 percent of the positive charge. With the high sodium value, the mass balance was nearly 113 percent, demonstrating that the problem with the charge balance was not that some of the anionic species had not been measured, but instead that the sodium concentration was overestimated. In order to balance the charge in the centrifuged solids, a sodium value of 170,000 μg/g was required. Using this value yielded a mass balance of 97.7 percent. The 170,000-μg/g value may be slightly underestimating the sodium concentration as it assumes that no free hydroxide is present. However, the measured free hydroxide concentration in the February 1998 supernatant grab samples was only 2,610 μg/mL, and the concentration in the solids would be expected to be much less. In addition, other sodium results from centrifuged solids were all below 170,000 μg/g. Centrifuged solids results from the July/August 1998 and February 1998 solids samples were 142,000 and 151,000 μg/g, respectively, while Herting (1996) listed a value of 111,000 μg/g. For comparison, the centrifuged solids results for sodium from tank 241-AN-107 was 130,000 μg/g.

Table 8-3. Reconstituted Saltcake Concentrations Using the Calculated Interstitial Liquid Means and the 1990 Core Centrifuged Solids(2 pages).[1]

Analyte	1990 Centrifuged Solids Means	Calculated Interstitial Liquid Means[2]	Combined Saltcake Concentration
	μg/g or μCi/g	μg/g or μCi/g	μg/g or μCi/g
Ag	<1.94E+00	<5.13E+00	<3.36E+00
Al	1.46E+04	1.05E+04	1.28E+04
B	<1.41E+03	3.13E+01	<7.95E+02
Ba	4.39E+01	<2.07E+01	<3.36E+01
Ca	3.49E+03	3.26E+02	2.08E+03
Cd	<2.70E+01	4.39E+01	<3.46E+01
Ce	<7.15E+02	<4.14E+01	<4.15E+02
Co	<1.00E+03	<8.27E+00	<5.58E+02
Cr	2.24E+03	2.03E+02	1.33E+03
Cu	8.90E+01	1.78E+01	5.72E+01
Fe	2.85E+03	3.74E+01	1.60E+03
K	<2.03E+03	1.85E+03	<1.95E+03
La	<4.45E+01	<1.74E+01	<3.24E+01
Mg	2.04E+02	<4.14E+01	<1.31E+02
Mn	8.24E+02	1.85E+01	4.65E+02
Mo	4.41E+01	3.74E+01	4.11E+01
Na	1.70E+05[3]	1.54E+05	1.63E+05
Nd	<3.32E+01	2.34E+01	<2.88E+01
Ni	5.75E+02	2.86E+02	4.46E+02
P	<3.00E+03	1.27E+03	<2.23E+03
Pb	<3.73E+02	1.23E+02	<2.62E+02
Si	2.36E+03	<2.58E+01	1.32E+03
Sr	3.42E+01	<3.42E+00	2.05E+01

Table 8-3. Reconstituted Saltcake Concentrations Using the Calculated Interstitial Liquid Means and the 1990 Core Centrifuged Solids(2 pages).[1]

Analyte	1990 Centrifuged Solids Means	Calculated Interstitial Liquid Means[2]	Combined Saltcake Concentration
	µg/g or µCi/g	µg/g or µCi/g	µg/g or µCi/g
U	2.86E+03	1.44E+01	1.59E+03
Zn	1.37E+02	<4.14E+00	7.77E+01
Zr	1.00E+03	6.47E+00	5.57E+02
Cl-	2.87E+03	2.86E+03	2.87E+03
F-	<1.90E+02	1.28E+03	<6.77E+02
NO_3^-	1.79E+05	1.63E+05	1.72E+05
NO_2^-	6.30E+04	6.15E+04	6.23E+04
PO_4^{3-}	3.61E+03	3.79E+03	3.69E+03
SO_4^{2-}	4.42E+04	1.05E+04	2.92E+04
NH_3	---	9.09E+01	4.06E+01
TIC	2.07E+04	9.35E+03	1.56E+04
TOC	2.69E+04	1.93E+04	2.35E+04
^{241}Am	9.90E-01	1.05E-01	5.95E-01
^{14}C	1.90E-03	4.85E-04	1.27E-03
$^{243/244}Cm$	5.90E-02	<1.39E-02	<3.89E-02
^{60}Co	4.30E-01	2.13E-01	3.33E-01
^{137}Cs	4.00E+02	2.94E+02	3.53E+02
^{154}Eu	1.60E+00	3.82E-01	1.06E+00
^{155}Eu	1.70E+00	<4.69E-01	<1.15E+00
^{3}H	3.50E-03	7.92E-04	2.29E-03
^{237}Np	1.70E-03	<1.47E-03	<1.60E-03
$^{239/240}Pu$	8.70E-02	4.06E-03	5.00E-02
^{125}Sb	<1.30E+00	<3.29E+00	<2.19E+00
^{79}Se	3.50E-03	4.16E-04	2.12E-03
^{90}Sr	2.80E+02	6.74E+01	1.85E+02
^{99}Tc	1.60E-01	9.64E-02	1.32E-01
Density	1.70E+00	1.40E+00	1.56E+00
% Water	3.50E+01	5.10E+01	4.21E+01

