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241-Z-361 Sludge Characterization Sampling and Analysis Plan

D. L. Banning
Lockheed Martin Hanford, Corp., Richland, WA 99352
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M. S. Miller
Environmental Quality Management

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241-Z-361 Sludge Characterization Sampling and Analysis Plan

July 1999

Prepared by

Environmental Quality Management
for
Babcock and Wilcox Hanford Corporation

EXECUTIVE SUMMARY

This sampling and analysis plan addresses the requirements for collection and analysis of samples of residual solids, or sludge, from Tank 241-Z-361. Tank 241-Z-361 is an inactive wastewater settling tank located near the Plutonium Finishing Plant in 200 West Area of the U.S. Department of Energy's (DOE) Hanford Site near Richland, Washington. The actions described in this document comprise the Phase II activities for characterization of the tank contents. The Phase I activities include collection and analysis of tank headspace vapor samples and collection of an internal tank video record. Phase I activities are addressed under a previously-approved sampling and analysis plan. The tank was not pressurized, no combustible gases were detected, and field measurements indicate that the headspace vapors were not acutely toxic. The results of the tank headspace vapor laboratory analysis are shown in Table ES-1.

Tank 241-Z-361 is identified in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994) as a unit to be remediated under the authority of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). The DOE owns and operates the Hanford Site with Fluor Daniel Hanford as the primary contractor responsible for site management through the Project Hanford Management Contract (PHMC). Babcock and Wilcox Hanford Corporation has the lead responsibility under the PHMC for the remediation of Tank 241-Z-361. The U.S. Environmental Protection Agency serves as the lead regulatory agency for remediation of this tank under the CERCLA process. Tank 241-Z-361 is identified within the CERCLA Plutonium/Organic-rich Process Condensate/Process Waste Group (DOE-RL 1992). This particular facility group has been prioritized for remediation beginning in the year 2004. Results of Tank 241-Z-361 sampling and analysis will determine whether expedited response actions are required before 2004 to mitigate hazards associated with tank contents. If evaluation of risk posed by this tank indicates the need for earlier action, then DOE will evaluate removal and disposal alternatives through the appropriate CERCLA pathway after consultation with the U.S. Environmental Protection Agency.

This SAP is provided in three major sections. Section 1.0 provides a summary of the historical information, selection of contaminants of potential concern, and data quality objectives process. Section 2.0 provides detailed sampling and analysis design based on Section 1.0. Section 3.0 is the quality assurance plan for the sampling, analysis, validation, and reporting.

This sampling and analysis plan describes the following project requirements:

- Project organization and management;
- Health and safety requirements;
- Collection and handling of sludge core samples, and supplemental tank vapor samples using the procedures developed for use in Hanford tanks;
- Analysis of sludge, residual supernate, and tank headspace samples for chemical and radiological constituents by Hanford Site laboratories;
- Data quality requirements;
- Data validation requirements; and
- Data management and quality assessment procedures, and reporting requirements.

Table ES-1. Volatile Compounds Detected in Tank 241-Z-361 Headspace During Phase I Activities.

Compound	Concentration Reported (ppmv)
Freon 11	0.61
Dichloromethane (Methylene chloride)	0.016
Chloroform	1.30
Carbon tetrachloride	0.16
Tetrachloroethylene, PCE	2.00
Trichloroethylene, TCE (TIC)	0.9 (TIC)
Acetone	0.02
Toluene	0.007
n-Butane	0.12
n-Pentane	0.06
Acetic Acid	0.054
Carbon dioxide	13,000

TIC = tentatively identified compound

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

TERMS

AAMS	Aggregate Area Management Study
AEA	alpha energy analysis
ARAR	applicable or relevant and appropriate requirement
BWHC	Babcock and Wilcox Hanford Corporation
CAS #	chemical abstract services number or unique identifier used in database
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COPC	constituent of potential concern
CPO	Characterization Program Operations
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	Data Quality Objectives
DS	decision statement
DST	double-shell tank
EPA	U.S. Environmental Protection Agency
EQL	estimated quantitation limit
ERDF	Environmental Restoration Disposal Facility
FDH	Fluor Daniel Hanford
GC/MS	gas chromatography/mass spectroscopy
GFAA	graphite furnace atomic absorption
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Documents*
HEPA	high efficiency particulate air
IC	ion chromatography
ICP	inductively coupled plasma
IDW	investigation derived waste
ISE	ion-selective electrode
JCO	Justification for Continued Operation
KOH	potassium hydroxide
LCS	laboratory control sample
LDR	land disposal restriction
LFL	lower flammability limit
LiBr	lithium bromide
LMHC	Lockheed Martin Hanford Corporation
MDA	minimum detectable activity
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
OTC	onsite transfer cask
PE-Ci	plutonium equivalent curies
PFP	Plutonium Finishing Plant

PHMC	Project Management Hanford Contract
PIC	person in charge
PNNL	Pacific Northwest National Laboratory
PQL	practical quantitation limit
PRC	plant review committee
PRF	Plutonium Reclamation Facility
QA	quality assurance
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RECUPLEX	facility for recovery of uranium and plutonium by extraction
RL	U.S. Department of Energy, Richland Operations Office
RPD	relative percent difference
RPP	River Protection Project
SAP	Sampling and Analysis Plan
TCLP	Toxicity Characteristic Leaching Procedure
TRU	transuranic
TRUPACT	transuranic package transporter
TTA	2-thenoyltrifluoroacetone
TWINS	Tank Waste Information Network System
USQ	Unreviewed Safety Question
VOA	volatile organic analyte (analysis)
WAC	*Washington Administrative Code*
WIPP	Waste Isolation Pilot Plant
WML	Waste Management Laboratory
WSCF	Waste Sampling and Characterization Facility

1.0 DATA QUALITY OBJECTIVE SUMMARY

1.1 INTRODUCTION

This sampling and analysis plan (SAP) identifies the type, quantity, and quality of data needed to support characterization of the sludge that remains in Tank 241-Z-361. The procedures described in this SAP are based on the results of the *241-Z-361 Sludge Characterization Data Quality Objectives* (DQO) (BWHC 1999) process for the tank. The primary objectives of this project are to evaluate the contents of Tank 241-Z-361 in order to resolve safety and safeguards issues and to assess alternatives for sludge removal and disposal.

Sampling and characterization of this tank are required to resolve an Unreviewed Safety Question (Wagoner 1997) concerning uncertain hazards and risks associated with the tank. The primary safety risk identified is due to an estimated 26 to 75 kg of plutonium expected in the tank waste. The most probable plutonium inventory is 26.8 kg (Freeman-Pollard 1994). In addition to the plutonium inventory, other constituents of the sludge need to be identified in order to evaluate removal alternatives and disposal options. Signatories of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994) have agreed that sludge characterization is appropriate to assess whether an early removal should be performed for the sludge. The U.S. Department of Energy (DOE) owns and operates the Hanford Site with Fluor Daniel Hanford as the primary contractor responsible for site management through the Project Hanford Management Contract (PHMC). Babcock and Wilcox Hanford Corporation (BWHC) has the lead responsibility under the PHMC for the remediation of Tank 241-Z-361. Tank 241-Z-361 has been designated for remediation under the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA); the U.S. Environmental Protection Agency (EPA) is the lead regulatory agency for this activity.

