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ENGINEERING DATA TRANSMITTAL

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16. KEY

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		Design Authority			
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2	1	Cog.Eng. L.M. Sasaki L M Sasaki 12/28/99	1		T.A. Brown J G Field for T A Brown 12/29/99 RK7 12/28/99
2		Cog. Mgr. J.G. Field J G Field 12/28/99	1	1	J.F. Sickels James Sickels 12-28-99
2		QA W.L. Adams W L Adams 12/28/99			
		Safety			
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To	From	Page 1 of 1
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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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J. H. Baldwin	R3-73	X			
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R. G. Brown	S7-12	X			
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K. D. Fowler	R2-11	X			
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Compatibility Grab Sampling and Analysis Plan for Fiscal Year 2000

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U.S. Department of Energy Contract DE-AC06-96RL13200

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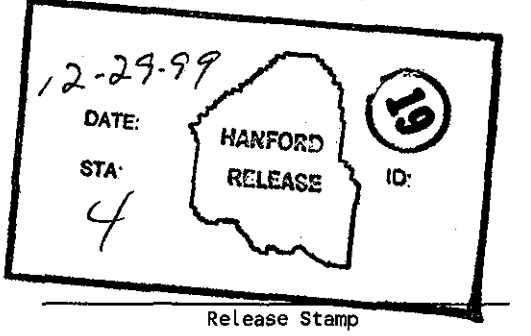

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RPP-5570
Revision 0

Compatibility Grab Sampling and Analysis Plan for Fiscal Year 2000

L. M. Sasaki
CH2M HILL Hanford Group, Inc.

Prepared for the U.S. Department of Energy
Office of River Protection

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LIST OF ABBREVIATIONS

AEA	alpha energy analysis
CHG	CH2M HILL Hanford Group, Inc.
CPO	Characterization Project Operations
CVAA	cold vapor atomic absorption
DQO	data quality objective
DSC	differential scanning calorimetry
EQL	estimated quantitation limit
FDH	Fluor Daniel Hanford, Inc.
GEA	gamma energy analysis
GFAA	graphite furnace atomic absorption
g/mL	grams per milliliter
IC	ion chromatography
ICP/AES	inductively coupled plasma – atomic emission spectroscopy
ICP/MS	inductively coupled plasma – mass spectrometry
J/g	joules per gram
LCS	laboratory control standard
LFL	lower flammability limit
MDA	minimum detectable activity
N/A	not applicable
NHC	Numatec Hanford Corporation
NP	not performed
QA	quality assurance
QC	quality control
RPD	relative percent difference
RPP	River Protection Project
SAP	sampling and analysis plan
TBD	to be determined
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TOC	total organic carbon
wt%	weight percent
μCi/g	microcuries per gram
μCi/mL	microcuries per milliliter
μg/g	micrograms per gram
μg/mL	micrograms per milliliter

1.0 SAMPLING AND ANALYSIS OBJECTIVES

This sampling and analysis plan (SAP) identifies characterization objectives pertaining to sample collection, laboratory analytical evaluation, and reporting requirements for grab samples obtained to address waste compatibility. It is written in accordance with requirements identified in *Data Quality Objectives for Tank Farms Waste Compatibility Program* (Mulkey et al. 1999) and *Tank Farm Waste Transfer Compatibility Program* (Fowler 1999).

In addition to analyses to support Compatibility, the Waste Feed Delivery program has requested that tank samples obtained for Compatibility also be analyzed to confirm the high-level waste and/or low-activity waste envelope(s) for the tank waste (Baldwin 1999). The analytical requirements to confirm waste envelopes are identified 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 1999a) and *Data Quality Objectives for RPP Privatization Phase I: Confirm Tank T is an Appropriate Feed Source for High-Level Waste Feed Batch X* (Nguyen 1999b).

2.0 SAMPLING EVENT REQUIREMENTS

Table 2-1 identifies tanks scheduled to be grab sampled to address waste compatibility. The number of samples, the riser to be used for sampling, and the elevations and depths at which the samples are to be obtained are identified. This SAP will be revised and updated as necessary to include additional grab sample events.

Prior to sampling, the dome space (below the riser) shall be measured for the presence of flammable gases. The measurement shall be taken from within the dome space and the data reported as a percentage of the lower flammability limit (LFL). The results shall be transmitted to River Protection Project (RPP) Process Engineering within ten working days of the sampling event (Schreiber 1998). If the results are above 25 percent of the LFL when analyzing by gas. chromatography/mass spectrometry or gas-specific monitoring gauges or above 10 percent of the LFL when analyzing with a combustible gas meter RPP Process Engineering shall notify the Flammable Gas Safety Project. The necessity for recurring sampling for flammable gas concentration and the frequency of such sampling will be determined by the Flammable Gas Safety Project. Any additional vapor sampling is not within the scope of this SAP.

Samples shall be obtained using plant operating procedure TO-080-403, *Supernatant or Sludge Sampling of Waste Storage Tanks*.

If quality-affecting changes to the sampling requirements must be made (including the risers or samples to be obtained), the change must be recorded and approved by the cognizant engineer and tank coordinator before sampling. This information may be recorded on a permanent data sheet or recorded directly in the work packages. These work packages contain the operating procedures and the chain-of-custody records for the sampling events.

No field/trip blanks are required during these sampling events. Samples should be shipped to the laboratory within three calendar days from the time of sampling.

Table 2-1. Tank Grab Sampling Information

Tank	Sample Number	Sample Type	Sample Location	Sample Elevation[1]	Sample Depth[1]
241-SY-102	2SY-99-5	Supernate (surface)	Riser 002	1 in. below liquid level	zipcord reading + 1 in.
	2SY-99-6	Supernate		336 in.	337 in.
	2SY-99-7	Supernate		252 in.	421 in.
	2SY-99-8	Supernate		156 in.	517 in.
	2SY-99-9	Supernate		72 in.	601 in.

Notes:

[1]Sample elevation is defined as distance from tank bottom to mouth of sample bottle; sample depth is defined as the distance from the top of the riser to the mouth of the sample bottle.

