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7. Abstract

This document is a plan which serves as the contractual agreement between the Characterization Program, Sampling Operations, WHC 222-S Laboratory, and PNL 325 Analytical Chemistry Laboratory. The scope of this plan is to provide guidance for the sampling and analysis of samples from tank 241-C-105.

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Tank 241-C-105
Tank Characterization Plan

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

by
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SAMPLING EVENT A: PUSH MODE CORE SAMPLING IN FISCAL YEAR 1995

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LIST OF ABBREVIATIONS

ACL	Analytical Chemistry Laboratory
B	B-plant high level waste
BL	B-plant low level waste
BNW	Battelle Northwest Laboratory waste
C-105	tank 241-C-105
CPLX	complexant concentrate
CW	coating waste
DOE	Department of Energy
DQO	data quality objective
DSC	differential scanning calorimetry
DST	double-shell tank
EB	evaporator bottoms
HHF	hydrostatic head fluid
IC	ion chromatography
ICP	inductively coupled plasma - atomic emission spectroscopy
IX	ion exchange waste
LW	Laboratory Waste
MW	metal waste
N	N-Reactor waste
NCPLX	non-complexed waste
OWW	organic wash waste
P	PUREX waste
PL	PUREX low level waste
PNL	Battelle Pacific Northwest Laboratory
PUREX	Plutonium-Uranium Extraction plant
QA	Quality Assurance
QC	Quality Control
R	REDOX waste
RSN	REDOX supernatant
SST	single-shell tank
TBP	tributyl phosphate
TCP	tank characterization plan
TGA	thermogravimetric analysis
TOC	total organic carbon
TPA	Tri-Party Agreement
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company

1.0 SPECIFIC TANK CHARACTERIZATION OBJECTIVES

The Defense Nuclear Facilities Safety Board has advised the DOE to concentrate the near-term sampling and analysis activities on identification and resolution of safety issues (Conway 1993). The data quality objective (DQO) process was chosen as a tool to be used to identify the sampling and analytical needs for the resolution of safety issues. As a result, a revision in the Federal Facility Agreement and Consent Order (Tri-Party Agreement) milestone M-44-00 has been made, which states that "A Tank Characterization Plan (TCP) will also be developed for each double shell tank (DST) and Single-shell tank (SST) using the DQO process...Development of TCPs by the DQO process is intended to allow users (e.g., Hanford Facility user groups, regulators) to ensure their needs will be met and that resources are devoted to gaining only necessary information." This document satisfies that requirement for the tank 241-C-105 (C-105) fiscal year 1995 sampling activity.

1.1 RELEVANT SAFETY ISSUES

There are four Watch List tank classifications (ferrocyanide, organic, hydrogen/flammable gas, and high heat load). These classifications cover the six safety issues related to public and worker health that have been associated with the Hanford Site underground storage tanks. These safety issues are as follows: ferrocyanide, flammable gas, organic, criticality, high heat, and vapor safety issues (Babad 1992). Tank C-105 was on the High Heat Load Watch List. However, it is presently classified as a non-Watch List low heat load tank with <11.7 KW/HR (<40,000 Btu/hr) and is monitored weekly. This Tank Characterization Plan shall identify characterization objectives pertaining to sample collection, hot cell sample isolation, and laboratory analytical evaluation and reporting requirements in accordance with the appropriate DQO documents. In addition, the current contents and status of the tank are projected from historical information.

1.1.1 Pretreatment, and Safety Screening Data Quality Objectives

The sampling and analytical needs associated with the pretreatment program, as well as the safety screening of all tanks, have been identified through the Data Quality Objective (DQO) process. Additional data needs associated with tank C-105 may be identified in subsequent DQO efforts, which may then be incorporated into future sampling events.

Pertinent documents to this effort include the following:

(1) *Tank Safety Screening Data Quality Objective* (Babad and Redus 1994), which describes the sampling and analytical requirements for screening all waste tanks for unidentified safety issues.

(2) *Interim Data Quality Objectives for Waste Pretreatment and Vitrification* (Kupfer et al. 1994) which describes the sampling and analytical requirements to support the TWRS technical strategy by identifying the chemical and physical composition of the waste in the tank. In addition, the DQO works to guide development efforts to define waste pretreatment processes, which will in turn define high-level and low-level waste feed to vitrification processes.

The safety screening DQO describes the sampling and analytical requirements that are used to screen waste tanks for unidentified safety issues. Both watch list and non-watch list tanks shall be sampled and evaluated to identify safety conditions related to the ferrocyanide, organic, flammable gas, vapor, and criticality safety issues. Safety screening for high heat tanks has already been completed.

The Pretreatment DQO addresses the characterization needs of the Pretreatment, High-Level Waste Disposal, and Low-Level Waste Disposal Programs. These programs are responsible for developing long-term treatment and storage processes for the Hanford Site waste. This technology development effort will require comprehensive physical and chemical information from waste tank samples. The pretreatment process must be able to separate the waste into feed streams that satisfy the safety issues associated with the operating requirements for the low-level and high-level vitrification facilities.

1.1.2 Data Quality Objectives Integration

The safety screening and pretreatment DQO efforts both require a minimum of two core samples to be taken from risers separated radially to the maximum extent possible by the existing installed risers. Tank C-105 contains a large amount of waste that shall be sampled for safety screening and pretreatment purposes using the push mode core sampling method.

The safety screening DQO requires tank samples to be analyzed in half-segments. However, the pretreatment DQO requires analyses to be run on solid and liquid core composites. In addition, the suite of analyses required by the pretreatment DQO is more extensive than those analyses required in the safety screening DQO (see Table 4). Therefore, to simplify the explanation of the pretreatment DQO analytical requirements, Figures 4 and 5 have been included in this Tank Characterization Plan which clarify their analytical preparation requests.

2.0 TANK, WASTE, AND SAMPLING INFORMATION

This section summarizes some of the available information for tank C-105. Discussions of the fill history and recent sampling events for the tank, as well as general information about the tank, are included.

2.1 AGE AND PROCESS HISTORY

Tank C-105 is a SST constructed between 1943 and 1944, and has a capacity of 2,014,000 liters (530,000 gallons). The following information was obtained from the document, *History and Status of Tanks 241-C-105 and 241-C-106* (Walker 1977).

Tank C-105 was placed in service during the first quarter of 1947. The first waste it received was metal waste (MW) from the Bismuth Phosphate Process. The tank was the second in a cascade which included tanks C-104 and C-106. MW from the extraction process contained all of the uranium, 90 percent of the original fission product activity, and approximately 1 percent of the plutonium. This waste was brought to the neutral point with 50 percent caustic and then treated

with an excess of sodium carbonate. The procedure yielded almost completely soluble waste at a minimum total volume. The MW remained in the tank until the third quarter of 1953 when a sluice mining program for recovery of the uranium was started. Virtually no solids were left after the last transfer of the slurry.

The tank was again filled to capacity during July and August 1954 with Tributyl Phosphate (TBP) waste. This material was generated during the processing of MW to recover uranium. The treatment involved addition of potassium ferrocyanide ($K_4Fe[CN]_6$) to act as a scavenging agent for cesium. In April 1956, the tank was pumped to a 300,200 liter (79,000 gallon) heel and the record states a sludge volume of 57,000 liters (15,000 gallons). This was the first reported solids measurement.

In August 1956 tank C-105 received Purex Coating Waste (CW) enroute to the 241-BY Tank Farm and to other tanks within the 241-C Farm. The tank remained full and static from mid 1960 to the second quarter 1963 when it was pumped to a 475,000 liter (125,000 gallon) heel; there was no record of a sludge measurement. Then, during the last quarter of 1963, the first transfer of Purex Neutralized High Level Waste was received from tank A-102. The ending volume was 2,022,000 liters (532,000 gallons) [1]. A significant liquid level decrease of 91 cm (36 inches) was recorded during the static period between the time of fill and the fourth quarter of 1967. Although "steaming" was indicated as the cause of this waste loss, no documentation of other decrease studies or temperature data is available. A 414,000 liter (109,000 gallon) sludge volume was first recorded in 1965 (two years after the Purex High Level Waste transfer).

From 1967 until February 1977, tank C-105 served as a receiver for Purex Supernatant Waste (PSN) and Purex Sludge Wash Waste (PSS) from the 241-A and 241-AX tank farms and also from tanks C-103 and C-106. Although administrative controls were applied to prevent/minimize it, some A and AX solids were believed to have been transported to C-105. This material was then pumped to the 221-B building for cesium recovery processing (Walker 1977).

The tank was declared inactive in November 1980. Table 1 summarizes the fill history from when tank C-105 was first placed on active status to the present time.

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[1] Since the capacity of tank C-105 is 530,000 gals, it is assumed that when volumes greater than 530,000 gals are given the overflow waste cascaded into tank C-106.