Notes:

[1]A less-than symbol was applied to the combined saltcake concentration if greater than 10 percent of the concentration came from a non-detected value.

[2]From Table 8-2.

[3]Calculated by performing a charge balance on the centrifuged solids results.

Reconstituted Concentrations Based on the Centrifuged Solids and Centrifuged Liquid from the 1990 Core. As mentioned above, a three-segment core sample was taken from tank 241-AN-102 in 1990. A composite was formed from the three segments. This composite was centrifuged before analysis, and the centrifuged fractions were analyzed independently. Douglas (1996) and WHC (1990) provide more detail regarding this sampling event.

To derive a true saltcake concentration using the 1990 data, the centrifuged fraction concentrations were combined based on the same weighting factors discussed previously (55.4 weight percent centrifuged solids and 44.6 weight percent centrifuged liquid). Because the data from this sampling event are not in the Tank Characterization Database (and, therefore, the AutoTCR), the data are reproduced in Table 8-4. The table also presents the reconstituted saltcake concentrations.

Table 8-4. Reconstituted Saltcake Concentrations Based on the Centrifuged Fractions of the 1990 Core(3 pages).

Analyte	Centrifuged Solids Concentration	Centrifuged Liquid Concentration	Calculated Saltcake Concentration
Metals	µg/g	µg/g	µg/g
Ag	<1.94	<1.16	<1.59
Al	14,600	9,250	12,200
As	<292	10.2	<166
B	<1,410	24.7	<792
Ba	43.9	2.55	25.5
Be	<1.17	0.142	<0.712
Ca	3,490	315	2,070
Cd	<27.0	36.1	<31.1
Ce	<715	<16.0	<403
Co	<1,000	<30.7	<568
Cr	2,240	286	1,370
Cu	89.0	20.9	58.6
Dy	<24.4	<0.998	<14.0
Fe	2,850	211	1,670
K	<2,030	1,370	<1,740
La	<44.5	10.9	<29.5
Li	<160	<0.793	<89.0
Mg	204	5.73	116
Mn	824	51.0	479
Mo	44.1	33.6	39.4
Na	3.22E+05	1.25E+05	2.34E+05
Nd	<33.2	21.6	<28.0
Ni	575	239	425
P	<3,000	1,150	<2,170
Pb	<373	147	<272
Re	<104	<1.14	<58.1
Rh	<525	<8.82	<295
Ru	<394	15.9	<225
Sb	<925	<7.83	<516
Se	<1,110	<7.90	<618
Si	2,360	112	1,360
Sr	34.2	2.13	19.9
Te	<345	8.93	<195
Th	<464	29.8	<270
Ti	<45.0	<0.855	<25.3

Table 8-4. Reconstituted Saltcake Concentrations Based on the Centrifuged Fractions of the 1990 Core(3 pages).