3.0 LABORATORY ANALYSIS REQUIREMENTS

3.1 ANALYSIS SCHEME

In order to comply with Mulkey et al. (1999) Fowler (1999), and Baldwin (1999) the following steps shall be performed on each sample. All samples shall be analyzed to meet the requirements of the Compatibility program. Direction on the analysis of samples for Waste Feed Delivery low-activity waste and high-level waste envelope analytes is provided in Table 5-1.

- Record visual observations such as color and clarity of the liquid and the presence of any solid particles in the liquid. Record the volume of settled solids, if present.
- Closely inspect the liquid sample for the presence and approximate volume of any potential organic layers. Record the volume of separable organic phase, if present.
- For samples expected to be supernatant samples:
  - Remove sufficient aliquots of liquid and perform the analyses listed in Table 3-1.
  - If the sample has greater than 25 percent settled solids, contact the tank coordinator for further instructions.
- For samples expected to contain solids:
  - Allow the solids to settle, record the volume percent settled solids, and then decant the liquid (supernatant) from the solids. Unless specified in Section 5, no analyses are required for the decanted supernatant.
  - Centrifuge the solids, record the bulk density of the "wet" sludge and the volume percent centrifuged solids, and then decant the liquid (interstitial liquid) from the centrifuged solids.
  - Remove sufficient aliquots of interstitial liquid and perform the analyses listed in Table 3-1.
  - Remove sufficient aliquots of centrifuged solids and perform the analyses as shown in Table 3-2.
- Archive remaining sample material for possible future analyses.

Opportunistic analyses as defined in Kristofzski (1996) are to be included when the laboratory is not operating at maximum capacity. Any decisions, observations, or deviations from this work plan during the sample breakdown and analyses shall be documented in writing with justification. These decisions, observations, and deviations shall be reported in the data report. The reporting formats for analyses are specified in Tables 3-1 and 3-2 and are described in Section 7.0

3.2 SPECIFIC METHODS AND ANALYSES

The analyses in Table 3-1 to be performed on the liquid grab samples are based on the compatibility data quality objective (DQO) and low-activity waste and high-level waste envelopes referenced in Section 1.0. The laboratory procedure numbers to be used for the analyses are included in the tables. Sample preparation procedures that may be used at the 222-S Laboratory are LA-549-141 for fusion digestion of solids, LA-505-159 or LA-505-163 for acid digestion of samples, and LA-504-101 for water leach of solids.

3.3 INSUFFICIENT SAMPLE RECOVERY

If the amount of material recovered from samples taken from the tank is insufficient to perform the analyses requested in the SAP, the laboratory shall notify the tank coordinator within one working day. A prioritization of the analyses is provided in Section 5.3. Any analyses prescribed by this SAP, but not performed, shall be identified in the appropriate data report with justification for non-performance.

Table 3-1. Chemical, Radiological, and Physical Analyses: Liquids

LIQUID ANALYSES

Project Name	Compatibility Grab Samples
Plan Number	RPP-5570, Rev. 0

PROGRAM	PROGRAM CONTACTS
A. Compatibility	DST/SST Compatibility: T. M. Blaak/R. E. Larson
B. Waste Feed Delivery (LAW)	Waste Feed Delivery: J. Jo
C. Waste Feed Delivery (HLW)	Waste Feed Delivery: T. W. Crawford
	RPP Process Engr: L. M. Sasaki

COMMENTS
Homogenization Test - Not Required
Field Blank - Not Required
Hot Cell Blank - Performed as Necessary

REPORTING LEVELS	
FORMAT I	Early Notify
FORMAT II	Process Control
FORMAT III	Safety Screen
FORMAT IV	Waste Management
FORMAT V	RCRA Compliance
FORMAT VI	Special

PROGRAM	PRIMARY ANALYSES			SAMPLE	PREP[1]	QUALITY CONTROL[2]				CRITERIA			REPORT FORMAT
	METHOD	ANALYSIS	PROCEDURE	LIQUID		DUP	SPIKE	BLK	STD	UNITS	NOTIFICATION LIMIT[3]	EXPECTED RANGE[3]	
A	Titration	OH^-	LA-211-102	X	d	ea smpl	N/A	ea AB	ea AB	µg/mL	see[4]	unknown	I, II, IV
A	pH	$[H^+]$	LA-212-106	X	d	ea smpl	N/A	N/A	ea AB	pH	see[5]	unknown	I, II, IV
A, B, C	IC	Cl^-, F^-, PO_4^{-3}, SO_4^{-2}, NO_3^-, NO_2^-, oxalate[6]	LA-533-105 LA-533-115	X	d[7]	ea smpl	1/riser	ea AB	ea AB	µg/mL	see[4]	unknown	I, II, IV
A	DSC	Energy[8]	LA-514-114	X	d	ea smpl	N/A	N/A	ea AB	J/g	ratio exo:endo > 1 or exo ≥ 480[9]	unknown	I, II, IV
A	TGA	% H_2O	LA-514-114	X	d	ea smpl	N/A	N/A	ea AB	wt%	none	unknown	II, IV
A	Visual	Organic	LA-519-151	X	d	N/A	N/A	N/A	N/A	N/A	presence	unknown	I, II, IV
A	Gravimetry	Specific Gravity	LA-510-112	X	d	ea smpl	N/A	N/A	ea AB	SpG	none	unknown	II, IV
A	Gravimetry	Bulk Density[10]	LA-519-132	X	d	N/A	N/A	N/A	N/A	g/mL	none	unknown	II, IV
A, B, C	ICP/AES	Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, K, La, Li, Mg, Mo, Mn, Na, Nd, Ni, P, Pb, S, Sb, Se, Si, Sr, Th, Ti, Tl, U, V, Y, Zn, Zr[11]	LA-505-151 LA-505-161	X	d[7]	ea smpl	1/riser[12]	ea PB	ea AB	µg/mL	see[4]	unknown	I, II, IV
A, B, C	ICP/MS	U isotopes (^{233}U, ^{235}U, ^{238}U), Ag, As, B, Ba, Be, Ce, Co, Cs, K, La, Li, Mo, Na, Nd, Pd, Pr, Rb, Rh, Ru, S, Sb, Se, Ta, Te, Th, Tl, V, W, Zn, ^{99}Tc, ^{126}Sn, ^{237}Np, ^{241}AMU, ^{243}AMU[13]	LA-506-101	X	d[7]	ea smpl	1/riser[12]	ea PB	ea AB	µg/mL	none	unknown	II, IV
A, B, C	α counting	^{238}Pu, $^{238/240}Pu$, ^{241}Am, $^{243/244}Cm$	LA-953-104	X	d[7]	ea smpl	1/riser[14]	ea PB	ea AB	µCi/mL	> 61.5[15]	unknown	I, II, IV
A, B, C	GEA	^{137}Cs, ^{60}Co, ^{154}Eu, ^{155}Eu	LA-548-121	X	d[7]	ea smpl	N/A	ea AB	ea AB	µCi/mL	see[16, 17]	unknown	I, II, IV
A, B, C	Sep. & ß Counting	^{90}Sr	LA-220-101	X	d[7]	ea smpl	1/riser[14]	ea AB	ea AB	µCi/mL	see[16, 18]	unknown	I, II, IV
A, B, C	Persulfate Oxidation	TIC/TOC	LA-342-100	X	d	ea smpl	1/riser	ea AB	ea AB	µg C/mL	> 45,000[9, 16, 19, 20]	unknown	I, II, IV
A	Visual	% Settled Solids[21]	LA-519-151	X	d	ea smpl	N/A	N/A	N/A	%	none	unknown	II, IV
A, C	Ion Selective Electrode	Ammonia	LA-631-001	X	d[7]	ea smpl	1/riser	ea PB	ea AB	µg/mL	none	unknown	II, IV
A, B, C	Phosphorescence	U Total	LA-925-009	X	d[7]	ea smpl	1/riser	ea AB	ea AB	µg/mL	none	unknown	II, IV
B, C	Liquid Scintillation	^{99}Tc	LA-438-101	X	d[7]	ea smpl	1/riser[14]	ea PB	ea AB	µCi/mL	none	unknown	IV
B, C	CVAA	Hg	LA-325-106	X	d[7]	ea smpl	1/riser	ea PB	ea AB	µg/mL	none	unknown	IV
C	GFAA	Sb, Se	LA-505-102	X	d[7]	ea smpl	1/riser	ea PB	ea AB	µg/mL	none	unknown	IV
C	Liquid Scintillation	^3H	LA-218-114	X	d[7]	ea smpl	1/riser	ea PB	ea AB	µCi/mL	none	unknown	IV
C	Liquid Scintillation	^{14}C	LA-348-104	X	d[7]	ea smpl	1/riser	ea PB	ea AB	µCi/mL	none	unknown	IV
C	Separation/GEA	^{129}I	LA-378-103	X	d[7]	ea smpl	1/riser[14]	ea PB	ea AB	µCi/mL	none	unknown	IV