Table 1: Historical Record of Waste in Tank C-105[a]

Qtr:Year	Waste Type and Description	Total Vol. (kgal)
1947	Second in cascade, began filling in Feb. Full in June 1947. Cascading to C-106, full Nov. 1947.	528
4:1953	MW removal in progress	48
4:1954	Received TBP waste	546
4:1956-4:1967	Collage of various wastes TBP, CW, P, BL, H2O, R, RSN	Avg: 431
1:1967-2:1977	PSS waste from AX-103 and AX-104. Transfers to B-plant	Avg: 313
3:1979-4:1980	CPLX, declared inactive	172
1:1994	NCPLX	150

[a] Anderson 1990 and Walker 1977

2.2 HISTORICAL SAMPLING EVENTS

In February 1991, analyses of archived samples were performed. The results of the analyses for tank C-105 can be found in Tables 2 and 3. The sample date for chemical and radiochemical analyses were April 1, 1990 and April 11, 1986.

Table 2: Chemical Results for Tank C-105 Sludge Waste[b]

Analyte	µg/g	Analyte	µg/g
Ag	170	Na	64400
Al	246,000	Nd	210
As	320	Ni	5900
B	300	Pb	1130
Ba	150	Sb	2500
Ca	1600	Se	1000
Cd	80	Si	10800
Ce	270	Sr	160
Cr	1400	Ti	230
Cu	160	Tl	1600
Fe	15300	U	10500
Mg	330	V	60
Mn	7120	Zr	710

b Thomas 1991

Table 3: Radiochemical Results for Tank C-105 Waste[b]

Analyte (sludge)	µCi/g	Analyte (Drainable Liquid)	µCi/mL
^{14}C	8.E-04	^{14}C	2.E-03
^{60}Co	7.E-01	^{60}Co	1.7E-02
$^{89/90}Sr$	8.E+02	$^{89/90}Sr$	5.E+00
^{99}Tc	1.E-01	^{99}Tc	2.E-01
^{129}I	1.E-04	^{129}I	2.7E-04
^{137}Cs	1.E+02	^{137}Cs	4.4E+02
$^{239/240}Pu$	2.E+00	U	2.6E-03
^{241}Am	1.E+00	^{241}Am	5.7E-03

[b]Thomas 1991

2.3 SAMPLE COLLECTION AND TRANSPORT

Tank C-105 is currently scheduled to be sampled by the push mode core sampling method. Samples shall be taken from risers 2 and 8. For detailed information regarding the sampling activities, refer to work packages ES-94-01185 and ES-94-01147, and work plans WTWP-94-059 and WTWP-94-062. This document contains the chain of custody records for this sampling event. In addition, refer to Plant Operating Procedure TO-020-455.

Current records indicate that there are 570,000 liters (150,000 gal) of non-complex waste in tank C-105. The approximate layer volume, as derived from Los Alamos National Laboratories Waste Status and Transaction Record Summary, is 57,000 liters (15,000 gal) of uranium recovery (UR) waste, 307,800 liters (81,000 gal) of cladding waste-redox (CWR), and 205,200 liters (54,000 gal) of unknown waste (ICF Kaiser Hanford Company 1994). The most current waste level is approximately 113 cm (44.5 inches). Tank C-105 is considered sound with respect to tank integrity and is partially isolated. (Hanlon 1994).

One push mode core from each riser, consisting of three segments each, shall be collected from risers 2 and 8 of tank C-105. The first segment from each core is expected to contain 16.51 cm (6.5 inches) of waste material, while the final two segments should contain 58.26 cm (19 inches) of waste each. It is necessary to reach the bottom of the tank; therefore, depending on the accuracy of this information, it may be necessary to take more or less segments.

Hydrostatic head fluid (HHF) with lithium bromide (LiBr) as a tracer shall be used to aid in the collection of the core samples. An HHF blank shall be prepared as part of the sampling procedure. The blank shall consist of a container filled with HHF (with LiBr tracer) from the same batch of HHF used during the push mode core sampling. It shall be analyzed for Li (and Br, if the Li notification limit is exceeded) in order to determine the concentration of the tracer at the time the core was taken. Only one HHF blank per tank is required. This blank is required in addition to the field/trip blank (sampler filled with

water). For specific information concerning sample handling custody and transport, refer to the quality assurance/quality control requirements in Section 4.2. The HHF and field/trip blanks shall each count as a segment.

3.0 SAMPLE EXTRUSION AND BREAKDOWN INSTRUCTIONS

3.1 TANK-SPECIFIC ANALYTICAL PROCEDURES

A flowchart depicting the general sample breakdown and analysis scheme is presented in Figures 1, 2, and 3. These steps are described in detail to provide the hot cell and laboratory chemists with guidance for the breakdown of the segments and may be altered as appropriate by the performing laboratory. Several analyses listed in Table 4 require a 45 day reporting time, as noted. The 45 day reporting format, Format III, is explained in Section 7.2.3.

Any decisions, observations, or deviations made to this work plan or during the sample breakdown shall be documented in writing (with appropriate justification) in the data report. The reporting formats for analyses are contained in Table 4.

Step 1 Receive push mode core samples and blanks at the laboratory in accordance with approved procedures. Extrude core segments in the hot cell. Open HHF and field blanks outside the hot cell. Although the blanks are processed outside the hot cell, they should be treated in the same fashion as the drainable liquids (i.e., follow liquids path). It should be noted, however, that the HHF blank is only to be analyzed for Li (and Br, if the Li notification limit is exceeded).

Step 2 Conduct the following on the material from each extruded segment:

- Perform a visual examination of the segment(s)
- Record observations. This may include a sketch of the extruded core sample in addition to written documentation of pertinent descriptive information such as color, texture, homogeneity, and consistency.
- Take color photographs and/or a videotape to visually document the extruded core segments.

Step 3 Separate any drainable liquid from the solids. Measure and record the volume. Retain drainable liquids for further processing.

Step 4 Is the segment 100% drainable liquid?

Yes: Proceed to Step 15
No: Proceed to Step 5

SOLIDS PATH

Step 5 Divide each extruded core segment into two equal segment subsamples (i.e., half-segments).

Step 6 Homogenize each subsample using the appropriate approved procedure.

Step 7 Will a homogenization test be performed?

Yes: Proceed to Step 8
No: Proceed to Step 9

NOTE: One subsample per core, at a minimum, should be used for the homogenization test. Additional tests may be performed at the laboratory's discretion.

Step 8 Conduct the homogenization test by taking a 1 to 2 gram aliquot from widely separated locations of the homogenized subsample. Conduct the homogenization test in accordance with Bell (1993).

Step 9 Collect sufficient aliquots from each homogenized subsample to perform the appropriate preparations and analyses listed in Table 4 in duplicate.

NOTE: If there is an insufficient amount of sample available in any subsample to perform all required analyses on the half segment, notify the Characterization Program within one business day and follow the prioritization of analyses given in Section 3.3.

Step 10 Remove at least 20 mL and up to 40 mL of each homogenized subsample for the archive sample (Bratzel 1994).

Step 11 Combine portions of each half segment proportional to the sludge recovery of each segment to build a core composite. This composite must be large enough to provide sample for the appropriate analyses in Table 4 and include 125 grams of material for process development work, plus 100 mL for archive.

Step 12 Collect sufficient aliquots from the solid composite to perform the appropriate preparations and analyses listed in Table 4 in duplicate.

Step 13 Remove 100 mL of the solid composite as the Pretreatment solid composite archive (Bratzel 1994).

Step 14 Remove 125 grams of the solid composite for process development work (see Section 6.2).

LIQUIDS PATH

Step 15 Closely inspect the liquid sample for the presence and approximate volume of any potential organic layers. Does the sample contain any immiscible (potential organic) layers?

Yes: Proceed to Step 16A
No: Proceed to Step 17

Step 16A Report any visually observed immiscible (potential organic) layer immediately by the early notification system.

Step 16B Separate and retain the potential organic layer for possible future analysis.

NOTE: Steps 18 through 24 shall be performed on the remaining (probable aqueous) liquid layer only.

Step 17 Filter the remaining liquid sample through a 0.45 micron filter.

Step 18 Is there greater than 1 gram of solid on the filter?

Yes: Proceed to Step 19
No: Proceed to Step 20

Step 19 Archive the solids for possible future analysis (Bratzel 1994).

Step 20 Remove sufficient aliquots from the segment-level liquid sample to perform the appropriate analyses listed in Table 4 in duplicate.

Step 21 Archive at least 20 mL and up to 40 mL of the segment-level drainable liquid as the segment level liquid archive (Bratzel 1994).

Step 22 Combine portions of each segment-level liquid sample to build a liquid composite.

Step 23 Collect sufficient aliquots from the liquid composite to perform the appropriate preparations and analyses listed in Table 4 in duplicate.

Step 24 Remove 100 mL of the liquid composite as the Pretreatment liquid composite archive (Bratzel 1994).

PRIMARY ANALYSIS PATH

Step 25 Perform primary analyses as listed in Table 4.

Step 26 Compare the primary analysis data with notification limits.

Step 27A Do the results exceed the notification limits (Table 4)?

Yes: If the results exceed the notification limits. Proceed to Step 27B.
No: If results do not exceed the notification limits, proceed to Step 30.

Step 27B Report results exceeding the notification limits using Format I reporting deliverable requirements as listed in Section 7.2.

SECONDARY ANALYSIS PATH

Step 28 Perform secondary analyses according to Table 4.

Step 29A Do the secondary analyses exceed the notification limits?