1.2 SCOPE

The Tank 241-Z-361 Justification for Continued Operation (JCO) (PMHC 1999) describes a phased authorization to conduct activities to address hazards posed by this tank and to characterize it in preparation for remediation. Phase I activities included surveys of the site and vapor sampling of headspace gases within the tank. The activities associated with sludge sampling and described in this SAP are described in the JCO as Phase II activities.

This SAP addresses only limited characterization needs related to the sludge materials within the tank. This characterization encompasses the evaluation of safety and security concerns and consideration of removal and disposal alternatives. Other USQ requirements include evaluating the tank structure to assess the risk of a seismic event or other natural hazards and assessing the potential for flammable gas build-up and deflagration from natural or work-induced ignition sources within a "sealed" tank. The safety issues associated with tank flammability and tank integrity were addressed under a separate SAP (Hill et al. 1998) conducted before the sampling described in this document. This SAP does not address other issues associated with final tank closure.

1.3 TANK 241-Z-361 DESCRIPTION

Tank 241-Z-361 is a rectangular, underground structure 8 m (26 ft) long, 4 m (13 ft) wide, and ranges from 5.2 m (17 ft) deep at the north (influent) end to 5.5 m (18 ft) deep on the south (effluent) end. The tank is constructed of steel-lined concrete with 30 cm (12 in.) thick concrete walls, a layer of waterproofing, and a 1-cm (3/8 in.) thick carbon-steel liner that covers the bottom and side walls up to 15 cm (6 in.) of the roof. The base of the tank is 23 cm (9 in.) thick, with grout and waterproofing added for a total thickness of 30 cm (12 in.). The roof is 25 cm (10 in.) thick. The top was sealed with masticm and approximately 10 cm (4 in.) of concrete was poured over the mastic. The elevation of the top of the tank is 205 m (672 ft 6 in.). Grade elevation is 205.6 m (674 ft 6 in.). The tank is located southeast of Building 241-Z in the 200 West Area of the Hanford Site and was placed in service in 1949. The location of the tank on the Hanford Site is indicated in Figure 1-1.

The tank provided settling capacity for solids entrained in liquid wastes that were generated by plutonium finishing and similar processes. Liquid entered the tank from retention basins and Sump Tank 241-Z-6 through two 15-cm (6 in.) stainless-steel pipes, which penetrated the tank wall through a baffled opening, and exited as overflow through a baffle into one 20-cm (8 in.) stainless-steel pipe into Cribs 216-Z-1, 216-Z-2, 216-Z-3, and 216-Z-12. The bottom of the inlet piping is at elevation 204 m (669 ft) and the bottom of the discharge pipe is at elevation 203.6 m (668 ft). Figure 1-2 provides a cross-sectional view of the tank.

The tank roof has three large manhole penetrations and eight riser pipe penetrations (Figure 1-3). A 1-m (3 ft) manhole exists at the north end of the tank. A second manhole is centered near the south, outside wall of the tank. A large concrete plug (1.2 m [4 ft] diameter) is located in the geometric center of the tank roof. There are two 20-cm (8 in.) risers (A and B), one 5-cm (2 in.) riser, one 8-cm (3 in.) riser built into the southwest corner of the tank, and one 8-cm (3 in.) riser in the northeast corner of the tank. One 15-cm (6 in.) riser was installed through the concrete plug in the center of the tank (riser E) and two 20-cm (8 in.) risers (F and G) were installed north of the center plug. Both 20-cm (8 in.) risers (G&FG) contain 10-cm (4 in.) dry wells that appear to extend from the tank roof into the sludge for an undetermined distance. Although one of the 20-cm (8 in.) risers in the south end had a pipe installed, the middle of the pipe has corroded away (riser A). Riser B has a 10-cm (4 in.) pipe installed that appears to extend from the tank roof into the sludge for an undermined depth. All eight risers are capped or flanged closed and no equipment remains in the tank.

The inlet and outlet pipes have been isolated and plugged or flanged 60 cm (2 ft) from the outer wall of the tank. The reinforced concrete that was poured over the top of the tank has been removed over the manholes and the tank was opened for sampling and photography in the mid-1970s. The manholes were subsequently reinstalled, covered with weather covers, and buried. The tank is covered with approximately 0.61 m (2 ft) of soil.

Figure 1-1. Site Location, Tank 241-Z-361 and Surrounding Buildings and Cribs.