PROGRAM	SECONDARY ANALYSES			SAMPLE	PREP[1]	QUALITY CONTROL[2]				CRITERIA			REPORT FORMAT
	METHOD	ANALYSIS	PROCEDURE	LIQUID		DUP	SPIKE	BLK	STD	UNITS	NOTIFICATION LIMIT[3]	EXPECTED RANGE[3]	
A	Potentiometric Titration	Caustic Demand[22]	LA-211-104	X	d	ea smpl	N/A	N/A	N/A	mole OH/L	none	unknown	II, IV

Table 3-1. Chemical, Radiological, and Physical Analyses: Liquids

Notes:

[1] d-direct, f-fusion, a-acid, w-water

[2] DUP = duplicate, BLK = blank, STD = calibration standard, ea = each, smpl = sample, AB = analytical batch, PB = preparation blank, N/A = not applicable, SE = sample event

[3] Units for notification limits and expected range are those listed in the "units" column. Except as noted, limits apply to all DSTs, SSTs, and saltwell receivers (DCRTs 244-BX, 244-S, 244-TX and 244-U and TK-003 of 244-CR Vault). Unless otherwise indicated, immediate notifications to be made to both On-Call Process Engineer and Tank Farm Operations Shift Manager

[4] OH, NO_3, NO_2, and Na Limits: For SSTs, there are no active limits for samples. For DSTs and saltwell receivers, there are variable limits dependent upon nitrate concentration:

For Saltwell receivers:

a. For $NO_3 \leq 1.0$ M: $0.010 \text{ M} \leq OH \leq 5.0$ M (upper OH limit is 8.0 M for solutions below 167°F, lower limit corresponds to pH 12 in dilute solutions.) and $0.011 \text{ M} \leq NO_2 \leq 5.5$ M.

b. For $1.0 \text{ M} < NO_3 \leq 3.0$ M: $0.1 [NO_2] \leq OH \leq 10$ M and $OH + NO_2 \geq 0.4 [NO_3]$

c. For $NO_3 > 3.0$ M: $0.3 \text{ M} \leq OH < 10$ M, $OH + NO_2 \geq 1.2$ M, and $NO_3 \leq 5.5$ M

For DSTs with tank temperatures below 212°F:

a. For $NO_3 \leq 1.0$ M: $0.010 \text{ M} \leq OH \leq 5.0$ M (upper OH limit is 8.0 M for solutions below 167°F, lower limit corresponds to pH 12 in dilute solutions), $0.011 \text{ M} \leq NO_2 \leq 5.5$ M, and $NO_3/(OH+NO_2) < 2.5$ M.

b. For $1.0 \text{ M} < NO_3 \leq 3.0$ M: $0.1 \times NO_3 \leq OH \leq 10$ M and $OH + NO_2 \geq 0.4 \times NO_3$

c. For $NO_3 > 3.0$ M: $0.3 \text{ M} \leq OH < 10$ M, $OH + NO_2 \geq 1.2$ M, and $NO_3 \leq 5.5$ M

d. For tanks with high operating temperatures (T > 212°F for AY and AZ tanks) the above limits apply, except that the OH must be < 4 M.

For DSTs AZ-101 and AZ-102 during aging waste operations:

a. Na < 5.5 M for AZ-101, < 5.0 M for AZ-102

b. For $NO_3 < 1.0$ M, $OH \geq 0.01$ M; for $1.0 \text{ M} < NO_3 < 3.0$ M, $OH \geq 0.8$ M; and for $NO_3 + NO_2 > 5.5$ M, $OH \geq 1.0$ M.

c. For NO_3 and OH both < 1.0 M, $NO_2 \geq 0.011$ M and $NO_3/(OH+NO_2) < 2.5$ M..

d. For $1.0 \text{ M} < NO_3 < 3.0$ M, $NO_2 + OH \geq 0.4 [NO_3]$

e. For $3.0 \text{ M} < NO_3 < 5.5$ M, $NO_2 + OH \geq 1.2$ M.

f. For AZ-101, the hydroxide limit in item b above does not apply, see limits for other DSTs for AZ-101 hydroxide limits.