Yes: Proceed to Step 29B
No: Proceed to Step 30

Step 29B Report results exceeding the notification limits using Format I reporting deliverable requirements as listed in Section 7.2.

Step 30 Report results as listed in Section 7.

Figure 1: Laboratory Flow Chart A

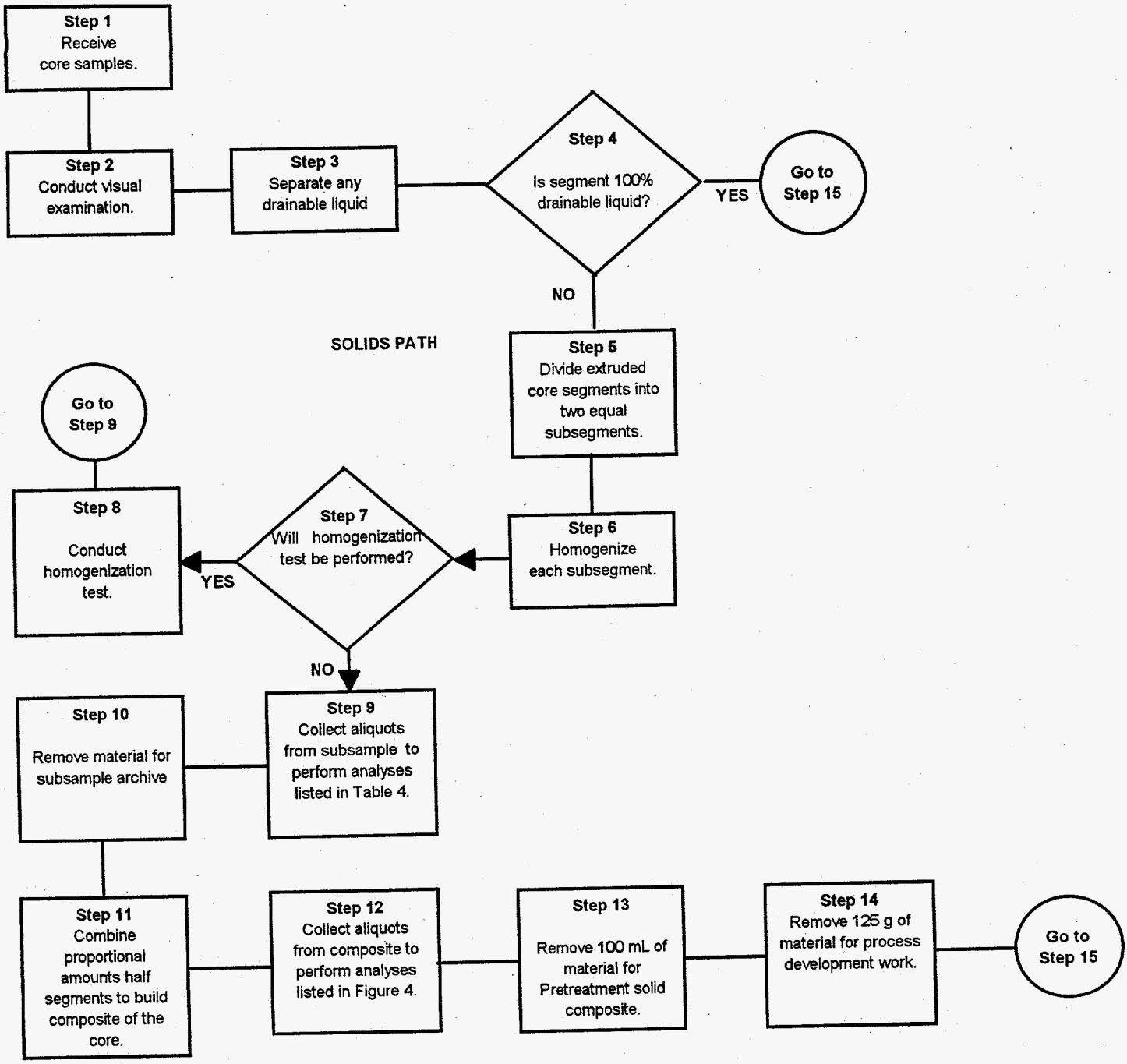


Figure 2: Laboratory Flow Chart B

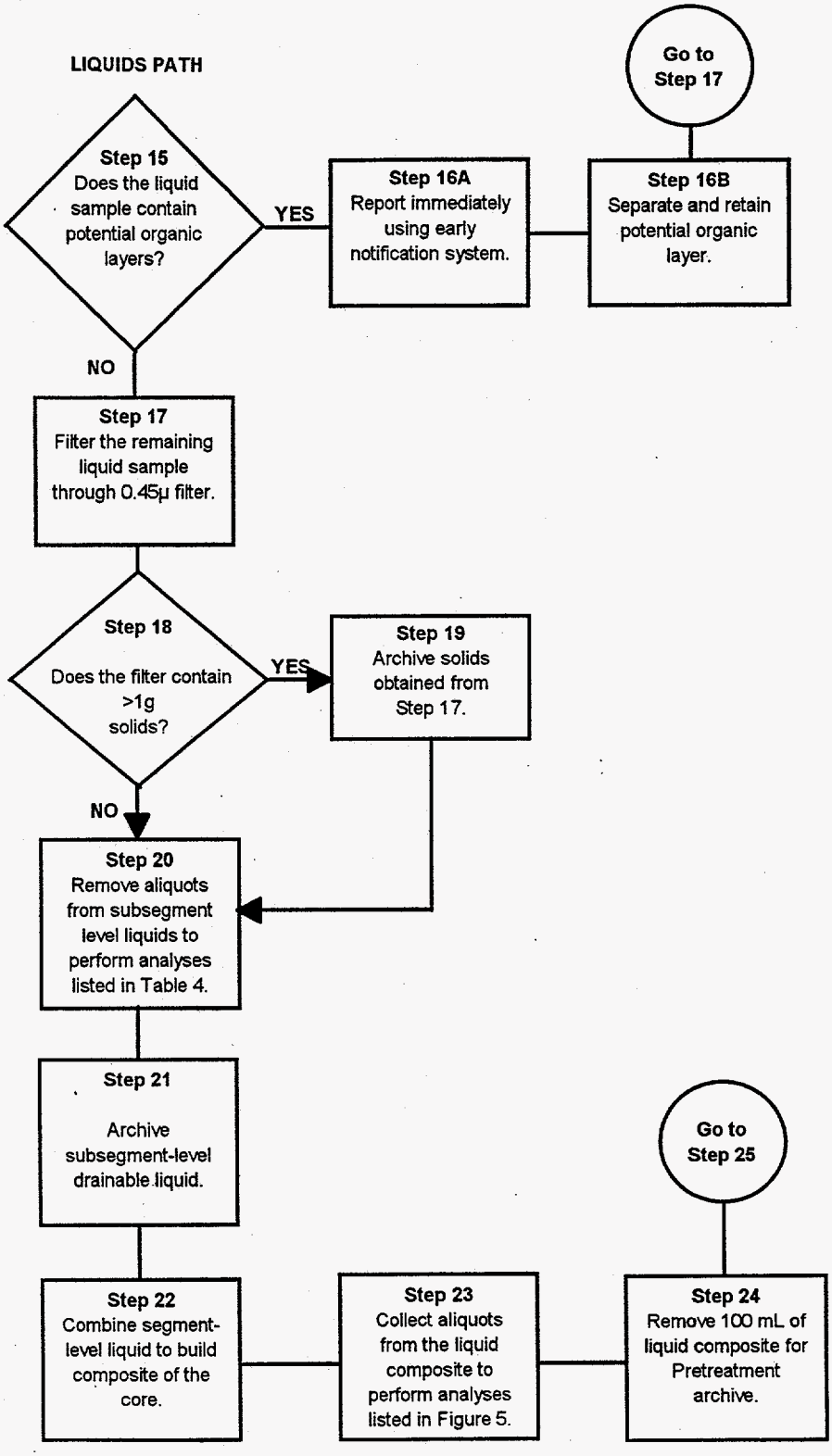
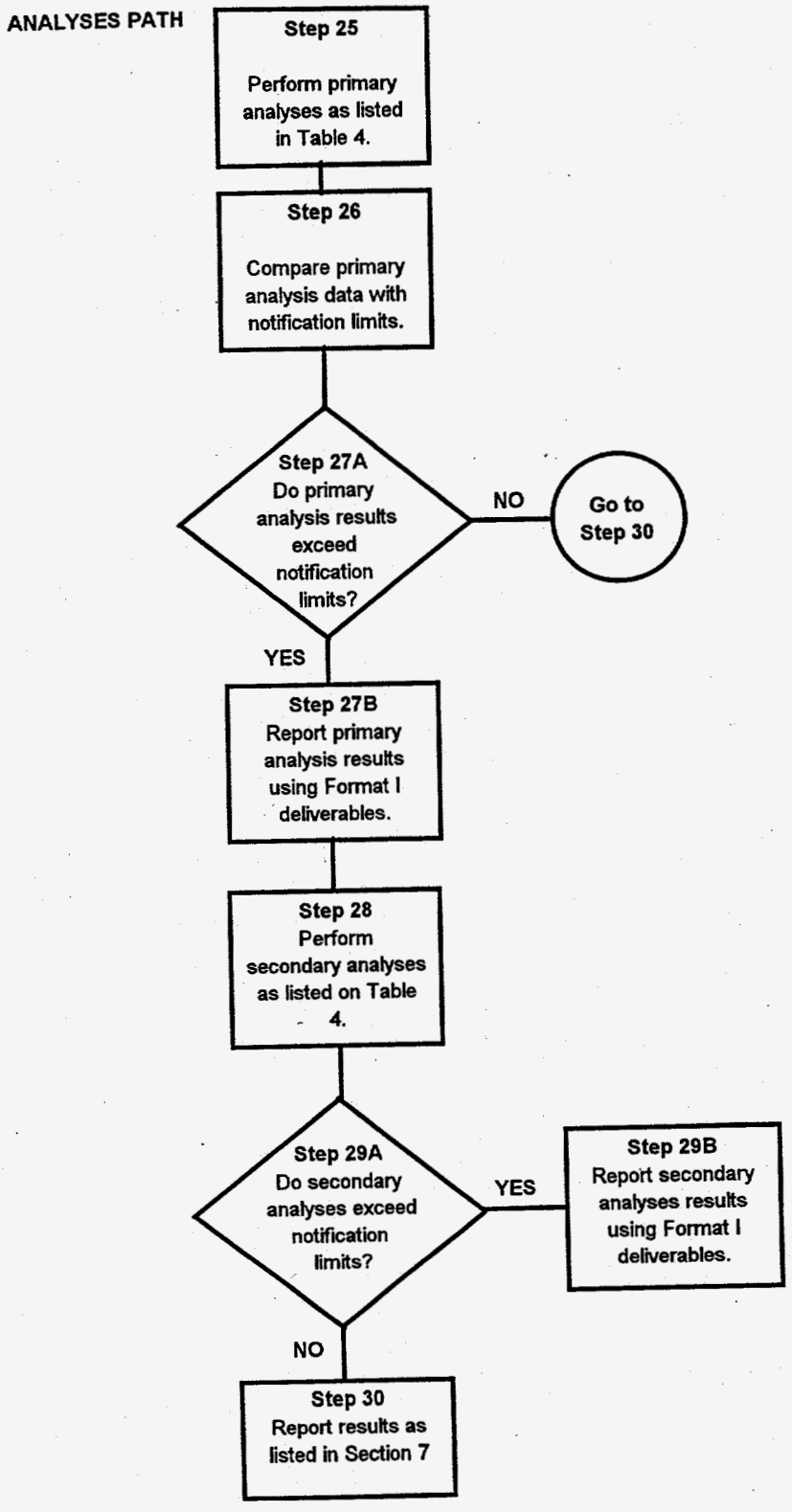