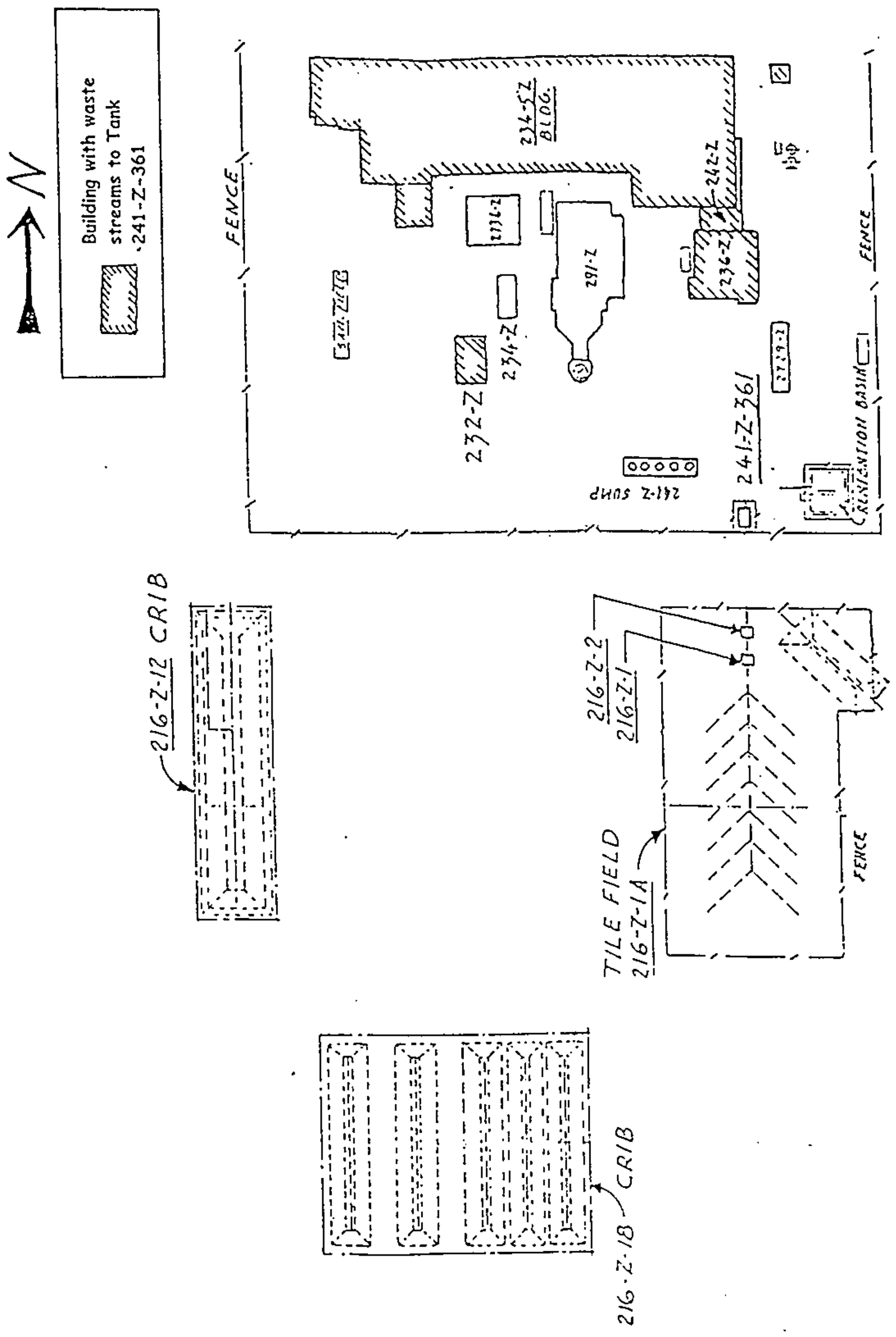


Figure 1-2. Cross-Section of Tank 241-Z-361.

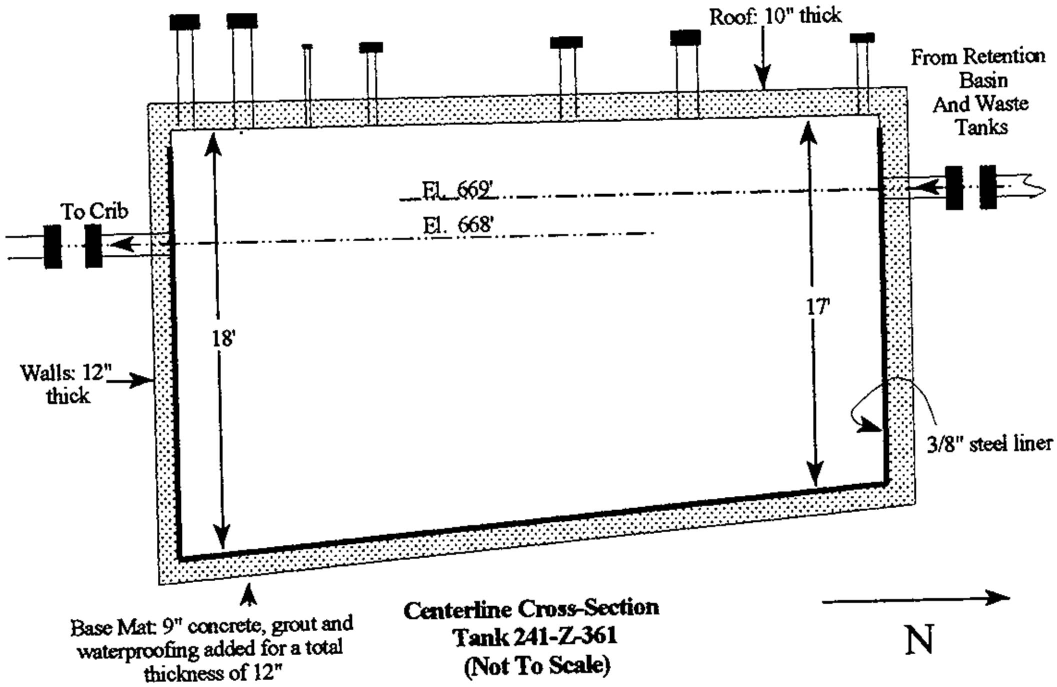
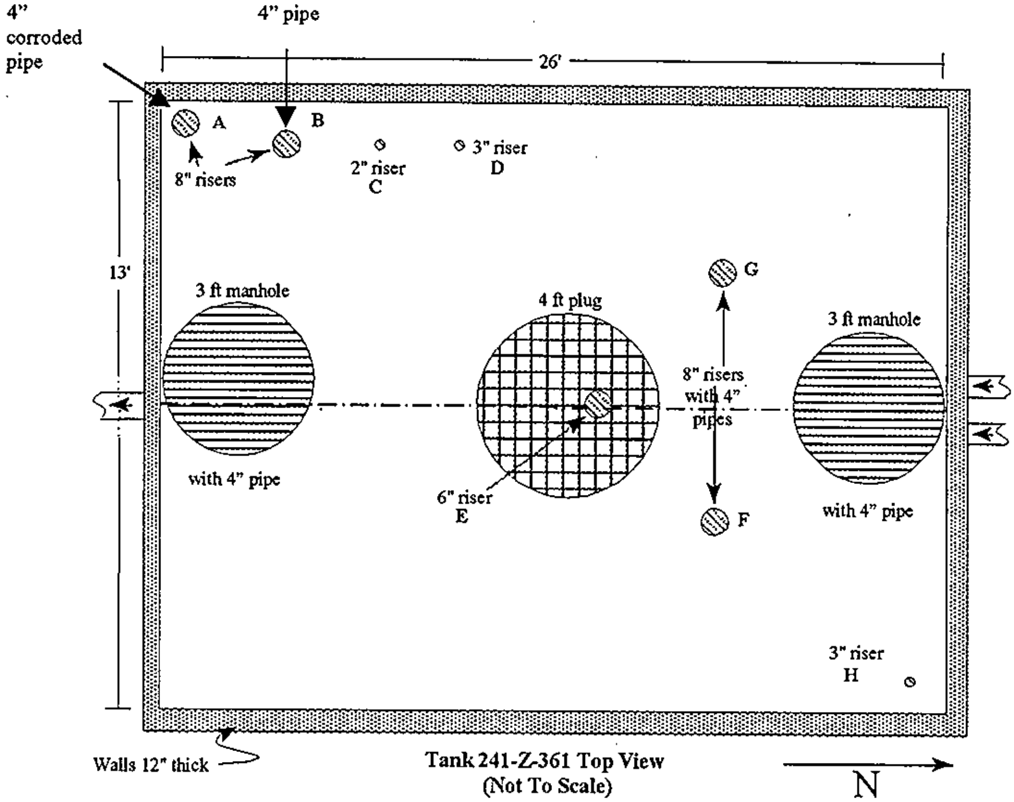


Figure 1-3. Plan View.



Photographs of the tank taken in 1975 (PHMC 1999) showed the inside of the tank, including walls and the surface of the sludge. It appeared at that time that the steel liner had corroded from the walls of the tank above the surface of the sludge. Pieces of the plastic waterproofing material are hanging down, exposing the concrete.

1.4 TANK CONTENTS

The following discussion provides an overview of the processes that contributed to the tank sludge. The discussion covers a review of process knowledge and includes a preliminary evaluation of the likely constituents of potential concern (COPCs).