Immediate notification required for results not within the above limits.

[5] Per CPS-T-149-00010, for DSTs, DCRTs, 244-AR, and 244-CR: if tank Pu inventory is > 10 kg and supernate depth is > 30 cm (12 in.), the investigation level for pH is ≤ 8.0. If Pu< 10 kg or supernate depth is < 30 cm (12 in.), then there is no pH restriction. Notify On-Call Process Engineer if pH ≤ 8.0.

[6] Results should be reported for all IC analytes, however, only the analytes indicated here are required to meet the QC criteria in Tables 3-1 and 4-1.

[7] Direct liquid samples may be diluted in acid or water to adjust to proper sample size and/or pH.

[8] If exotherm is observed, both the endotherm and exotherm values must be reported.

[9] Dry weight basis. Limit applies to DSTs and SSTs.

[10] In order to preserve sample volume, bulk density measurement may be performed instead of specific gravity.

[11] Results should be reported for all ICP analytes, however, only the required analytes are required to meet the QC criteria in Tables 3-1 and 4-1.

ICP/AES analytes required for Compatibility are Al, Fe, Mn, Ni, and Cr.

Analytes required for Waste Feed Delivery LAW envelopes are Al, Ba, Ca, Cd, Cr, Fe, K. La, Ni, Pb, and U.

Analytes required for the Waste Feed Delivery HLW envelope are Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, S, Sb, Se, Si, Sr, Th, Ti, Tl, U, V, Y, Zn, and Zr.

[12] Either serial dilutions or matrix spikes will be performed.

[13] ICP/MS analytes required for Compatibility are U-235 and U-238.

Analytes required for Waste Feed Delivery LAW envelopes are Ba, K, ^{99}Tc, ^{237}Np, ^{241}AMU, ^{242}AMU, and ^{243}AMU.

Analytes required for the Waste Feed Delivery HLW envelope are Ag, As, B, Be, Ce, Co, Cs, K, La, Li, Mo, Na, Nd, Pd, Pr, Rb, Rh, Ru, S, Sb, Se, Ta, Te, Th, Tl, V, W, Zn, ^{99}Tc, ^{126}Sn, ^{233}U, ^{235}U, ^{237}Np, and ^{241}AMU.

Total Cs is the sums of all isotopes, therefore spikes and LCS do not apply. Analytical results for the following ICP/MS analytes will be semi-quantitative: Ag, Mo, Nd, Pd, Rb, Ru, Sb, Se, and Te.

[14] Tracer or carrier may be used in place of a spike and results corrected for recovery. For ^{99}Tc, a spike is used and results are corrected for recovery.

[15] This notification limit applies to ^{239}Pu only.

[16] Immediate notification applicable to On-Call Process Engineer only.

[17] Notification required if Cs > 3.28E+05 µCi/L for SSTs, 4.10E+05 µCi/L for SY Farm, or 5.74E+05 µCi/L for AN, AP, and AW farms.

[18] Notification required if Sr > 2.30E+05 µCi/L for SSTs, 2.88E+05 µCi/L for SY Farm, or 4.04E+05 µCi/L for AN, AP, and AW farms.

[19] Corrected from weight basis to volumetric basis assuming a liquid density of 1.0 g/mL.

[20] This notification limit applies to TOC only.

[21] Analysis may not be necessary if the amount of solids is small. Under these circumstances, the project and tank coordinators shall determine if the analysis is to be performed.

[22] To be performed if analysis indicates waste is hydroxide deficient.

Table 3-2. Chemical, Radiological, and Physical Analyses: Solids

SOLID ANALYSES			
Project Name	Compatibility Grab Samples	COMMENTS	REPORTING LEVELS
Plan Number	RPP-5570, Rev. 0	Homogenization Test - Not Required	FORMAT I: Early Notify
PROGRAM	PROGRAM CONTACTS	Field Blank - Not Required	FORMAT II: Process Control
A. Compatibility	DST/SST Compatibility: T. M. Blaak/R. E. Larson	Hot Cell Blank - Performed as Necessary	FORMAT III: Safety Screening
B. Waste Feed Delivery (LAW)	Waste Feed Delivery: J. Jo		FORMAT IV: Waste Management
C. Waste Feed Delivery (HLW)	Waste Feed Delivery: T. W. Crawford		FORMAT V: RCRA Compliance
	RPP Process Engr: L. M. Sasaki		FORMAT VI: Special