Figure 3: Laboratory Flow Chart C



3.2 INSUFFICIENT SEGMENT RECOVERY

If the amount of material recovered from the core samples taken from tank C-105 is insufficient to perform the analyses requested and permit a minimum 20 gram archive per segment, the laboratory project coordinator or project manager shall notify the Tank Cognizant Engineer and the manager of Analytical Services, Program Management and Integration within one working day. A prioritization of the analyses requested in this document is given in Section 3.3. Any analyses prescribed by this document, but not performed, shall be identified in the appropriate data report, with justification for non-performance.

3.3 PRIORITIZATION OF REQUESTED ANALYSES

The analyses to be performed for the safety screening and pretreatment DQOs have been proiritized below. Confirmation of prioritization levels or revision of sample breakdown procedures may be provided based upon the sample recovery, readily observable physical property distinctions within the sample, and the requested sample breakdown procedures provided in section 3.1.

PRIORITY LEVEL 1

The DSC, TGA, Total Alpha (when necessary), and Li analyses shall be performed.

PRIORITY LEVEL 2

Secondaries for safety screening (TOC, RSST, bromide, cyanide, plutonium 239/240. iron, manganese and total uranium) shall be performed.

PRIORITY LEVEL 3

The Pretreatment analytical needs as listed in Table 4 (and clarified in Figures 4 and 5) shall be performed.

4.0 SPECIFIC ANALYTE, QUALITY CONTROL, AND DATA CRITERIA

4.1 SPECIFIC METHODS AND ANALYSES

The analyses in Table 4 to be performed on the tank C-105 core samples are based on the Pretreatment, and Safety Screening DQOs referenced in Section 1.1.2. The laboratory procedure numbers, which shall be used for the analyses, are included in the table.

4.2 QUALITY ASSURANCE/QUALITY CONTROL

4.2.1 Laboratory Operations

The 222-S Laboratory has a quality assurance program plan (Meznarich 1994) and a quality assurance project plan (Taylor 1993) that shall provide the primary direction for the quality assurance/quality control of analyzing the waste tank core samples at the 222-S Laboratory. If the analyses are performed at the 325 Analytical Chemistry Laboratory (ACL), the analysis shall be guided by the 325 Quality Assurance Plan (Kuhl-Klinger 1994). Additionally, the *Hanford Analytical Services Quality Assurance Plan* (DOE 1994), when implemented, shall be used as quality assurance/quality control guidance.

Method specific quality control such as calibrations and blanks are also found in the analytical procedures. Sample quality control (duplicates, spikes, standards) are identified in Table 4. If no criteria are provided in Table 4, the performing laboratory shall perform to its quality assurance plan(s).

4.2.2 Sample Collection

Two core samples with 3 segments each are to be taken and shipped to the performing laboratory by Sampling Operations in accordance with Work Packages ES-94-01185 and ES-94-01147. Those work packages shall also initiate the chain-of-custody for the samples. Approved plant operating procedure TO-020-455 and procedure TO-080-090 ("Load/Transport Sample Cask[s]") are to be used during the sampling event. Samples shall be identified by a unique number before being shipped to the performing laboratory. The sampling team is responsible for documenting any problems and procedural changes affecting the validity of the sample in a field notebook. Sampling Operations shall enter this information in the comment section of the chain-of-custody form for addition to the data reports.

Sampling Operations should transport each segment collected to the performing laboratory within 1 working day of removing the segment from the tank, but must transport each segment within 3 days. The field blank and HHF blanks shall each count as a segment. Sampling Operations is responsible for verbally notifying the laboratory (373-2435 for 222-S Laboratory; 376-2639 for 325 ACL) at least 24 hours in advance of an expected shipment. If samples are to be delivered to 325 ACL after 3:00 pm, the laboratory shall be notified at least 72 hours in advance of actual sample shipment so that proper shift operations can be planned.

4.2.3 Sample Custody

The chain-of-custody form is initiated by the sampling team as described in Work Packages ES-94-01185 and ES-94-01147. Core samples are shipped in a cask and sealed with a waste Tank Sample Seal. All sample shipments are to be labeled with the following information:

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 WHC 222-S Laboratory are described in laboratory procedure LO-090-101. Receipt and control of samples for the 325 Laboratory are described in procedure PNL-ALO-051.

Table 4: C-105 Chemical, Radiological, and Physical Requirements

SOLID ANALYSES

Project Name	C-105 Push Mode Core Sample			REPORTING LEVELS	
Plan Number	WHC-SD-WM-TP-259, REV. 0			FORMAT I	Early Notify
		COMMENTS		FORMAT II	Process Control
PROGRAM	PROGRAM CONTACTS	Homogenization Test - Not Required		FORMAT III	Safety Screen
A. Safety Screening	Safety Screening H. Babad	Field Blank - Required		FORMAT IV	Waste Management
B. Pretreatment	Pretreatment M. J. Kupfer	Hot Cell Blank - Not Required		FORMAT V	RCRA Compliance
	TWRS R. D. Schreiber	HHF Blank - Required		FORMAT VI	Special
	222-S Laboratory J. G. Kristofzski	TANK	#CORES / RISER #		
	325 Laboratory S. G. McKinley	C-105	2 / 2 and 8		