1.4.1 General

Tank 241-Z-361 was in service from 1949-1973. In 1975, all but approximately 800 L (210 gal) of the supernate was pumped from the tank and the tank was isolated. The tank was sealed in 1985 to prevent gas-phase communication with the surface. The tank contents are expected to include constituents from nearly all of the Plutonium Finishing Plant (PFP) processes from its operating life span. The sludge is expected to be dominated by the non-water soluble components of effluent from Buildings 234-Z, 236-Z, and 232-Z. The sludge is believed to contain between 26 and 75 kg of plutonium (Freeman-Pollard 1994). This same document suggests a probable inventory of 26.8 kg. An assessment of material unaccounted for estimated the tank contents as 31.2 kg plutonium (Lipke et al. 1997). The same document presented a criticality evaluation based on the core and bottle samples taken. This evaluation concluded that a criticality event was unlikely under the conditions existing in the tank. A recent review of the tank conditions, based on current knowledge of tank contents and conservative assumptions, has confirmed that a criticality event in Tank 241-Z-361, while not entirely incredible, is highly unlikely during the planned characterization activities. The planned activities include collection of core samples using the tools and equipment specified in this SAP. Following completion of characterization activities, criticality hazards will be re-evaluated using the results of sludge analysis to support selection and evaluation of remedial alternatives. While the tank was in use, the contents were neutralized by adding fly ash, and later sodium hydroxide, to raise the pH to 8-10. Liquid samples collected in March of 1975, however, had a pH as low as 4. It is assumed that the pH will be greater than 2, which will render the plutonium mostly insoluble.

Documentation about the individual chemical processes at Z-Plant are sketchy. Although records describing the finishing process and the reclamation process for the radionuclides, especially plutonium, are quite complete, any discussions about additives like organic reagents and solvents are very limited. Large volumes of water were discharged through Tank 241-Z-361; however, soluble components should have been washed away and future additions of water to the tank would not dissolve the plutonium or other solids (Jones 1997).

Two approaches were used to assess the COPCs within Tank 241-Z-361. The first approach involved a review of existing documents; the second looked at specific waste streams. These approaches and the results of the analysis are described below.

1.4.1.1 Historical Documents. Several historical documents were reviewed to obtain a better understanding of the operations at the PFP. Summaries of these documents are provided below:

- *History and Stabilization of the Plutonium Finishing Plant (PFP) Complex, Hanford Site* (Gerber 1997).

  Gerber (1997) provides a historical view of operations at Z-Plant and includes references to particular chemicals used. However, the individual waste streams and the flow of these waste streams are not addressed. For the chemical constituents, this document appears to be largely based on the Aggregate Area Management Study (AAMS) Report (DOE-RL 1992).

- *Tank 241-Z-361 Process and Characterization History* (Jones 1997).

  Jones (1997) interviewed operations personnel from Z-Plant and used historical documents, where available, such as laboratory books, notes, memos, etc., to specify the operations and waste that potentially discharged to Tank 241-Z-361. Jones provides a list of known and suspected chemicals in the sludge.

- *Z-Plant Source Aggregate Area Management Study Report* (DOE-RL 1992).

  The AAMS Report (DOE-RL 1992) lists specific waste streams from each location and provides as much detail about the contents of the waste streams as possible. It appears, however, that historical documents, such as those used in Jones (1997), were not incorporated in the AAMS report. This oversight contributed to the discrepancies noted and discussed below in Section 1.4.1.2.

- *Inventory of Chemicals Used at Hanford Site Production Plants and Support Operations (1944-1980)* (Klem 1990).

  Klem (1990) consists of tables of chemicals used at the Hanford Site and lists these by locations. A list for Z-Plant is included.

For the characterization DQO (BWHC 1999), the chemical compounds listed in each of the above documents were combined in one final list. Table 1-1 presents the list of compounds known or suspected to be present in the sludge of Tank 241-Z-361.

Table 1-1. Known and Suspected Compounds in Sludge of Tank 241-Z-361. (3 Sheets)

CAS #	Constituent
120-82-1	1,2,4-Trichlorobenzene
64-19-7	Acetic acid
67-64-1	Acetone
2243-76-7	Alizarin yellow
134-32-7	alpha-Naphthylamine
7429-90-5	Aluminum
7440-35-9	Americium
86954-36-1	Americium-241
7664-41-7	Ammonia
I16	Ammonium oxalate
7440-38-2	Arsenic
7440-39-3	Barium
71-43-2	Benzene
7440-41-7	Beryllium
7440-69-9	Bismuth
7440-42-8	Boron
24959-67-9	Bromide
115-40-2	Bromocresol purple
L2	Bulk oil
7440-43-9	Cadmium
58-08-2	Caffeine
7440-70-2	Calcium
1333-86-4	Carbon
56-23-5	Carbon tetrachloride
3812-32-6	Carbonate
R1	Cation exchange column
R2	CAW waste stream, aque, org.
7440-45-1	Cerium
7440-46-2	Cesium
10045-97-3	Cesium-137
16887-00-6	Chloride
67-66-3	Chloroform
11104-59-9	Chromate
7440-47-3	Chromium
7440-48-4	Cobalt
7440-50-8	Copper
135-20-6	Cupferron
124-18-5	Decane

Table 1-1. Known and Suspected Compounds in Sludge of Tank 241-Z-361. (3 Sheets)

CAS #	Constituent
78-46-6	Dibutylbutylphosphonate (DBBP)
107-66-4	Dibutylphosphate (DBP)
75-71-8	Dichlorodifluoromethane
R3	Di-n-butly phosphoric acid
16984-48-8	Fluoride
7440-55-3	Gallium
302-01-2	Hydrazine
14280-30-9	Hydroxide
7553-56-2	Iodine
7439-89-6	Iron
L4	Karo syrup
8016-28-2	Lard oil
7439-92-1	Lead
7439-93-2	Lithium
7439-95-4	Magnesium
14333-14-3	Manganate
7439-96-5	Manganese
7439-97-6	Mercury
667-56-1	Methanol
7439-98-7	Molybdenum
R4	Monobutyl phosphate
71-36-3	n-Butanol
112-40-3	n-Dodecane
7440-02-0	Nickel
7440-03-1	Niobium
7697-37-2	Nitrate
14797-65-0	Nitrite
112-80-1	Oleic acid
338-70-5	Oxalate
144-62-7	Oxalic acid
76-01-7	Pentachloroethane
7723-14-0	Phoshorus
14265-44-2	Phosphate
7440-06-4	Platinum
7440-07-5	Plutonium
I125	Plutonium-238
I126	Plutonium-239
R5	Plutonium-240

Table 1-1. Known and Suspected Compounds in Sludge of Tank 241-Z-361. (3 Sheets)

CAS #	Constituent
9003-53-6	Polystyrene
7440-09-7	Potassium
100-21-0	p-Phthalic acid
7440-13-3	Protactinium
7440-14-4	Radium
7440-16-6	Rhodium
7440-21-3	Silicon
7440-22-4	Silver
7440-23-5	Sodium
10098-97-2	Strontium-90
NA17	Sugar
14808-79-8	Sulfate
14265-45-3	Sulfite
63705-05-5	Sulfur
7440-25-7	Tantalum
13494-80-9	Tellurium
25167-20-8	Tetrabromoethane
127-18-4	Tetrachloroethylene
326-91-0	Thenoyltrifluoro acetone
125-20-2	Thymolphthalein
108-88-3	Toluene
126-73-8	Tributylphosphate (TBP)
25549-16-0	Tri-iso-octylamine
77-86-1	Tris (hydroxymethyl)amino methane
7440-33-7	Tungsten
7440-61-1	Uranium
13968-55-3	Uranium-233
13966-29-5	Uranium-234
57-13-6	Urea
R6	used anion exchange resins
1330-20-7	Xylene
7440-66-6	Zinc
7440-67-7	Zirconium