PROGRAM	PRIMARY ANALYSES			SAMPLE	PREP[1]	QUALITY CONTROL[2]				CRITERIA			REPORT FORMAT
	METHOD	ANAL.	PROCEDURE	SOLIDS		DUP	SPIKE	BLK	STD	UNITS	NOTIFICATION LIMIT[3]	EXPECTED RANGE[3]	
A	Titration	OH^-	LA-211-102	X	w	ea smpl	N/A	ea AB	ea AB	µg/g	none	unknown	II, IV
A	pH	$[H^+]$	LA-212-105	X	d	ea smpl	N/A	N/A	ea AB	pH	none	unknown	II, IV
A, B, C	IC	Cl^-, F^-, PO_4^{-3}, SO_4^{-2}, NO_3^-, NO_2^-, oxalate[4]	LA-533-105 LA-533-115	X	w	ea smpl	1/riser	ea AB	ea AB	µg/g	none	unknown	II, IV
A	DSC	Energy[5]	LA-514-114	X	d	ea smpl	N/A	N/A	ea AB	J/g	ratio exo:endo > 1 or exo > 480[6]	unknown	I, II, IV
A	TGA	% H_2O	LA-514-114	X	d	ea smpl	N/A	N/A	ea AB	wt%	none	unknown	II, IV
A	Visual	Organic	LA-519-151	X	d	N/A	N/A	N/A	N/A	N/A	presence	unknown	I, II, IV
A	Gravimetry	Bulk Density	LA-519-132	X	d	N/A	N/A	N/A	N/A	g/mL	none	unknown	II, IV
A, B, C	ICP/AES	Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, K, La, Li, Mg, Mo, Mn, Na, Nd, Ni, P, Pb, S, Sb, Se, Si, Sr, Th, Ti, Tl, U, V, Y, Zn, Zr[7]	LA-505-151 LA-505-161	X	f or a	ea smpl	1/riser[8]	ea PB	ea AB	µg/g	none	unknown	II, IV
A, B, C	ICP/MS	U isotopes (^{233}U, ^{235}U, ^{238}U), Ag, As, B, Ba, Be, Ce, Co, Cs, K, La, Li, Mo, Na, Nd, Pc, Pr, Rb, Rh, Ru, S, Sb, Se, Ta, Te, Th, Tl, V, W, Zn, ^{99}Tc, ^{126}Sn, ^{237}Np, ^{241}AMU, ^{243}AMU[9]	LA-506-101	X	f or a	ea smpl	1/riser[8]	ea PB	ea AB	µg/g	none	unknown	II, IV
A, B, C	α counting	^{238}Pu, $^{239/240}Pu$, ^{241}Am, $^{243/244}Cm$	LA-953-104	X	f	ea smpl	1/riser[10]	ea PB	ea AB	µCi/g	> 41[11]	unknown	I, II, IV
A, B, C	GEA	^{137}Cs, ^{60}Co, ^{154}Eu, ^{155}Eu	LA-548-121	X	f	ea smpl	N/A	ea PB	ea AB	µCi/g	see[12, 13]	varied	II, IV
A, B, C	Sep. & ß Counting	^{90}Sr	LA-220-101	X	f	ea smpl	1/riser[10]	ea AB	ea AB	µCi/g	see[12, 14]	unknown	II, IV
A, B, C	Persulfate Oxidation	TOC/TIC	LA-342-100	X	d	ea smpl	1/riser	ea AB	ea AB	µg C/g	> 45,000[6, 12, 15]	varied	I, II, IV
A	Visual	% Settled Solids[16]	LA-519-151	X	d	ea smpl	N/A	N/A	N/A	%	none	unknown	II, IV
A, C	Ion Selective Electrode	Ammonia	LA-631-001	X	a	ea smpl	1/riser	ea PB	ea AB	µg/g	none	unknown	II, IV
A, B, C	Phosphorescence	U Total	LA-925-009	X	f	ea smpl	1/riser	ea AB	ea AB	µg/g	none	unknown	II, IV
B, C	Liquid Scintillation	^{99}Tc	LA-438-101	X	f	ea smpl	1/riser[10]	ea PB	ea AB	µCi/g	none	unknown	IV
B, C	CVAA	Hg	LA-325-106	X	d	ea smpl	1/riser	ea PB	ea AB	µg/g	none	unknown	IV
C	Gravimetry	Wt% oxides @ 1050 °C	see[17]	X	d	N/A	N/A	N/A	ea AB	wt%	none	unknown	IV
C	GFAA	Sb, Se	LA-505-102	X	a	ea smpl	1/riser	ea PB	ea AB	µg/g	none	unknown	IV
C	Liquid Scintillation	^3H	LA-218-114	X	w	ea smpl	1/riser	ea PB	ea AB	µCi/g	none	unknown	IV
C	Liquid Scintillation	^{14}C	LA-348-104	X	w	ea smpl	1/riser	ea PB	ea AB	µCi/g	none	unknown	IV
C	Separation/GEA	^{129}I	LA-378-103	X	w	ea smpl	1/riser[10]	ea PB	ea AB	µCi/g	none	unknown	IV

PROGRAM	SECONDARY ANALYSES			SAMPLE	PREP[1]	QUALITY CONTROL[2]				CRITERIA			REPORT FORMAT
	METHOD	ANAL.	PROCEDURE	SOLIDS		DUP	SPIKE	BLK	STD	UNITS	NOTIFICATION LIMIT[3]	EXPECTED RANGE[3]	
A	Potentiometric Titration	Caustic Demand[18]	LA-211-104	X	d	ea smpl	N/A	N/A	N/A	mole OH/L	none	unknown	II, IV

Table 3-2. Chemical, Radiological, and Physical Analyses: Solids

Notes:

[1] d-direct, f-fusion, a-acid, w-water

[2] DUP = duplicate, BLK = blank, STD = calibration standard, ea = each, smpl = sample, AB = analytical batch, PB = preparation blank, N/A = not applicable

[3] Units for notification limits and expected range are those listed in the "units" column. Except as noted, limits apply to all DSTs, SSTs, and saltwell receivers (DCRTs 244-BX, 244-S, 244-TX, and 244-U and TK-003 of 244-CR Vault). Unless otherwise indicated, immediate notifications to be made to both On-Call Process Engineer and Tank Farms Operations Shift Manager.

[4] Results should be reported for all IC analytes, however, only the analytes indicated here are required to meet the QC criteria in Tables 3-2 and 4-1.

[5] If exotherm is observed, both the endotherm and exotherm values must be reported.

[6] Dry weight basis. Limit applies to DSTs and SSTs.

[7] Results should be reported for all ICP analytes, however, only the required analytes are required to meet the QC requirements of Tables 3-2 and 4-1.
ICP/AES analytes required for Compatibility are Al, Fe, Mn, Ni, and Cr.
Analytes required for Waste Feed Delivery LAW envelopes are Al, Ba, Ca, Cd, Cr, Fe, K, La, Ni, Pb, and U.
Analytes required for the Waste Feed Delivery HLW envelope are Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, S, Sb, Se, Si, Sr, Th, Ti, Tl, U, V, Y, Zn, and Zr.

[8] Either serial dilutions or matrix spikes will be performed.