PRO-GRAM	PRIMARY ANALYSES				SAMPLE[1]		PREP[2]	QUALITY CONTROL[3]						CRITERIA			FOR-MAT
	METHOD	ANAL.	WHC PROCEDURE	PNL PROCEDURE	SOLID COMP	⅓ SEG SLDG		DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	
A	DSC	Energy	LA-514-113	PNL-ALO-508		X	d[5]	ea smpl	N/A	N/A	ea AB	±10	90-110	cal/g[5]	> 115	unknown	I, III, IV
A,B	TGA	% H_2O	LA-560-112	PNL-ALO-508	X	X	see[13], d[6]	ea smpl	N/A	N/A	ea AB	±10	90-110	wt%	17	unknown	I, III, IV
A	Alpha	Total Alpha	LA-508-101	PNL-ALO-421 PNL-ALO-423		X	f	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µCi/g	>41	unknown	I, III, IV
B	Hot Persulfate	TOC	LA-342-100	PNL-ALO-381	X		see[13]	ea smpl	1/mtrx	ea AB	ea AB	±10	90-110	µgC/g	none	unknown	IV
B	Sep. & ß counting	Sr/Y-90	LA-220-101	PNL-ALO-431 PNL-ALO-433	X		see[13]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/g	none	unknown	IV
B	ICP	Al	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	197,000-295,000	IV
B	ICP	Ba	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	120-180	IV
B	ICP	Bi	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	ICP	Ca	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	1,300-1,900	IV
B	ICP	Ce	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	200-300	IV
B	ICP	Cr	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	1,100-1,600	IV
B	ICP	Fe	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	12,000-18,000	IV
B	ICP	K	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	ICP	La	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
A,B	ICP	Li	LA-505-151	PNL-ALO-211		X	see[13]	ea smpl	see[9]	ea PB	ea AB	±10	90-110	µg/g	100	unknown	I, IV
B	ICP	Mg	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	300-400	IV
B	ICP	Mn	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	5,700-8,500	IV
B	ICP	Na	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	52,000-77,000	IV
B	ICP	Ni	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	5,000-7,000	I, IV
B	ICP	P	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	ICP	S	LA-505-151	PNL-ALO-240[18]	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	ICP	Si	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	9,000-13,000	IV
B	ICP	Zr	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/g	none	600-900	IV
B	ICP[14]	Ag	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	100-200	IV
B	ICP[14]	As	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	300-400	IV
B	ICP[14]	B	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	200-400	IV
B	ICP[14]	Be	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	unknown	IV
B	ICP[14]	Cd	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	60-100	IV
B	ICP[14]	Cu	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	100-200	IV
B	ICP[14]	Mo	LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	unknown	IV

Table 4: C-105 Chemical, Radiological, and Physical Requirements

PRO-GRAM	PRIMARY ANALYSES					SAMPLE[1]		PREP[2]	QUALITY CONTROL[3]						CRITERIA			FOR-MAT
	METHOD	ANAL.		WHC PROCEDURE	PNL PROCEDURE	SOLID COMP	½ SEG SLDG		DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	
B	ICP[14]	Pb		LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[15]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	1,400-900	IV
B	ICP[14]	Sb		LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[15]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	2,000-3,000	IV
B	ICP[14]	Se		LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[15]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	800-1,200	IV
B	ICP[14]	Sr		LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[15]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	100-200	IV
B	ICP[14]	Zn		LA-505-151	PNL-ALO-211	X		see[13]	ea smpl[15]	N/A[17]	N/A[17]	N/A[17]	N/A		µg/g	none	unknown	IV
B	IC	Cl⁻		LA-533-105	PNL-ALO-212	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	IC	F⁻		LA-533-105	PNL-ALO-212	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	IC	NO_2^-		LA-533-105	PNL-ALO-212	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	IC	NO_3^-		LA-533-105	PNL-ALO-212	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	IC	PO_4^{3-}		LA-533-105	PNL-ALO-212	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	IC	SO_4^{2-}		LA-533-105	PNL-ALO-212	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	Hot Persulfate	CO_3^{2-} (TIC)		LA-342-100	PNL-ALO-381	X		see[13]	ea smpl	N/A	ea AB	ea AB	see Table 6		µgC/g	none	unknown	IV
B	Sep. & α counting	Pu-239/240		LA-503-156	PNL-ALO-423 PNL-ALO-422	X		see[13]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/g	>41	2.32-3.48	I, IV
B	Germanium Detection	GEA	Am-241	LA-548-120	PNL-ALO-449	X		see[13]	ea smpl	N/A	ea PB	ea AB	see Table 6		µCi/g	none	1.2-0.8	IV
B			Eu-154													none	unknown	IV
B			Cs/Ba-137													none	unknown	IV
B		GEA[14]	Co-60						ea smpl[16]	N/A[17]	N/A[17]	N/A[17]	N/A		µCi/g	none	0.588-0.882	IV
B			Eu-155													none	unknown	IV
B			Sb-125													none	unknown	IV
B			Sn-113													none	unknown	IV
B	Electrode	pH		LA-212-103	PNL-ALO-290	X		see[13]	ea smpl	N/A	N/A	ea AB	see Table 6		units	none	unknown	
B	Titration	OH^-		LA-661-103	PNL-ALO-225	X		see[13]	ea smpl	1/mtrx	ea PB	N/A	see Table 6			none	unknown	IV
B	Gravimetry	Wt% sol.		LA-564-101	PNL-ALO-504	X		see[13]	ea smpl	N/A	ea AB	ea AB	see Table 6		wt%	none	unknown	IV
B	Wt% oxides	Wt% oxides		N/A	PNL-ALO-501	X		see[13]	ea smpl	N/A	ea AB	ea AB	see Table 6		wt%	none	unknown	IV
B	Sep. & α counting	Np-237		LA-933-141	PNL-ALO-421 PNL-ALO-425	X		see[13]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/g	none	unknown	IV
B	Liquid Scintillation	C-14		LA-348-104	PNL-ALO-478 PNL-ALO-482	X		see[13]	ea smpl	1/mtrx[8]	ea PB	ea PB	see Table 6		µCi/g	none	0.0007-0.0010	IV
B	Liquid Scintillation	Tc-99		LA-438-101	PNL-ALO-432	X		see[13]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/g	none	0.084-0.126	IV
B	Germanium Detection	GEA	I-129	LA-378-103	PNL-ALO-454	X		see[13]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/g	none	9.6E-5 to1.4E-4	IV
B	X-Ray Defraction	Chrystalline Compounds		LA-507-151	PNL-ALO-268	X		see[13]	ea smpl	N/A	ea PB	ea AB	see Table 6			none	unknown	IV
B	Wt% solids	Wt% Residual solids		LA-504-101	PNL-ALO-501	X		see[13]	ea smpl	N/A	ea PB	ea AB	see Table 6		wt%	none	unknown	IV
B	Flouresecence	U, total		LA-925-106	PNL-ALO-445	X		see[13]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/g	none	unknown	IV
B	Density	Density		LA-560-101	PNL-ALO-501	X		see[13]	ea smpl	N/A	N/A	N/A	see Table 6		g/mL	none	unknown	IV

PRO-GRAM	SECONDARY ANALYSES		WHC PROCEDURE	PNL PROCEDURE	SAMPLE[1] SOLID COMP[13]	SAMPLE[1] ½ SEG SLDG	PREP[2]	QUALITY CONTROL[3] DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	CRITERIA UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	FOR-MAT
A	Distillation[10]	CN	LA-695-102	PNL-ALO-285		X	d[9]	ea smpl	1/mtrx	ea AB	ea PB	±10	90-110	µg/g	> 39,000	unknown	I, III, IV
A	Hot Persulfate	TOC	LA-342-100	PNL-ALO-381		X	d[9]	ea smpl	1/mtrx	ea AB	ea AB	±10	90-110	µg C/g	none	unknown	III, IV

Table 4: C-105 Chemical, Radiological, and Physical Requirements

PRO-GRAM	PRIMARY ANALYSES				SAMPLE[1]		PREP[2]	QUALITY CONTROL[3]						CRITERIA			FOR-MAT
	METHOD	ANAL.	WHC PROCEDURE	PNL PROCEDURE	SOLID COMP	½ SEG SLDG		DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	
A	Sep. & α counting[11]	Pu-239/240	LA-503-156	PNL-ALO-423 PNL-ALO-422		X	f	ea smpl	1/mtrx[8]	ea PB	ea AB	±10	90-110	µCi/g	>41	unknown	I, III, IV
A	ICP[11]	Fe	LA-505-151	PNL-ALO-211		X	f,a	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µg/g	none	unknown	III, IV
A	ICP[11]	Mn	LA-505-151	PNL-ALO-211		X	f,a	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µg/g	none	unknown	III, IV
A	ICP[11]	U	LA-505-151	PNL-ALO-211		X	f,a	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µg/g	none	unknown	III, IV
A,B	IC[15]	Br	LA-533-105	PNL-ALO-212		X	w	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µg/g	1200	unknown	I,III,IV
A	RSST[10]	Energy	see 10 below	N/A		X	d[6]	ea smpl	N/A	N/A	ea AB	±20	80-120	cal/g[5]	> 115	unknown	III, IV

[1] ½ SEG SLDG-½ segment, sludge; SOLID COMP-composite of the sludge

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

[3] PR-precision, AC-accuracy, ea-each, smpl-sample, DUP-duplicate, SPK/MSD-spike or matrix spike duplicate, AB-analytical batch, PB-preparation batch, N/A-not applicable, mtrx-matrix

[4] Units for notification limits and expected range are those listed in the "units" column.

[5] Dry weight basis.

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

[7] Action limit is applicable up to 500 °C.

[8] Tracer or carrier may be used in place of a spike and results corrected for recovery.

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

[10] This analysis required if DSC exceeds notification limits. The RSST method, yet to be proceduralized, may be found in WHC-SD-WM-TP-104.

[11] Performed only if total alpha exceeds notification limit.

[12] These analyses are secondary analyses for the safety screening DQO. Therefore, if the DSC limit is exceeded, these analyses must be performed and reported within 90 days of receipt of the last sample at the laboratory dock.

[13] For composite analyses, refer to Figure 5

[14] This analysis is not required if instrument recalibrations or running the instrument using different parameters are needed to obtain the analyte result.

[15] This analysis required if Li exceeds notification limit.