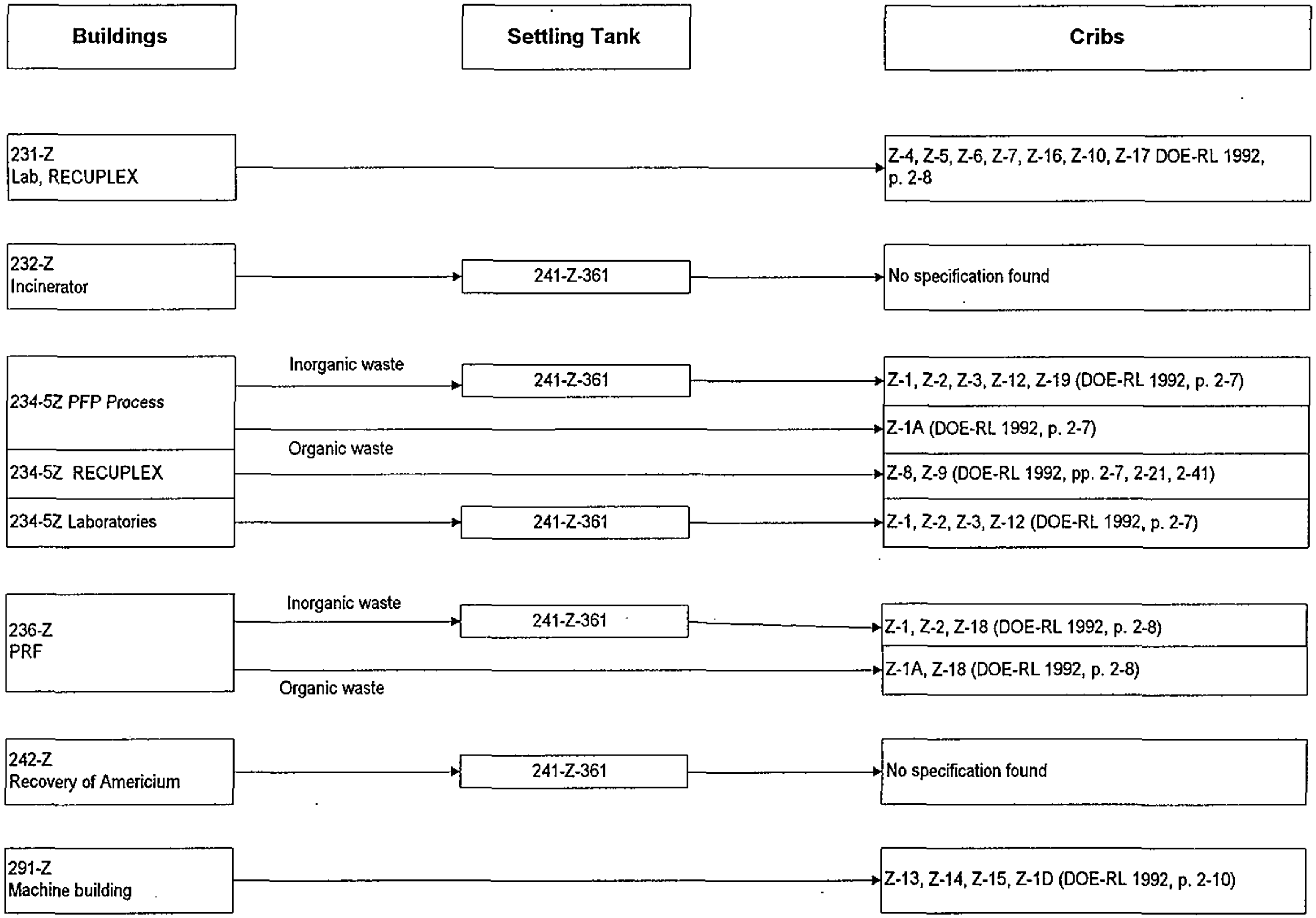
CAS # = chemical abstract services number or unique identifier used in database

1.4.1.2 Waste Streams at Z-Plant. A second approach to compiling a list of COPCs used Jones (1997) and other historical documents to clearly identify the specific waste streams from each building. This analysis indicates that some process waste streams were not discharged into Tank 241-Z-361 (Figure 1-4). This approach indicates a much smaller expected volume of certain organic constituents in the sludge than if the entire organic process waste stream were assumed to be discharged into the 241-Z-361 settling tank. Because all of the laboratory waste was discharged into the 241-Z-361 settling tank and the laboratories tested the individual processes (finishing and reclamation) on a benchscale, the same types of organics were discharged through the tank as were generated from process activities. Therefore, elimination of a process waste stream from the total list of known and suspected compounds makes no difference on the number of COPCs, only on the expected concentrations. Because steam-jetting was used to move material from facilities to the settling tank, often over long distances, the effect on the volatile constituents present in the tank sludge is unclear.

Several facilities in the vicinity of the PFP (234-5Z) may have contributed to the sludge in Tank 241-Z-361. PFP was built in 1948 and began processing plutonium in mid-1949. The incinerator (232-Z) operated from December 1961 until May 1973. The Plutonium Reclamation Facility (PRF) (236-Z) began operations in May 1964. The Waste Treatment Facility (242-Z), which reclaimed americium, operated from August 1964, until August 1976. Waste from some of these processes went through transfer lines to the Sump Tanks (241-Z-D4, 241-Z-D5, 241-Z-D7, 241-Z-D8) in Building 241-Z. Waste from Sump Tank 241-Z-D6 went to Tank 241-Z-361, while waste streams from the other sump tanks were directly discharged to the appropriate cribs, trenches, and ditches.

Any waste stream sent to Sump Tank 241-Z-D6 was routed through Tank 241-Z-361, and then sent to Cribs 216-Z-1, 216-Z-2, 216-Z-3, and 216-Z-12 (see Appendix A, Attachment A-1 of BWHC 1999). For a short time period in June 1966, Cribs 216-Z-1 and 216-Z-2 also were used as replacements for 216-Z-1A, while the tile field was changed (see Appendix A, Attachments A-2 and A-3 of BWHC 1999); however, this waste did not go through the 241-Z-361 settling tank. This interim use might account for inconsistent information in historical documents (DOE-RL 1992, Gerber 1997), which state that waste to 216-Z-1A was directed through Tank 241-Z-361.

Diagrams provided in various documents are in conflict regarding the routing of waste flow from the 241-Z-361 settling tank; however, text that supports some of these diagrams shows that Cribs 216-Z-1A and 216-Z-18 were not connected to Tank 241-Z-361 (WHC 1990 and ARHC 1968). Any waste directed to Sump Tanks 241-Z-D4, 241-Z-D5, 241-Z-D7, and 241-Z-D8 was directly disposed to Cribs 216-Z-1A, 216-Z-9, 216-Z-11, and 216-Z-18 and did not pass through Tank 241-Z-361.