[9] ICP/MS analytes required for Compatibility are U-235 and U-238.
Analytes required for Waste Feed Delivery LAW envelopes are Ba, K, ^{99}Tc, ^{237}Np, ^{241}AMU, ^{242}AMU, and ^{243}AMU.
Analytes required for the Waste Feed Delivery HLW envelope are Ag, As, B, Be, Ce, Co, Cs, K, La, Li, Mo, Na, Nd, Pd, Pr, Rb, Rh, Ru, S, Sb, Se, Ta, Te, Th, Tl, V, W, Zn, ^{99}Tc, ^{126}Sn, ^{233}U, ^{235}U, ^{237}Np, and ^{241}AMU.
Total Cs is the sums of all isotopes, therefore spikes and LCS do not apply. Analytical results for the following ICP/MS analytes will be semi-quantitative: Ag, Mo, Nd, Pd, Rb, Ru, Sb, Se, and Te.

[10] Tracer or carrier may be used in place of a spike and results corrected for recovery. For ^{99}Tc, a spike is used and results are corrected for recovery.

[11] This notification limit applies to ^{239}Pu only.

[12] Immediate notification applicable to On-Call Process Engineer only.

[13] Notification required if Cs > 3.28E+05 µCi/L for SSTs, 4.10E+05 µCi/L for SY Farm, or 5.74E+05 µCi/L for AN, AP, and AW farms.

[14] Notification required if Sr > 2.30E+05 µCi/L for SSTs, 2.88E+05 µCi/L for SY Farm, or 4.04E+05 µCi/L for AN, AP, and AW farms.

[15] This notification limit applies to TOC only.

[16] Analysis may not be necessary if the amount of solids is small. Under these circumstances, the project and tank coordinators shall determine if the analysis is to be performed.

[17] No procedure is available for wt% oxides. Work will be performed to an approved test plan, which will then be referenced in the data package.
Gravimetric wt% oxide is to be performed by heating at 1050 °C.

[18] To be performed if analysis indicates waste is hydroxide deficient.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Processes, services, activities, and conditions adverse to quality which do not conform to requirements specified in this SAP or references herein shall be controlled to prevent inadvertent use. Nonconforming sampling and analysis processes shall be identified, controlled, reported, and dispositioned as required by *Nonconforming Item Reporting and Control* (LMHC 1999).

Quality requirements for conducting Characterization Project sampling and analysis are described in *Tank Waste Remediation System Characterization Project, Quality Policies* (Board 1998) and this SAP. Characterization Project sampling and analysis shall be conducted in conformance with these QA requirements.

4.1 LABORATORY OPERATIONS

Laboratories performing analyses in support of this SAP shall have approved and implemented quality assurance (QA) plans. These QA plans shall meet the minimum requirements of *Hanford Analytical Services Quality Assurance Requirements Document* (DOE 1998) as a baseline for laboratory quality systems. *222-S Laboratory Quality Assurance Plan* (Markel 1999) specifies the requirements for assuring the quality of sample analysis conducted at the 222-S Laboratory.

Analytical quality control (QC) requirements (duplicates, spikes, blanks, laboratory control samples) are identified in Tables 3-1, 3-2, and 4-1. The laboratory shall also use calibration and calibration check standards appropriate for the analytical instrumentation being used (see DOE [1998] for definitions of QC samples and standards). The criteria presented are goals for demonstrating reliable method performance. It is understood that the laboratory will follow its internal QC system for required actions whenever QC failures occur. If sample QC failures occur or if any analyses cannot be performed (e.g., insufficient sample), analysts shall consult with supervisors/customers to determine the proper action. The laboratory should provide a suggested course of action at that time. All sample QC failures and limitations on the associated data shall be discussed in the narrative of the data report. Proper notification of all data not meeting QC requirements shall be included with the data.

4.2 SAMPLE COLLECTION

Before sampling can be performed on a tank, available risers must be identified for use in the sampling event. The selected risers must be inspected and prepared to confirm their ability to be used in sampling. Safety hazards must be identified and special precautions must be taken if needed. If deemed necessary by the sampling cognizant engineers and tank coordinator, video surveillance should be performed to identify any potential problems that may occur during the sampling event.

Samples are to be taken from a tank and shipped to the performing laboratory by Characterization Project Operations (CPO) in accordance with the respective work package(s). The chain-of-

custody form for this work package shall identify samples by a unique number for each sample. Pertinent sampling information (e.g., unusual waste characteristics or sampling problems) should be noted in the comments section of the chain-of-custody form.

Characterization Project Operations should transport each sample collected to the performing laboratory within 3 calendar days of removing the sample from the tank. A verbal notification by CPO is to be made to the 222-S Laboratory at 373-2435 at least 24 hours in advance of an expected shipment.

Table 4-1. QC Precision and Accuracy Requirements for the Analyses

Analysis/Method	Duplicate Criteria (RPD)[1]	Spike Criteria (% recovery)[2]	Preparation Blank Criteria[3]	LCS Criteria (% recovery)[4]
Liquids				
DSC	≤ 30	N/A	N/A	80 - 120
TGA	≤ 20	N/A	N/A	80 - 120
Bulk density	N/A	N/A	N/A	N/A
Specific gravity	≤ 20	N/A	N/A	N/A
ICP/AES	≤ 20	75 - 125	< EQL	80 - 120
ICP/MS	≤ 20	75 - 125	< EQL	80 - 120
IC	≤ 20	75 - 125	< EQL	80 - 120
TIC/TOC	≤ 20	75 - 125	< EQL	80 - 120
OH	≤ 20	N/A	< EQL	80 - 120
pH	≤ 20	N/A	N/A	± 0.1 pH unit
AEA	≤ 20	75 - 125[5]	< MDA	70 - 130
GEA	≤ 20	N/A	< MDA	NP
^{90}Sr	≤ 20	75 - 125[5]	< MDA	75 - 125
Ammonia	≤ 20	75 - 125	< EQL	80 - 120
U Total	≤ 20	75 - 125	< EQL	80 - 120
^{99}Tc	≤ 20	75 - 125	< MDA	80 - 120
CVAA	≤ 20	75 - 125	< EQL	80 - 120
GFAA	≤ 20	75 - 125	< EQL	80 - 120
^{3}H	≤ 20	N/A	< MDA	80 - 120
^{14}C	≤ 20	75 - 125	< MDA	80 - 120
^{129}I	≤ 20	N/A[5]	< MDA	NP
Caustic demand	N/A	N/A	N/A	N/A
Solids				
DSC	≤ 30	N/A	N/A	80 - 120
TGA	≤ 30	N/A	N/A	80 - 120
Bulk density	N/A	N/A	N/A	N/A
ICP/AES	≤ 20	75 - 125	< EQL	80 - 120
ICP/MS	≤ 20	75 - 125	< EQL	80 - 120
IC	≤ 20	75 - 125	< EQL	80 - 120