Analyte	Centrifuged Solids Concentration	Centrifuged Liquid Concentration	Calculated Saltcake Concentration
Tl	<11,200	<234	<6,310
U[1]	2,860	4.93	1,590
V	<26.5	<0.801	<15.0
Zn	137	12.1	81.3
Zr	1,000	1.04	554
Ions	**μg/g**	**μg/g**	**μg/g**
Br^-	<799	<11.4	<448
Cl^-	2,870	1,060	2,060
Cr^{6+}	<30.2	<3.19	<18.2
F^-	<190	1,760	<890
NO_3^-	1.79E+05	28,800	1.12E+05
NO_2^-	63,000	9,860	39,300
PO_4^{-3}	3,610	2,310	3,030
SO_4^{-2}	44,200	3,090	25,900
Radionuclides	**μCi/g**	**μCi/g**	**μCi/g**
^{241}Am	0.99[2]	0.0786[2]	0.584
^{14}C	0.0019	5.07E-04	0.00128
^{144}Ce	<1.8	<0.186	<1.08
^{242}Cm	Not Detected	3.57E-04	1.59E-04
$^{243/244}Cm$	0.059	0.00486	0.0349
^{60}Co	0.43	0.100	0.283
^{134}Cs	<0.22	<0.0186	<0.130
^{137}Cs	400	143	285
^{152}Eu	<0.17	<0.00543	<0.0966
^{154}Eu	1.6	0.214	0.982
^{155}Eu	1.7	0.236	1.05
^{153}Gd	<0.66	<0.0714	<0.397
^{3}H	0.0035	0.00129	0.00251
^{94}Nb	3.1E-04	4.64E-06	1.74E-04
^{237}Np	0.0017	<1.64E-06	<9.43E-04
^{238}Pu	0.029	0.0171	0.0237
$^{239/240}Pu$	0.087	0.0500	0.0705
^{106}Ru	<2.0	<0.200	<1.20
^{125}Sb	<1.3	<0.107	<0.768
^{79}Se	0.0035	1.21E-04	0.00199
^{113}Sn	1.5	<0.300	<0.965
^{90}Sr	280	32.1	169
^{99}Tc	0.16	0.0214	0.0982
Total beta	940	1,930	1,380
Physical Properties			
Percent water			40.3[3]
Density	1.7 g/mL	1.4 g/mL	1.5[4] g/mL

Table 8-4. Reconstituted Saltcake Concentrations Based on the Centrifuged Fractions of the 1990 Core(3 pages).

Analyte	Centrifuged Solids Concentration	Centrifuged Liquid Concentration	Calculated Saltcake Concentration
Carbon	µg C/g	µg C/g	µg C/g
TIC	20,700	1,970	12,300
TOC	26,900	3,170	16,300

Notes:

[1]Reported uranium concentration determined by fluorescence.

[2]Based on gamma energy analysis data in order to provide the most conservative estimate.

[3]The weight percent water for the saltcake was taken from a percent solids determination on the core composite (done by drying at 105 °C [221 °F] for 24 hours). A weight percent water mean based on TGA data could not be calculated because TGA was not performed on the centrifuged liquid.

[4]The reported density value is from a density determination on the core composite; it was not calculated by taking a weighted mean from the centrifuged solids and centrifuged liquid results.

Calculated Concentrations Based on the A1 Saltcake Solids Template. Like the A1 saltcake liquid template, the A1 saltcake solids template is based on sampling data from other tanks containing the same waste type, supplemented with HDW model data (Agnew et al. 1997a). A multiplier was used to scale the template vector to the sample data using the sample weight percent water and density. Based on the weight percent water (42.1 percent) and density (1.56 g/mL) for the vector reconstituted from the 1990 core centrifuged solids and the calculated IL means, a multiplier of 0.938 was applied to the template data. A more detailed description of template data can be found in Tran (1999).

Calculated Concentrations Based on the 1994/1995 Solids Grab Samples. In 1996, two solids grab samples taken in 1994/1995, 102-AN-3 (1994) and 102-AN-3 (1995), were characterized. The samples were analyzed as directed in Herting (1995), and the results were reported in Herting (1996).

The samples were prepared by decanting (and discarding) the supernatant from the settled solids. Three aliquots of the settled solids (two from 102-AN-3 (1994) and one from 102-AN-3 (1995)) were taken, and each was centrifuged to separate the interstitial liquid. The interstitial liquid was analyzed separately. The solids remaining after centrifugation were subjected to a water wash, and both the water wash liquid and the washed solids were analyzed. Herting (1996) derived a total saltcake concentration for each aliquot by combining the results from the three fractions according to weighting factors. These results are presented in Table 1 of Herting (1996); they are not in the Tank Characterization Database or the AutoTCR. A mean concentration was derived by averaging the calculated saltcake results from the three aliquots. This vector was not used for calculating any inventories, and is only included for comparison purposes.