RECUPLEX = facility for recovery of uranium and plutonium by extraction

Figure 1-4. Flow Diagram for Process Wastes.

The different sources of waste streams illustrated in Figure 1-4 are described individually below:

- **231-Z**. Any operations in Building 231-Z, including the early RECUPLEX operations, discharged to cribs north of the 234-5Z building, and the waste was not directed to Tank 241-Z-361.

- **232-Z**. The incinerator in Building 232-Z processed plutonium-contaminated solid waste in preparation for plutonium recovery. The building also housed equipment used for supporting operations such as off-gas treatment and leaching. The aqueous wastewater from the latter processes were discharged into Sump Tank 241-Z-D6 (see Appendix A, Attachment A-4 of BWHC 1999), and from there into Tank 241-Z-361. The waste consisted mostly of carbon, as well as used sodium hydroxide-urea scrubber solution.

- **234-5Z**. Building 234-5Z is the site of the primary PFP. From 1955 through 1962 it housed the RECUPLEX process line, which reclaimed additional plutonium from the PFP liquid and solid wastes and scraps. This building also houses the analytical and developmental laboratories. Four distinct waste streams came from Building 234-5Z: aqueous inorganic process waste from the PFP process, separate organic aqueous waste and inorganic waste streams from the RECUPLEX operations, and inorganic and organic wastes from the analytical and developmental laboratory. The PFP process waste stream included traces of plutonium and other transuranic (TRU) compounds, as well as the inorganic reagents for the finishing process. The PFP waste was directed into Sump Tank 241-Z-D6, and then on to Tank 241-Z-361. The inorganic waste stream from the process line that purified and converted plutonium nitrate solutions to other usable plutonium forms and compounds, included traces of plutonium, as well as the inorganic reagents for the conversion process. The second organic waste stream was from the reclamation process and included mixtures of tributylphosphate with carbon tetrachloride and acidic aqueous waste. The organic waste stream from RECUPLEX was discharged directly into Cribs 216-Z-8, 216-Z-9, and Tank 216-Z-8. RECUPLEX waste was not sent through Tank 241-Z-361. The analytical and development laboratories at PFP performed the benchscale processes before they were used in the fullscale operations. Constituents such as inorganic reagents, acids, organic solvents, reaction indicators, etc., should be expected in this waste stream. The waste from the laboratories was sent to Sump Tank 241-Z-D6 and discharged through Tank 241-Z-361.

- **236-Z.** The PRF, located in Building 236-Z, recovered plutonium from scrap solutions. The waste was similar to the waste from RECUPLEX; dibutylphosphate was also used. The waste from PRF operations was separated into two streams: one for inorganic process waste, one for organic solvents. The inorganic process waste stream was discharged to Sump Tank 241-Z-D6 and then to Tank 241-Z-361 (DOE-RL 1992, p. 2-8). The organic waste stream was directly discharged from the PRF to Cribs 216-Z-1A and 216-Z-18 (DOE-RL 1992, p. 2-8).

- **242-Z**. Building 242-Z housed the americium recovery process line. This process included the recovery of americium from the PFP process line. The liquid waste from the recovery process consisted of concentrated nitric acid with traces of TRU elements and metals. In addition, dibutylbutylphosphonate was used for this process. The waste from this process was discharged to Sump Tank 241-Z-D6, and then to Tank 241-Z-361.

- **291-Z**. Building 291-Z housed the ventilation exhaust fans, instrument air compressors, and vacuum pumps that handled all ventilation exhaust from Buildings 234-5Z, 236-Z, and 242-Z. Routine effluents from these facilities were non-contact cooling and condensate wastewater from heating, ventilating and air conditioning equipment, cooling water for the compressors, and vacuum-pump seal water. On at least one occasion, there is evidence that the floor drains were filled with antifreeze and then flushed directly to the regularly used trenches for this facility, not routed to the 241-Z-361 settling tank. Therefore, the presence of ethylene glycol is of no concern to the characterization of Tank 241-Z-361. This waste was discharged directly to drains 216-Z-13, 216-Z-14, and 216-Z-15 and Ditch 216-Z-1D. This waste was not routed through Tank 241-Z-361.

The analyses of process stream flow, discussed above for each PFP Facility, were used along with the information provided in the balance of this section to move from the COPC list in Table 1-1 to a final list of analytes as presented in Table 1-6.

1.4.1.3 Results of Phase I Tank Headspace Vapor Sampling and Analysis. Headspace vapor samples were collected from Tank 241-Z-361 using SUMMA® Canisters connected to tubing extended to within 12 inches of the sludge surface. The vapor samples were passed through in-line high efficiency particulate air (HEPA) filters before entering the canisters. These filters were surveyed to determine the presence of alpha- and beta-emitting nuclides. The preliminary results of the vapor samples and HEPA filter counts are shown in Table 1-2.

The organic compounds detected in the headspace vapor samples were added to the final analyte list in Table 1-7.

1.4.2 Historical Characterization Data

Historical discharge records, provided in Appendix D of Jones (1997) were used to develop a plot for cumulative discharges of plutonium to the tank from 1952 through 1972 (Figure 1-5). Discharges correspond to three distinct time frames, which are marked by slope changes in the cumulative discharge figure. Between 1952 and 1957, yearly discharges were generally less than 100 g/yr. Discharges increased dramatically between 1957 and 1965, on the order of several hundred to 1,000 g/yr, and then slowed down again between 1965 and 1972, with yearly discharges generally less than 200 g/yr. Based on these data, one could conclude that three strata exist within the tank, corresponding to distinctly different plutonium concentrations. Visual characteristics of sludge samples, however, suggest that even more strata may be present.

Table 1-2. Results of Headspace Vapor Analysis from Tank 241-Z-361.

Analyte	Concentration Reported
Freon II	0.61 ppmv
Dichloromethane	0.016 ppmv
Chloroform	1.30 ppmv
Carbon tetrachloride	0.16 ppmv
Tetrachloroethylene	2.00 ppmv
Trichloroethylene (TIC)[1]	0.9 ppmv
Acetone	0.02 ppmv
Toluene	0.007 ppmv
n-Butane	0.12 ppmv
n-Pentane	0.06 ppmv
Acetic acid	0.054 ppmv
Carbon dioxide	13,000 ppmv
Oxygen	19.2%
Total organic volatiles	4 ppmv
Combustible gases	0% LEL
Gross alpha	1.51 E-11 µCi/cc
Gross beta	1.02 E-10 µCi/cc

[1]TIC = tentatively identified compound
LEL = lower explosion limit

The plan view of the tank, presented in Figure 1-3, illustrates the various risers that have been used for sample collection. Several core samples and bottle samples were collected from the tank in 1975 and 1977. Figure 1-6 includes graphical plots of the plutonium concentrations detected in all core and bottle samples collected between 1975 and 1977. The physical description of a core sample collected in 1977 identifies twelve distinct layers, based solely on visual inspection (Jones 1997) from a "Northwest" riser. Table 1-3 provides a summary of this core description; available information does not specify the exact riser used for sample collection.