Table 4-1. QC Precision and Accuracy Requirements for the Analyses

Analysis/Method	Duplicate Criteria (RPD)[1]	Spike Criteria (% recovery)[2]	Preparation Blank Criteria[3]	LCS Criteria (% recovery)[4]
TIC/TOC	≤ 20	75 - 125	< EQL	80 - 120
OH	≤ 20	75 - 125	< EQL	80 - 120
pH	≤ 20	N/A	N/A	± 0.1 pH unit
AEA	≤ 20	75 - 125[5]	< MDA	70 - 130
GEA	≤ 20	N/A	< MDA	NP
^{90}Sr	≤ 20	75 - 125[5]	< MDA	75 - 125
Ammonia	≤ 20	75 - 125	< EQL	80 - 120
U Total	≤ 20	75 - 125	< EQL	80 - 120
^{99}Tc	≤ 20	75 - 125	< MDA	80 - 120
CVAA	≤ 20	75 - 125	< EQL	80 - 120
GFAA	≤ 20	75 - 125	< EQL	80 - 120
^{3}H	≤ 20	N/A	< MDA	80 - 120
^{14}C	≤ 20	75 - 125	< MDA	80 - 120
^{129}I	≤ 20	N/A[5]	< MDA	NP
Wt% oxides	N/A	N/A	N/A	TBD
Caustic demand	N/A	N/A	N/A	N/A

Notes:

N/A = not applicable
NP = not performed
MDA = minimum detectable activity
EQL = estimated quantitation limit
LCS = laboratory control standard

[1]For the calculation of the relative percent difference (RPD), both the sample and duplicate results must exceed the EQL or MDA. Failures are permissible if the requirements in the QA section are followed.
[2]The criteria are recommended. Failures are permissible if the requirements in the QA section are followed.
[3]When a blank exceeds the EQL or MDA, sample results that exceed the contribution from the blank twenty-fold or more are reportable. See also the QA section of this SAP.
[4]For some analyses, this could be a method spike or a blank spike. Ranges are percent recovery of theoretical.
[5]A tracer or carrier may be substituted for the spike.

4.3 SAMPLE CUSTODY

The chain-of custody form is initiated by the sampling team as described in the work package. Samples are shipped in a sample pig and sealed with a Waste Tank Sample Seal (see below).

WASTE TANK SAMPLE SEAL	
Supervisor:	Sample No.:
Date of Sampling:	Time of Sampling:
Shipment No.:	Serial No.:

The sealed and labeled samples are shipped to the laboratory along with the chain-of-custody form. The receipt and control of samples in the 222-S Laboratory are described in laboratory procedure LO-090-101.

5.0 EXCEPTIONS, CLARIFICATIONS, AND ASSUMPTIONS

5.1 EXCEPTIONS TO DQO REQUIREMENTS

Baldwin (1999) requests that any samples obtained for Compatibility also be analyzed to confirm or determine the low-activity waste and/or high-level waste envelopes (as defined by Tables 4.1 through 4.4 of Nguyen 1999b and Tables 4.1 and 4.2 of Nguyen 1999a, respectively). In general, liquid grab samples obtained for Compatibility will also be analyzed for the low-activity waste envelope analytes. Analysis for high-level waste envelope analytes and/or the analysis of solids will depend on the waste type that is sampled and will be addressed on a tank-by-tank basis.

Directions for the analysis of specific tank samples for envelope analytes and other special instructions are provided in Table 5-1.

5.2 CLARIFICATIONS AND ASSUMPTIONS

Any exothermic reaction determined by differential scanning calorimetry (DSC) must be reported on a dry weight basis as shown in equation 1 using the weight percent water determined from thermogravimetric analysis (TGA).

$$Exotherm\ (dry\ weight) = \frac{[exotherm\ (wet\ weight) \times 100]}{(100 - \%\ water)}$$

Note: A large error in the DSC value may result when converting samples containing greater than 90 percent water to a dry weight basis. However, this conversion is still required.

The laboratory is requested to report all analytical results recovered from the inductively coupled plasma - atomic emission spectroscopy (ICP/AES) and ion chromatography (IC) analyses, even though only specific analytes are requested. These opportunistic analyses (Kristofzski 1996) are to be reported only if no additional preparatory work is required (e.g., running additional standards) and if the error associated with the results are documented. No reruns nor additional analyses should be performed to improve recovery for analytes not specifically requested in Tables 3-1 or 3-2.

5.3 PRIORITIES FOR COMPATIBILITY GRAB SAMPLES

In the event that the sample material recovered is insufficient to perform all the analyses prescribed by this SAP, the analyses have been prioritized (from highest to lowest priority) as follows:

1. Ammonia (for single-shell tank and double-contained receiver tank samples), hydroxide, ion chromatography, and pH.
2. Separable organics, DSC, and TGA
3. Specific gravity/bulk density
4. Volume percent solids, $^{235/238}U$, $^{239/240}Pu$, ^{241}Am, ICP/AES (Al, Fe, Cr, Mn, Ni, Zr)
5. TOC, ICP/AES (Na)
6. ^{90}Sr, ^{137}Cs
7. Other analytes listed in Tables 3-1 and 3-2.

Table 5-1. Tank-Specific Analytical Exceptions

Tank	Exceptions
241-SY-102	Samples 2SY-99-5 through 2SY-99-9 do not require analysis for Waste Feed Delivery low-activity waste or high-level waste envelope analytes.

6.0 ORGANIZATION

The organization and responsibility of key personnel involved with these tank characterization projects are listed in Table 6-1.