[16] Duplicate analysis should be performed; however, preparation of special dilution sizes to analyze these components will not be required.

[17] No additional standards, spikes, or blanks should be prepared solely for the purpose of obtaining information on this analyte.

[18] If analyses are performed at the 325 ACL, sulfur will be analyzed by Infrared Absorption.

Table 4: C-105 Chemical, Radiological, and Physical Requirements

LIQUID ANALYSES

Project Name	C-105 Push Mode Core Sample		REPORTING LEVELS
Plan Number	WHC-SD-WM-TP-259, REV. 0		FORMAT I: Early Notify
		COMMENTS	FORMAT II: Process Control
PROGRAM	PROGRAM CONTACTS	Homogenization Test - Not Required	FORMAT III: Safety Screen
A. Safety Screening	Safety Screening H. Babad	Field Blank - Required	FORMAT IV: Waste Management
B. Pretreatment	Pretreatment M. J. Kupfer	Hot Cell Blank - Not Required	FORMAT V: RCRA Compliance
	TWRS R. D. Schreiber	HHF Blank - Required	FORMAT VI: Special
	222-S Laboratory J. G. Kristofzski	TANK: C-105 / #CORES: 2 / RISER #: 2 and 8	
	325 Laboratory S. G. McKinley		

PRO-GRAM	PRIMARY ANALYSES				SAMPLE[1]		PREP[2,11]	QUALITY CONTROL[3]						CRITERIA			FOR-MAT
	METHOD	ANAL.	WHC PROCEDURE	PNL PROCEDURE	LIQUID COMP[11]	FB & S-LEV LIQ		DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	
A.	DSC	Energy	LA-514-113	PNL-ALO-508		X	d[3]	ea smpl	N/A	N/A	ea AB	±10	90-110	cal/g[5]	> 115[7]	unknown	I, III, IV
A	TGA	% H_2O	LA-560-112	PNL-ALO-508		X	d[6]	ea smpl	N/A	N/A	ea AB	±10	90-110	wt%	< 17	unknown	I, III, IV
A,B	Hot Persulfate	TOC	LA-342-100	PNL-ALO-381	X		d[8]	ea smpl	1/mtrx	ea AB	ea AB	±10	90-110	µgC/mL	none	unknown	IV
B	Sep. & ß counting	Sr/Y-90	LA-220-101	PNL-ALO-431 PNL-ALO-433	X		d[8]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/mL	none	unknown	IV
B	ICP	Al	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Ba	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Ca	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Cr	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Fe	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	K	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
A,B	ICP	Li	LA-505-151	PNL-ALO-211		X	d[6]	ea smpl	see[9]	ea PB	ea AB	±10	90-110	µg/mL	100	unknown	I,III,IV
B	ICP	Mg	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Mn	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Na	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	P	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	S	LA-505-151	PNL-ALO-240[16]	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Si	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP	Zr	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl	see[9]	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	ICP[12]	Ag	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	As	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Cd	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Cu	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Mo	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Pb	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Se	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Sr	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV
B	ICP[12]	Zn	LA-505-151	PNL-ALO-211	X		d[6]	ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µg/mL	none	unknown	IV

Table 4: C-105 Chemical, Radiological, and Physical Requirements

PRO-GRAM	PRIMARY ANALYSES					SAMPLE[1]		PREP[2,11]	QUALITY CONTROL[3]						CRITERIA			FOR-MAT
	METHOD	ANAL.		WHC PROCEDURE	PNL PROCEDURE	LIQUID COMP[11]	FB & S-LEV LIQ		DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	
B	IC	Cl^-		LA-533-105	PNL-ALO-212	X		d[5]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	IC	F^-		LA-533-105	PNL-ALO-212	X		d[5]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	IC	NO_2^-		LA-533-105	PNL-ALO-212	X		d[5]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	IC	NO_3^-		LA-533-105	PNL-ALO-212	X		d[5]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	IC	PO_4^{3-}		LA-533-105	PNL-ALO-212	X		d[5]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	IC	SO_4^-		LA-533-105	PNL-ALO-212	X		d[5]	ea smpl	1/mtrx	ea PB	ea AB	see Table 6		µg/mL	none	unknown	IV
B	Hot Persulfate	CO_3^{2-} (TIC)		LA-342-100	PNL-ALO-381	X		d[5]	ea smpl	N/A	ea AB	ea AB	see Table 6		µg C/mL	none	unknown	IV
B	Sep. & α counting	Pu-239/240		LA-503-156	PNL-ALO-423 PNL-ALO-422	X		d[5]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/mL	> 41	2.32 to 3.48	I, IV
B	Germanium Detection	GEA	Am-241	LA-503-156	PNL-ALO-450	X		d[5]	ea smpl	N/A	ea PB	ea AB	see Table 6		µCi/mL	none	0.8 to 1.2	IV
B			Eu-154													none	unknown	IV
B			Cs/Ba-137													none	unknown	IV
B		GEA[12]	Co-60						ea smpl[14]	N/A[15]	N/A[15]	N/A[15]	N/A		µCi/mL	none	1.4E-02 to 2.1E-02	IV
B			Eu-155													none	unknown	IV
B			Sb-125													none	unknown	IV
B			Sn-113													none	unknown	IV
B	Electrode	pH		LA-212-103	PNL-ALO-290	X		d[5]	ea smpl	N/A	N/A	ea AB	see Table 6		pH	none	unknown	IV
B	Titration	OH^-		LA-661-103	PNL-ALO-225	X		d[5]	ea smpl	1/mtrx	ea PB	N/A	see Table 6		µg/mL	none	unknown	IV
B	Sep. & α counting	Np-237		LA-933-141	PNL-ALO-421 PNL-ALO-425	X		d[5]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/mL	none	unknown	IV
B	Liquid Scintillation	C-14		LA-348-104	PNL-ALO-474 PNL-ALO-482	X		d[5]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/mL	none	1.6E-03 to 2.4E-03	IV
B	Liquid Scintillation	Tc-99		LA-438-101	PNL-ALO-432	X		d[5]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/mL	none	8.4E-02 to 1.3E-01	IV
B	GEA	I-129		LA-378-103	PNL-ALO-454	X		d[5]	ea smpl	1/mtrx[8]	ea PB	ea AB	see Table 6		µCi/mL	none	9.6E-05 to 1.4E-04	IV
A, B	Visual	Organic Layer		LA-519-151	PNL-ALO-501	X		d[5]	N/A	N/A	N/A	N/A	N/A		none	presence	unknown	I,IV
B	Density	Density		LA-560-101	PNL-ALO-501	X		d[5]	ea smpl	N/A	N/A	N/A	see Table 6		g/mL	none	unknown	IV

Table 4: C-105 Chemical, Radiological, and Physical Requirements

PRO-GRAM	SECONDARY ANALYSES				SAMPLE[1]		PREP[2]	QUALITY CONTROL[3]						CRITERIA			FOR-MAT
	METHOD	ANAL.	WHC PROCEDURE	PNL PROCEDURE	LIQUID COMP[11]	FB & S-LEV LIQ		DUP	SPK/ MSD	BLK	CALIB STD	PR	AC	UNITS	NOTIFICATION LIMIT[4]	EXPECTED RANGE[4]	
B	Distillation[10]	CN	LA-695-102	PNL-ALO-285		X	d[6]	ea smpl	1/mtrx	ea PB	ea PB	±10	90-110	µg/mL	> 39,000	unknown	I, III, IV
B	IC[13]	Br	LA-533-105	PNL-ALO-212		X	d[6]	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µg/mL	1200	unknown	I,III,IV
A,B	RSST[10]	Energy	see 10 below	N/A		X	d[6]	ea smpl	N/A	N/A	ea AB	±20	80-120	cal/g[5]	> 115	unknown	I, III, IV
A	Hot *Persulfate*	TOC	LA-342-100	PNL-ALO-381		X	d[6]	ea smpl	1/mtrx	ea PB	ea AB	±10	90-110	µgC/mL	> 30,000	unknown	III, IV

[1]LIQ COMP-composite of the liquid, S-LEV LIQ-liquid taken from the segment level, FB-field blank

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

[3]PR-precision, AC-accuracy, ea-each, smpl-sample, DUP-duplicate, SPK/MSD-spike or matrix spike duplicate, AB-analytical batch, PB-preparation batch, N/A-not applicable, mtrx-matrix

[4]Units for notification limits and expected range are those listed in the "units" column.

[5]Dry weight basis.

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

[7]Action limit is applicable up to 500 °C.

[8]Tracer or carrier may be used in place of a spike and results corrected for recovery.

[9]Serial dilutions or matrix spikes will be performed.

[10]This analysis required if DSC exceeds notification limits. The RSST method, yet to be proceduralized, may be found in WHC-SD-WM-TP-104.
and reported within 90 days of receipt of the last sample at the laboratory dock.

[11]For composite analyses, refer to Figure 6

[12]This analysis is not required if instrument recalibrations or running the instrument using different parameters are needed to obtain the analyte result.