Lipke et al. (1997) presents total plutonium concentrations in wet sludge from the five different locations and timeframes plotted in Figure 1-6. Summary statistics of these data are provided in Table 1-4.

Figure 1-5. Cumulative Discharge to the 241-Z-361 Tank.

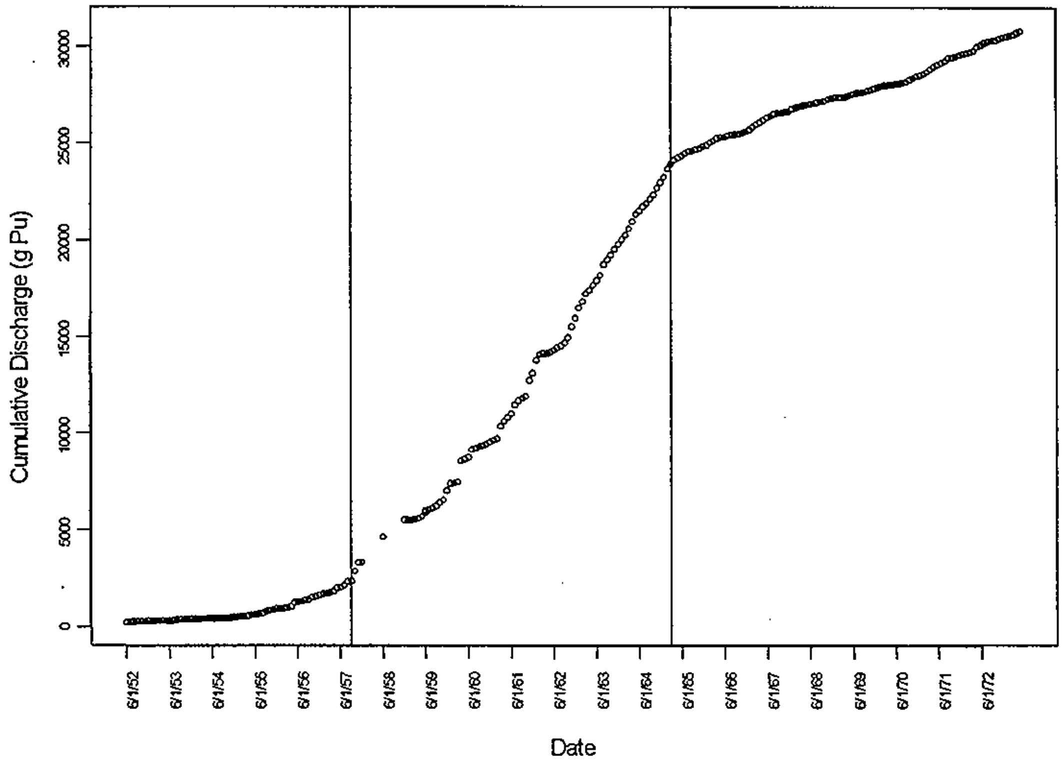
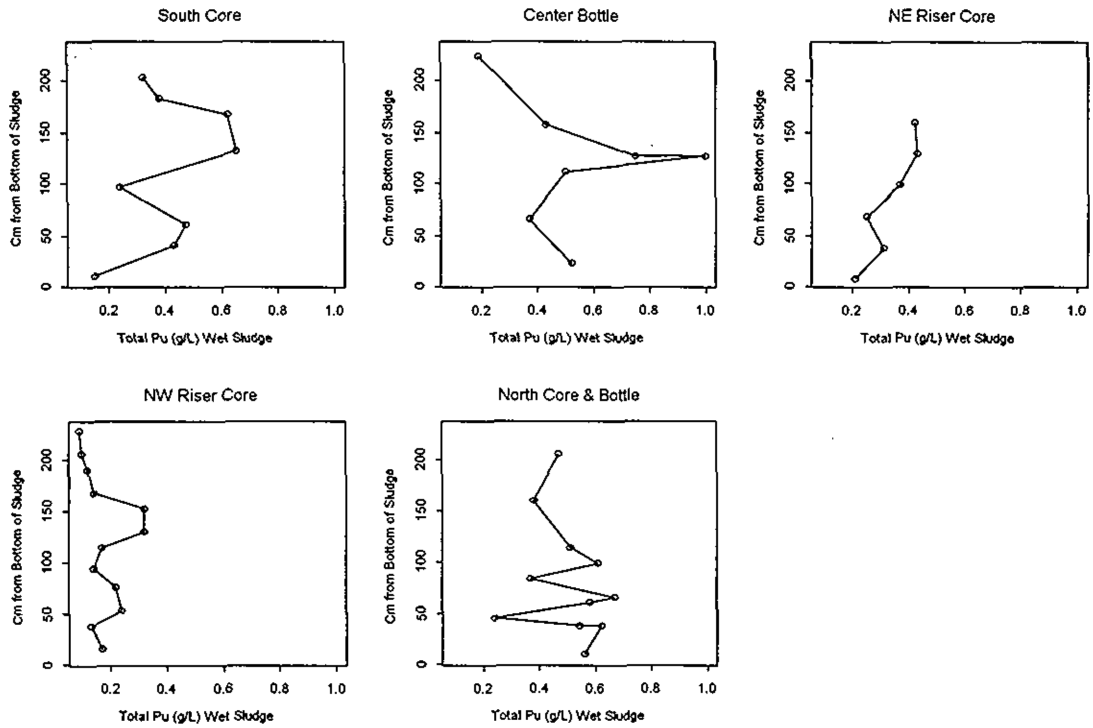


Figure 1-6. Plutonium Concentrations by Depth for Historical Data from Tank 241-Z-361.



The historical data provide no additional input to either the spatial or vertical distribution of tank solids; however, they do provide enough information to conclude that a criticality event is unlikely (Lipke et al. 1997). Based on the analysis presented in the criticality report, Lipke estimated that the tank contains between 30 and 32 kg of plutonium. The anticipated stratification and geometries make it highly unlikely that a criticality event would take place during either sampling or retrieval. Examination of worst-case geometries led to the same conclusion.

1.5 STATEMENT OF THE PROBLEM

Due to the potential amount of plutonium in the tank, it is important to understand the horizontal and vertical distribution of the waste to determine whether there is a need to expedite removal of sludge from the tank. Data are also required to evaluate worker health and safety and criticality concerns during characterization and remediation activities. The conceptual model for the Tank 241-Z-361 (Figure 1-7), puts the historical data into context with the site history and process knowledge.

Table 1-3. Northwest Riser Core Description.