Table 6-1. Tank Project Key Personnel

Responsibility	Organization	Individual
Manager, Data Development and Interpretation	RPP Process Engineering (CHG)	J. G. Field, 376-3753
Process Engineering point of contact for Compatibility Samples	RPP Process Engineering (CHG)	L. M. Sasaki, 373-1027
Process Engineering point of contact for Stabilization	RPP Process Engineering (CHG)	J. G. Field, 376-3753
Double-Shell Tank Farm Compatibility Program point of contact	Double-Shell Tank Farms: Engineering (CHG)	T. M. Blaak, 373-3880
Single-Shell Tank Farm Compatibility Program point of contact	SST Engineering (CHG)	R. E. Larson, 373-9100
Manager, Field Sampling	Characterization Project Operations (CHG)	J. F. Sickels, 373-0259
222-S Laboratory point of contact (day shift)	Hanford Analytical Laboratory Operations (FDH)	W. I. Winters (NHC), 373-1951
222-S Laboratory point of contact (off hours)	Analytical Services (FDH)	222-S Laboratory shift manager, 373-2435
Process Engineering point of contact for immediate notifications	RPP Process Engineering (CHG)	On-Call Process Engineer, 539-2074 or 85-9654 (pager)
Double-Shell Tank Farm point of contact	Tank Farm Operations	Double-Shell Tank Farm Operations shift manager, 373-2689
Single-Shell Tank Farm point of contact	Tank Farm Operations	Single-Shell Tank Farm Operations shift manager, 373-3475

7.0 DELIVERABLES

All analyses will be reported as Format I, II, or IV as indicated in Tables 3-1 and 3-2. Additional information regarding reporting formats is given in Schreiber (1998).

7.1 FORMAT I REPORTING

Tables 3-1 and 3-2 contain the notification limits for selected analytes. Any results exceeding their notification limits shall be reported via telephone to the Process Engineering On-Call Process Engineer and/or the appropriate Tank Farm Operations shift manager as soon as the data are obtained and reviewed by the responsible scientist. This verbal notification must be followed within one hour by electronic notification to Process Engineering On-Call Process Engineer (and the Tank Farm Operations shift manager, if required), the RPP Process Engineering Data Development and Interpretation manager, and the Process Engineering point of contact for Compatibility Samples. Additional analyses for verification purposes may be contracted between the performing laboratory and Process Engineering by either a revision to this SAP or by a letter.

7.2 FORMAT II REPORTING

A letter report documenting the results of the analyses shall be issued to the RPP Process Engineering Data Development and Interpretation manager, the tank coordinator responsible for the tank, the Process Engineering point of contact for Stabilization, and the point of contact for Tank Farm Compatibility Samples within 90 days of the receipt of the sample at the laboratory loading dock. If a turnaround time of less than 90 days is required for specific samples to meet tank farm needs, the turnaround time will be negotiated with Analytical Services and included in Section 5.0. The format II report is not required to contain supporting raw data, QC results, or associated analytical procedure numbers. However, the results require review and approval by the cognizant scientist or manager of the laboratory operation.

7.3 FORMAT IV REPORTING

The format IV report shall be a data package reporting the results of analyses performed and will resemble a regulatory data package without third party validation. The data package should be prepared by tank and include the data for all sample, including (as applicable) composites, solids, liquids, and associated blanks taken and analyzed for the sampling event. The recommended reporting format and the raw data that shall be included are given in detail in Section A5.0 of Schreiber (1998). This data package shall be issued as a document approved for public release through the document control system within 120 calendar days of the receipt of the last sample at the laboratory sample receiving/loading dock. The raw data shall be accessible to the program in accordance with the laboratory's Records Inventory and Disposition Schedule and until the respective waste tank is closed or the waste is treated.

In addition to this data package, an electronic version of the analytical results shall be provided to the Tank Characterization Database representative on the same day that the final data package is issued. The data must be available to the Washington State Department of Ecology within 7 days of the release of the data package. The electronic version shall be in the standard electronic format (Lang et al. 1999).

8.0 CHANGE CONTROL

Under certain circumstances, it may become necessary for the performing laboratory to make decisions concerning a sample without review of the data by the customer of the Characterization Project. All significant changes (such as analysis of new samples) shall be documented by RPP Process Engineering via an engineering change notice to this SAP or by a letter. All changes shall also be clearly documented in the final data report. Insignificant changes may be made by the tank coordinator by placing a notation in the permanent record (i.e., note change in laboratory notebook or memo to file). Significance is determined by the tank coordinator.

At the request of the Characterization Project, additional analysis of sample material from this characterization project shall be performed following a revision of this SAP or issuance of a letter.

9.0 REFERENCES

Baldwin, J. H., 1999, *Letter of Instruction for Laboratory Work to Determine LAW and HLW Waste Feed Envelopes When Compatibility Tests are Conducted*, (letter 82400-99-073 to J. G. Field, November 18), Lockheed Martin Hanford Corporation, Richland, Washington.

Board, D. C., 1998, *Tank Waste Remediation System, Characterization Project, Quality Policies*, HNF-SD-WM-QAPP-025, Rev. 4, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

DOE, 1998, *Hanford Analytical Services Quality Assurance Requirements Document*, DOE/RL-96-68, Rev. 2, U.S. Department of Energy, Richland Field Office, Richland, Washington.

Fowler, K. D., 1999, *Tank Farm Waste Transfer Compatibility Program*, HNF-SD-WM-OCD-015, Rev. 2, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Kristofzski, J. G., 1996, *Directions for "Opportunistic Analyses,"* (memorandum 75310-96-168 to J. H. Baldwin, et al., September 11), Westinghouse Hanford Company, Richland, Washington.

Lang, L. L., Bobrowski, S. F., and S. J. Harris, 1999, *Standard Electronic Format Specification for Tank Characterization Data Loader: Version 3.0*, HNF-3638, Rev. 1, prepared by Pacific Northwest National Laboratory for Lockheed Martin Hanford Corp., Richland, Washington.

LMHC, 1999, *Nonconforming Item Reporting and Control*, LMH-PRO-298, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Markel, L. P., 1999, *222-S Laboratory Quality Assurance Plan*, HNF-SD-CP-QAPP-016, Rev. 3C, Waste Management Hanford, Inc., for Fluor Daniel Hanford, Inc., Richland, Washington.

Mulkey, C. H., M. Miller, and L. Jackson, 1999, *Data Quality Objectives for Tank Farms Waste Compatibility Program*, HNF-SD-WM-DQO-001, Rev. 3, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Nguyen, D. M., 1999a, *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.

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Schreiber, R. D., 1998, *Fiscal Year 1999 Memorandum of Understanding for the TWRS Characterization Project*, HNF-3578, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.