Other Possible Solids Characterization Sources Not Used in Developing the Best-Basis Inventory. Solids were obtained and analyzed during the February 1998 and July/August 1998 sampling events. However, for various reasons, the data were not used to derive inventory estimates.

In the February 1998 grab sampling event, the samples that were intended to be solids grab samples were inadvertently taken at an elevation of 50 in. from the tank bottom, and therefore consisted primarily of supernatant. (As detailed earlier, the solids level is estimated to be 32.5 in. from the tank bottom.) The fourteen samples ranged from <1.7 percent to 22 percent settled solids, with an average of 12 percent. The composite formed from these solids is more representative of the suspended solids in the supernatant, and may or may not represent the saltcake solids. There was also a concern expressed in Person (1998a) that the solids may have precipitated as a result of cooling, as the laboratory hotcell is at least 10 °F cooler than the tank temperature.

The solids data from the July/August 1998 grab sampling event were based on the analysis of a single grab sample. During the July/August 1998 grab sampling event, three grab samples were requested at an elevation of 14 in. Two were taken at 14 in., while the third was obtained one in. higher. The two grab samples taken at 14 in. contained 66 and 72 percent settled solids. The third sample collected one in. higher contained only 12 percent solids. However, of the three samples, only the one with 12 percent solids was analyzed. Questions concerning the validity of the data were raised because of the extremely low metals concentrations, especially the iron, chromium, manganese, and zirconium.

A total of 32 samples from the July/August 1998 sampling event were sent to the original waste treatment plant contractor. These samples were then shipped to Savannah River for analysis. Solids in the samples were analyzed. However, at this time, the data are only in draft format, and because of the sample preparation procedures (dilution to certain molar sodium levels), no unaltered concentrations can be derived from the data. Therefore, none of these data were used to calculate inventories.

Data Hierarchy for the Saltcake. The preferred vector in the saltcake was the reconstituted concentrations using the calculated IL means and the 1990 core centrifuged solids. The reconstituted saltcake concentrations from the 1990 core centrifuged solids and liquids were used when data were missing from the preferred vector or the preferred vector had a higher less-than value. The A1 saltcake solids template data were only used when data were unavailable or below detection limits in the other two vectors. Means from the 1994/1995 solids grab samples were not used to derive any inventories.

All inventory calculations were performed using the Best-Basis Inventory Maintenance Tool. The updated best-basis inventory values for tank 241-AN-102 can be found in the *Best-Basis Inventory Estimate (Nonradioactive)* and *Best Basis Inventory Estimate (Radioactive)* Standard Reports. Unique data treatments are discussed below by analyte.

Mercury. A mercury inventory of 0 kg, estimated from a distribution of the process-knowledge-based mercury global inventory, was used for tank 241-AN-102 (Higley 2000).

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 is consistent with that used by Agnew et al. (1997a).

Reference List

Adams, M. R., 2000, *River Protection Project Process Engineering Desk Instruction and Guidance Manual*, HNF-SD-WM-PROC-021, Rev. 3F, CH2M HILL Hanford Group, Inc., Richland, Washington.

Adams, M. R., J. G. Douglas, N. L. Hulse, and J. W. Hunt, 2000, *Fiscal Year 2001 Tank Characterization Technical Sampling Basis and Waste Information Requirements Document*, RPP-5832, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. FitzPatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997a, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Waste Status and Transaction Record Summary (WSTRS), Rev. 4*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

BNFL, 2000, *Interface Control Document ICD-23 Between DOE and BNFL Inc. for Waste Treatability Samples*, BNFL-5193-ID-23, Rev. 3c.r1, BNFL Inc., Richland, Washington.

Brown, T. M., J. W. Hunt, and L. J. Fergestrom, 1998, *Tank Characterization Technical Sampling Basis*, HNF-SD-WM-TA-164, Rev. 4, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Certa, P. J., 1998, *Data Quality Objectives for TWRS Privatization Phase I: Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X*, HNF-1796, Rev. 0, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

CHG, 2000a, *Measurements/SACS Surface Level*, available on the Tank Characterization Database at http://twins.pnl.gov/data/datamenu.htm.