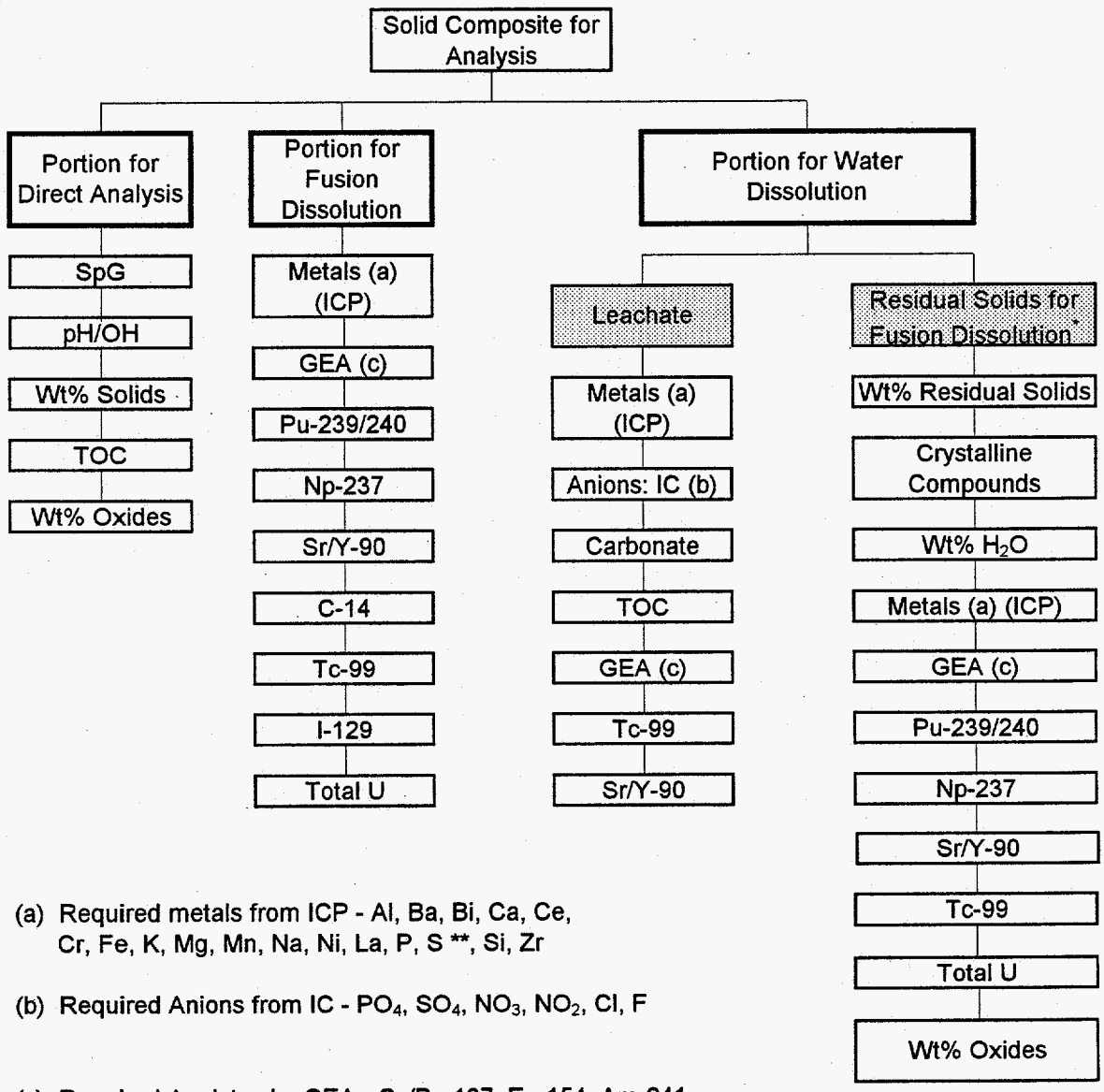
[13]This analysis required if Li exceeds notification limit.

[14]Duplicate analysis should be performed; however, preparation of special dilution sizes to analyze these components will not be required.

[15]No additional standards, spikes, or blanks should be prepared solely for the purpose of obtaining information on this analyte.

[16]If analyses are performed at the 325 ACL, sulfur will be analyzed by Infrared Absorption.

Figure 4: Analytical Scheme for Solid Composite



(a) Required metals from ICP - Al, Ba, Bi, Ca, Ce, Cr, Fe, K, Mg, Mn, Na, Ni, La, P, S **, Si, Zr

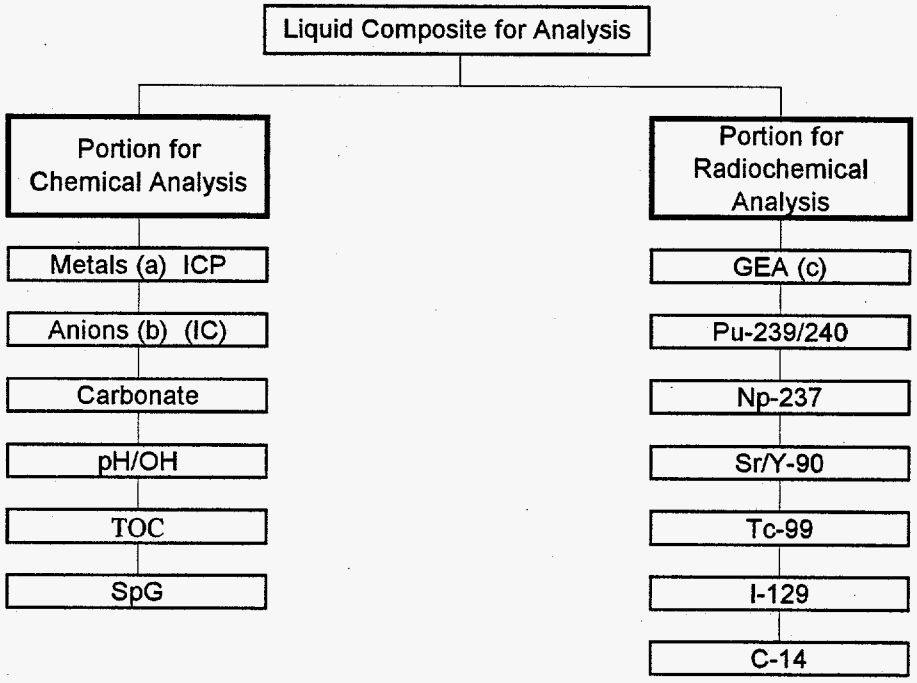
(b) Required Anions from IC - PO_4, SO_4, NO_3, NO_2, Cl, F

(c) Required Analytes by GEA - Cs/Ba-137, Eu-154, Am-241

NOTE: * Perform fusion of residual solids unless judged that insufficient solids remain after water digestion. If little or no solids remain, the fusion dissolution of entire sample will be used for material balance calculations

** S is determined by infrared absorption at PNL 325 ACL

Figure 5: Analytical Scheme for Liquid Composite



(a) Required metals from ICP - Al, Ba, Ca, Cr, Fe, K, Mg, Mn, Na, P, S **, Si, Zr

(b) Required Anions from IC - PO_4, SO_4, NO_3, NO_2, Cl, F

(c) Required Analytes by GEA - Cs/Ba-137, Eu-154, Am-241

** S is determined by the infrared absorption method at PNL 325 ACL.

5.0 ORGANIZATION

The organization and responsibility of key personnel involved in this tank C-105 characterization project are listed in Table 5.

Table 5: Tank C-105 Project Key Personnel List

Name or Title	Organization	Responsibility
J. L. Deichman	Analytical Services	Manager, Analytical Services, Program Management & Integration
J. G. Kristofzski	222-S Analytical Operations	Program Support Manager of Analytical Operations
S. G. McKinley	325 Analytical Chemistry Laboratory	Project Manager for Tank Waste Characterization
H. Babad	WHC Characterization Program	Characterization Program Point of Contact
R. D. Schreiber	TWRS Characterization Support	Tank C-105 Tank Characterization Plan Cognizant Engineer
M. J. Kupfer	Process Systems Engineering	Pretreatment Point of Contact
East Tank Farm Operations Shift Manager	Tank Farms Operations	200 East Tank Farm Notification Limit Point of Contact (373-2689)

6.0 EXCEPTIONS, CLARIFICATIONS AND ASSUMPTIONS

6.1 EXCEPTIONS TO DQO REQUIREMENTS

In the safety screening DQO, it is specified that cyanide analyses are to be run on a quarter-segment level and that the notification limit for the DSC analysis is 125 cal/g. However, both the soon-to-be-released revision of the Safety Screening DQO and the Ferrocyanide DQO (Meacham et al. 1994) have changed the requirements such that the cyanide analysis is now to be run on a half-segment level and the DSC notification limit is 115 cal/g (dry weight basis). Therefore, although this Tank Characterization Plan uses the current safety screening DQO, it specifies that cyanide is to be run on a half-segment basis and that notification shall be made if the DSC value exceeds 115 cal/g (dry weight basis).

6.2 CLARIFICATIONS AND ASSUMPTIONS

A number of clarifications and assumptions relating to the notification limits or decision thresholds identified in the applicable DQO efforts need to be made with respect to the analyses in Table 4. Each of these issues are discussed below.