CHG, 2000b, *241-AN-107/Tank Interpretive Report*, Tank Waste Information Network System, Internet at http://twins.pnl.gov/reports/remotetcr.asp.

CHG, 2000c, *Sample Analysis/Tank Transfers*, available on the Tank Characterization Database at http://twins.pnl.gov/data/datamenu.htm.

Douglas, J. G., 1996, *Analytical Results for Double-Shell Tank 241-AN-102: June, 1990, Push-Mode Core Sample*, WHC-SD-WM-TI-743, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Esch, R. A., 1996, *Final Report for Tank 241-AN-102, Grab Samples 2AN-95-1 through 2AN-95-6 and 102-AN-1 through 102-AN-4*, WHC-SD-WM-DP-165, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Esch, R. A., 1998a, *Tank 241-AN-102 Low Activity Waste Envelope C Analytical Results for the Final Report*, HNF-SD-WM-DP-310, Rev. 0, Waste Management Federal Services of Hanford, Inc., for Fluor Daniel Hanford, Inc., Richland, Washington.

Esch, R. A., 1998b, *Tank 241-AN-102 Low Activity Waste Envelope C Analytical Results for PAS-1 Shipping*, HNF-1660, Rev. 0, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Field, J. G., and D. T. Vladimiroff, 1999, *Updated Pumpable Liquid Volume Estimates and Jet Pump Durations for Interim Stabilization of Remaining Single-Shell Tanks*, HNF-2978, Rev. 1, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Fowler, K. D., 2000, *Tank Farm Waste Transfer Compatibility Program*, HNF-SD-WM-OCD-015, Rev. 3, CH2M HILL Hanford Group, Inc., Richland, Washington.

Gasper, K. A., 1998, *Planning Basis for Privatization Contractors' Sample Needs* (Internal memorandum to J. W. Hunt, April 9), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Hanlon, B. M., 2000, *Waste Tank Summary Report for Month Ending May 31, 2000*, HNF-EP-0182-146, CH2M HILL Hanford Group, Inc., Richland, Washington.

Herting, D. L., 1994, *Characterization of Supernate Samples from Tank 102-AN*, (Internal memorandum 8E110-PCL94-112 to J. M. Jones, December 28), Westinghouse Hanford Company, Richland, Washington.

Herting, D. H., 1995, *Test Plan for Tank 102-AN Sample Testing*, (Internal memorandum 8E110-PCL95-007 to K. G. Carothers, January 19), Westinghouse Hanford Company, Richland, Washington.

Herting, D. H., 1996, *Tank 241-AN-102 Caustic Demand and Sludge Characterization*, (Internal memorandum 75764-PCS96-085 to K. G. Carothers, August 22), Westinghouse Hanford Company, Richland, Washington.

Higley, B. A., 2000, *Reconciliation of Process Knowledge and Sample Based Mercury Inventories of Underground Storage Tanks*, (internal memorandum 6N100-00-051 to T. T. Tran, April 27), CH2M HILL Hanford Group, Inc., Richland, Washington.

Hulse, N. L., 2000, *Request for Grab Samples from Tank 241-AN-102*, (Internal memorandum 74B10-00-008R1 to L. L. Lockrem and J. F. Sickels, August 1), CH2M HILL Hanford Group, Richland, Washington.

Jo, J., 1996, *Tank 241-AN-102 Grab Sampling and Analysis Plan*, WHC-SD-WM-TSAP-065, Rev. 1A, Westinghouse Hanford Company, Richland, Washington.

Jo, J., 1998a, *Tank 241-AN-102 Privatization Grab Sampling and Analysis Plan*, HNF-2158, Rev. 1A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Jo, J., 1998b, *Request for Grab Samples from Tank 241-AN-102*, (Internal memorandum 7A120-98-038 to R. Akita, D. B. Hardy, W. J. Kennedy, C. M. Seidel and G. A. Stanton, August 4), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Kirkbride, R. A., G. K. Allen, J. H. Baldwin, T. W. Crawford, B. A. Higley, T. M Hohl, J. Jo, S. L. Lambert, R. M. Orme, D. E. Place, J. A. Seidl, J. N. Strode, and R. S. Wittman, 2000, *Tank Farm Contractor Operation and Utilization Plan*, HNF-SD-WM-SP-012, Rev. 2, Numatec Hanford Corporation, Richland, Washington.

Kummerer, M., 1995, *Heat Removal Characteristics of Waste Storage Tanks*, WHC-SD-WM-SARR-010, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Leach, C. E., and S. M. Stahl, 1997, *Hanford Site Tank Farm Facilities Interim Safety Basis*, WHC-SD-WM-ISB-001, Rev. 0M, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

LMHC, 1998, *Work Package from February 1998 Sampling Event*, ES-97-00599-0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Markel, L. P. 1998, *222-S Laboratory Quality Assurance Plan*, HNF-SD- CP-QAPP-016, Rev. 3B, Waste Management Federal Services of Hanford, Inc., for Fluor Daniel Hanford, Inc., Richland, Washington.

Meacham, J. E., D. L. Banning, M. R. Allen, and L. D. Muhlestein, 1997, *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue*, HNF-SD-WM-DQO-026, Rev. 0, DE&S Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Nguyen, D. M., 1999, *Data Quality Objectives for TWRS Privatization Phase I: Confirm Tank T is an Appropriate Feed Source for Low-Activity Waste Feed Batch X*, HNF-1796, Rev. 2, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland Washington.

Patello, G. K., M. J. Truex, and K. D. Wiemers, 1999, *Low-Activity Waste and High-Level Waste Feed Processing Data Quality Objectives*, PNNL-12163, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

Pauly, T. R., 1998, *Subcontract Number 80232764-9-K001; Change in and Clarification of Tank Waste Sample Volumes and Shipping Dates to Support the Privatization Project*, (Letter FDH-9858161A, to L. E. Hall, September 30), Fluor Daniel Hanford, Inc., Richland, Washington.

Person, J. C., 1998a, *Solubility Screening Tests for Tank 241-AN-102*, (Internal memorandum 8C510-98-026 to R. A. Esch, August 31), Numatec Hanford Corporation, Richland, Washington.

Person, J.C., 1998b, *Test Plan for Tank 241-AN-102 Solubility Screening Tests*, HNF-2516, Rev. 1, Numatec Hanford Corporation, for Fluor Daniel Hanford, Inc., Richland, Washington.

Reynolds, R. E., W. T. Cowley, J. A. Lechelt, B. C. Simpson, and C. DeFigh-Price, 1999, *Evaluation of Tank Data for Safety Screening*, HNF-4217, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Seidel, C. M., 1998, *Letter of Instruction Supporting Privatization Phase 1B PAS-I Shipment*, (Internal memorandum 3110-98-101 to D. B. Hardy and J. E. Hyatt, July 31), Waste Management Federal Services of Hanford, Inc., for Fluor Daniel Hanford, Inc., Richland, Washington.

Short, J. J., 1999, *Contract No. DE-AC06-99RL14047 - Additional Sample Material Requirements to Support Interface Control Document (ICD)-23*, (Letter 99-PDD-095 to M. P. DeLozier, November 10), U.S. Department of Energy, Office of River Protection, Richland, Washington.

Stanton, G. A., 2000, *Baseline Sampling Schedule, Change 00-01*, (Internal memorandum 79500-00-GAS-001 to Distribution, January 10), CH2M HILL Hanford Group, Richland, Washington.

Tran, T. T., 1999, *Review and Approval of Fiscal Year 2000 Waste Type Templates for Deriving Best Basis Inventories*, (Interoffice memorandum 74B20-99-044 to J. G. Field, November 22), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Turner, D. A., H. Babad, L. L. Buckley, and J. E. Meacham, 1995, *Data Quality Objective to Support Resolution of the Organic Complexant Safety Issue*, WHC-SD-WM-DQO-006, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Core Characterization Work Sheet*, Tank Characterization Resource Center, Tank 241-AN-102 file item #22, Westinghouse Hanford Company, Richland, Washington.

Wiemers, K. D. and M. Miller, 1997, *Low Activity Waste Feed Data Quality Objectives*, WIT-98-010, Rev. 0, Preliminary Report, Pacific Northwest National Laboratory, Richland, Washington.

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