- Any exotherm 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.

$$Exotherm\ (dry\ wt) = \frac{[exotherm\ (wet\ wt) \times 100]}{(100 - \%\ water)} \qquad (1)$$

NOTE: If there is greater than 90 percent water in a sample, converting to a dry weight bases may lead to a large error in the DSC value. However, the conversion is still required.

- The safety screening DQO (Babad and Redus 1994) requires that additional analyses be performed if total alpha activity measures greater than 1 g/L. Total alpha is measured in μCi/g rather than g/L. To convert the notification limit for total alpha into a number more readily usable by the laboratory, it was assumed that all alpha decay originates from Pu-239. The notification limit may then be calculated as shown in equation (2):

$$\left(\frac{1\ g}{L}\right)\left(\frac{1\ L}{10^3\ mL}\right)\left(\frac{1}{density}\ \frac{mL}{g}\right)\left(\frac{0.062\ Ci}{1\ g}\right)\left(\frac{10^6\ \mu Ci}{1\ Ci}\right) = \frac{61.5}{density}\ \frac{\mu Ci}{g} \qquad (2)$$

NOTE: If a density of 1.5 is assumed for the solid material, the notification becomes 41 μCi/g.

- The safety screening DQO does not sufficiently address the analyses of any drainable liquid present. To adequately characterize the tank, the Characterization Program has requested that all analyses performed on the solids for the safety screening DQO, with the exception of total alpha analysis, shall also be performed on any drainable liquids and the field blank.

- The Pretreatment Program has requested 125 grams of the solid composite material for process development work. A test plan (Lumetta 1994) will be used to guide this process development work. Since the Characterization Program is responsible for the taking of tank samples, the Characterization Program will need to approve the test plan. This approval will not only ensure that the DQO process has been used in the generation of the test plan and that there is justification for the samples, but also that the facility receiving the sample is in a position to adequately handle radioactive material. At such time that the test plan is approved by the Characterization Program, the Characterization Program will direct the performing laboratory, via letter of instruction, to allow shipment of the sample material to the Process Chemistry section of Pacific Northwest Laboratory.

- In the pretreatment DQO the achieved precision and accuracy are listed at two concentrations: greater than the minimum detectable quantity detection limits and near (< 10 times) the minimum detectable quantity. Table 6 is a list of the Pretreatment precision and accuracy requirements. These target values are required by the pretreatment DQO, and if exceeded should be noted in the final report.

Table 6: Required Accuracy and Precision for Pretreatment Sample Analytes

Analyte	Sample Accuracy in Percent	Sample Precision in Percent*
Al	20(1)	20
	50(2)	40
Ba	40	40
	80	80
Bi	50	20
	120	50
Ca	20	20
	50	50
Ce	10	30
	20	40
Cr	20	20
	40	50
Fe	50	30
	50	60
K	20	20
	40	40
La	10	20
	50	70
Mg	20	30
	30	100
Mn	50	30
	70	100
Na	20	20
	20	30
P	Presence/absence only	Presence/absence only
	Presence/absence only	Presence/absence only
S	Presence/absence only	Presence/absence only
	Presence/absence only	Presence/absence only
Ni	20	10
	30	50
Si	20	30
	30	80

Analyte	Sample Accuracy in Percent	Sample Precision in Percent*
Zr	20	30
	50	60
Cl	20	20
	50	30
F	30	30
	70	60
SO4	20	20
	60	30
NO3	20	20
	50	30
NO2	20	20
	50	30
PO4	20	20
	50	50
CO3	20	20
	50	50
TOC	50	50
	100	100
acid H^+ (pH)	10	20
	50	100
Hydroxide OH^-	10	20
	50	100
U (total)	20	20
	60	60
^{14}C	40	50
	50	200
^{99}Tc	60	20
	100	50
^{129}I	60	100
	100	100
^{137}Cs	10	20
	40	60
^{90}Sr	20	30
	30	60

Analyte	Sample Accuracy in Percent	Sample Precision in Percent*
^{154}Eu	10	20
	40	60
$^{239/240}Pu$	20	40
	40	70
^{241}Am	20	30
	50	80
^{237}Np	60	40
	140	80

(1) The first row for an analyte lists the accuracy and precision at high concentrations (>10 times the detection limit).

(2) The second row gives the values at low concentrations (<10 times the detection limit).

* Precision requirements are based on relative percent difference between duplicates rather than standard deviation of the analyte concentration.

- Several ICP and GEA analyses are listed in the Pretreatment DQO and Table 4 for which the Pretreatment Program has requested information without additional quality assurance/quality control requirements (see footnotes, Table 4). These results will not be used in any of the Pretreatment decision rules; rather, this information will assist in detecting unexpected analyte concentrations, and could indicate the need for obtaining more extensive analyses from a core at a later date. The Pretreatment Program has requested a reporting of the instrument results for these analyses, with the following caveats:

  - If instrument recalibration or running the instrument using different parameters is required to obtain the analyte result, the additional analysis is not required.

  - No additional standards, spikes, or blanks should be prepared solely for the purpose of obtaining information on the these additional analytes.

  - Duplicate analyses should be performed; however, preparation of special dilution sizes to analyze these components will not be required.

- In the Pretreatment DQO, Sn-123 by GEA is listed as one of the additional analytes for which no quality assurance/quality control is required. However, Sn-123 is not an isotope obtained by GEA, although Sn-113 is such an analyte. Therefore, it is assumed in this Tank Characterization Plan that Sn-113 rather than Sn-123 is the analyte of interest.

- In the Pretreatment DQO, the list of metals analyzed by ICP includes sulfur. The ICP method at the 325 ACL is not configured for sulfur analysis. Therefore, if tank C-105 is analyzed at the 325 ACL, the sulfur analysis will need to be done by the Infrared Absorption method rather than by ICP.

7.0 DELIVERABLES

All analyses of tank C-105 waste material shall be reported as Format I, III, or IV, as shown in Table 4. Additional information regarding reporting formats are found in "Revised Interim Tank Characterization Plan Guidance" (Schreiber 1994a).

7.1 PROGRESS REPORTS

Each laboratory performing analyses on tank C-105 waste material from this core sampling project shall provide monthly status reports to the Characterization Program. This report shall contain 1) a summary of the activities on the analysis of tank C-105, 2) preliminary results to the program, and 3) schedule and cost information on a DQO basis.

Monthly and accumulative costs will be compared to the base as part of the Progress report. Monthly variances greater than 10% and $10,000, and accumulative variances greater than $50,000 from the estimated costs or schedule must be explained in the report. Cost reporting shall consist of the following:

1. budgeted cost of work scheduled
2. monthly cost (actual cost of work performed)
3. year-to-date costs (actual cost of work performed)

Schedule reporting shall consist of the following:

1. monthly schedule
2. year-to-date schedule

7.2 FORMAT I REPORTING

Table 4 contains the notification limits for each analyte. Any results exceeding their notification limits shall be reported by calling the East Tank Farm Operations Shift Manager at 373-2689 and the Characterization Program (Schreiber 1994b). This verbal notification must be followed within 1 working day by written communication to J. L. Deichman, R. D. Schreiber, S. J. Eberlein,T. J. Kelly, H. Babad, D. R. Bratzel, and N. W. Kirch documenting the observations. Additional analyses for verification purposes may be contracted between the performing laboratory and the contacts above either by a revision to this document, by a letter of instruction, or by a memorandum of understanding.

7.3 FORMAT III REPORTING

A Format III report, reporting the results of the primary safety screen analyses, shall be issued to H. Babad, R. D. Schreiber, S. J. Eberlein, D. R. Bratzel, P. Sathyanarayana, and N. W. Kirch within 45 days of receipt of the last segment of the last core sample at the laboratory loading dock. Although normally raw data would not be attached to this type of report, the DSC and TGA scans have been requested due to the interpretive nature of the analysis. If analyses for the safety screening secondary analytes are required, these results shall be provided within 90 days of receipt of the last segment of the last core sample at the laboratory loading dock. No calibration data are

requested for these reports. Detailed information regarding the contents of this reporting format are given in (Schreiber 1994a).

7.4 FORMAT IV REPORTING

Analytical results requested for the characterization project of tank C-105 shall be compiled into a Format IV type data package. The data package shall be provided to Analytical Services and the Characterization Program within 216 days of the sampling event. Detailed information regarding the contents of this reporting format are given in (Schreiber 1994a).

In addition to this data package, an electronic version of the analytical results shall be provided to Characterization Support for entry in the Tank Characterization Database. The data must be available to the Washington State Department of Ecology within 216 days of the sampling event, so this electronic copy must be sent at the time of data package delivery or within 209 days of the sampling event, whichever is earlier, to allow time for data entry. The electronic version shall be in the standard electronic format specified in (Bobrowski 1994).

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 or the Characterization Program. These changes shall be documented. Changes may be documented through the use of internal characterization change notices or analytical deviation reports for minor, low-impact changes and documented in applicable laboratory records. All significant changes (such as changes in scope) shall be documented by Characterization Support via an Engineering Change Notice to the Tank Characterization Plan. All changes shall also be clearly documented in the final data package.

Additional analysis of core sample material from this characterization project at the request of the Characterization Program shall be performed according to a revision of this Tank Characterization Plan.

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