Sample	Depth [a]		Sample Description [b]	Pu g/L Wet	Density (g/mL)
	in.	cm			
NW-1	6	15	Dark Brown – almost Black – loose – wet	0.17	2.08
NW-2	15	38	Color of Sample NW-1 – thicker	0.13	1.86
NW-3	21	53	Small amount of free liquid on top color of sample NW-1 – thicker than NW 2	0.24	2.17
NW-4	30	76	Dark Brown – lighter than NW-2- thinner	0.22	2.50
NW-5	37	94	Lighter color than NW-4 - very watery - thin soup	0.14	1.69
NW-6	45	114	Thicker than NW-5 - lighter color than NW-5 - gritty – sandy	0.17	1.63
NW-7	51	130	Thicker than NW-6 - dark tan color - pasty, creamy consistency	0.32	1.79
NW-8	60	152	Same as NW-7 except lighter color	0.32	2.17
NW-9	66	168	Free liquid on top – only slightly darker color than NW-8 – same consistency	0.14	1.56
NW-10	75	191	Same as NW-9	0.12	1.50
NW-11	81	206	Tan-brown; same as NW-10 – slightly darker	0.10	1.56
NW-12	90	229	Lot of liquid on top, light brown, darker than the NW-9 - NW-11 samples	0.09	1.71

[a] Depth units are inches from bottom of the sludge; depth information from Criticality Report (Lipke et al. 1997).

[b] Descriptions based on information found in PHMC (1999).

Table 1-4. Summary Statistics by Location of Historical Total Plutonium (in Wet Sludge) Data.

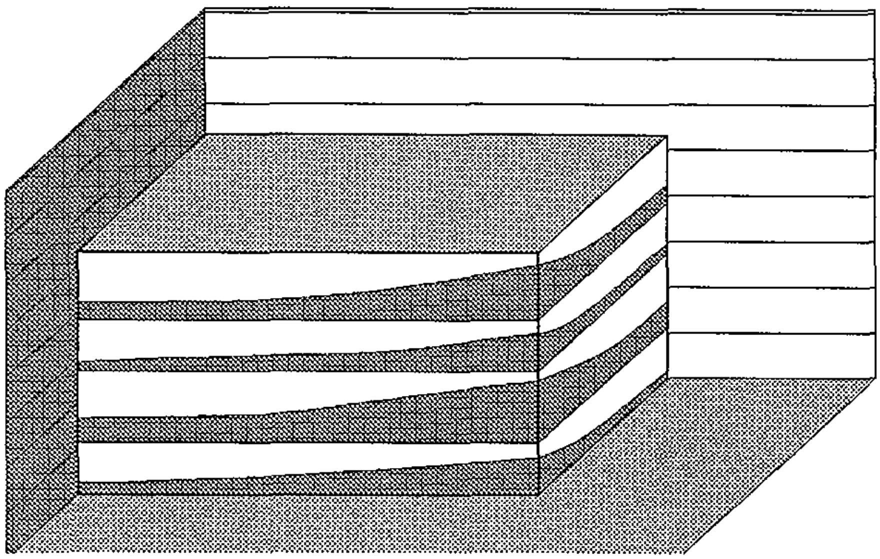
Location	Number Results	Minimum*	Average*	Maximum*	Standard Deviation
South Core	8	0.15	0.41	0.65	0.1737
Center Bottle	7	0.19	0.54	1.00	0.2649
NE Riser Core	6	0.21	0.33	0.43	0.0904
NW Riser Core	12	0.09	0.18	0.32	0.0789
North Core & Bottle	11	0.24	0.51	0.67	0.1291
Over all samples	44	0.09	0.38	1.00	0.2018

*Concentration units are g/L.

Based on process knowledge, a single-waste distribution model has been hypothesized for the sludge. A basic assumption is that the sludge is mostly undisturbed, except for the small areas near the risers that have been sampled previously by either core or bottle, or both. It is thought that the undisturbed plutonium salts are distributed in strata which correspond to historical discharge activities.

A distribution of wastes was hypothesized to support the development of the conceptual model. This distribution is illustrated by the cross section shown in Figure 1-7. The dark layers in Figure 1-7 represent the heavier plutonium salts that would have settled out of the tank influent first, followed by the lighter salts which are represented by the light layers in the figure. Because the waste stream entered the tank at a high velocity, the particulates would be transported to the center of the tank before beginning to settle out of the liquids. Therefore, the heavier plutonium salts would have mounded toward the center of the tank. The lighter salts would then have settled out more slowly, accumulating around the perimeter of the mound of plutonium salts and evening out the depth of the overall stratum. Based on discharge records and sample descriptions, between three and twelve strata are thought to be present.

Figure 1-7. Waste Distribution Model Tank 241-Z-361.



Because sample data illustrated in Figure 1-6 and Table 1-4 were collected over different time periods, it is impossible to determine whether the variability is due to time differences, location differences, or a combination of both. An analysis of variance indicated that the differences observed qualitatively are statistically significant. The differences cannot, however, be attributed specifically to either time or location because these factors are confounded. The overall conclusion from the historical data is that the conceptual model is impossible to verify based on available data.

The contents of Tank 241-Z-361 must be characterized to determine whether it is necessary to remove the sludge to resolve safety, safeguards, and environmental issues. The DOE declared an USQ for the tank in 1997 (Wagoner 1997), based on the potential for flammable gas build-up, unevaluated structural concerns, and the possibility of criticality concerns changing with time.

Process knowledge indicates that there would have been low plutonium concentrations in the wastes disposed through the tank and relatively few other radionuclides should be present (PHMC 1999). Limited sampling of the sludge indicates that plutonium is distributed within strata throughout the tank; however, this distribution is somewhat heterogeneous and ill-defined. Characterization data, therefore, are required to evaluate the need for an early removal action and, as required, to determine the appropriate methods for (1) removal of the sludge from Tank 241-Z-361, (2) stabilization and packaging of the waste, and (3) sludge disposal. Additional data may be required during the implementation of any agreed-upon removal process or to support removal of the sludge in a non-expedited time frame.

Specific problems that must be resolved in order to support this characterization are summarized below:

Problem Statement #1. *Existing characterization information indicates a potential need for an early CERCLA removal action; however, available data are limited and do not reflect current conditions.*

Problem Statement #2. *Insufficient data are available to determine whether a criticality, chemical, or safeguards concern could arise during remedial actions.*

Problem Statement # 3. *Sufficient characterization data are not available to ensure worker safety during remedial actions.*

Problem Statement # 4. *Available data are not adequate to assess early retrieval, treatment, and disposal options.*

1.6 DECISIONS

The DQO (BWHC 1999), which provides the basis for this SAP, includes a development of decision statements and discussion of decision rules that determine how the data generated from sludge characterization will be used. These decisions are discussed in the following section.

1.6.1 Decision Statements

Decision statements are generally phrased in terms of a resolution to the problem statement(s) and will define the performance criteria for the DQO. Table 1-5 presents a summary of the decision statements for sludge characterization. Remedial action decisions will be made by EPA based on action recommendations by DOE.

Table 1-5. Decision Statements.

DS	Description
#1	Determine whether a CERCLA early action (e.g., removal or interim action) is required. Considerations for early action include, but are not limited to, tank instability, criticality, chemical hazards and safeguards and security issues.
#2	Determine whether the inventory poses a potential criticality, chemical, or safeguards issue during removal or treatment.
#3	Determine the precautions necessary to ensure worker safety during removal and disposal or treatment, based on sludge characterization.
#4	Determine the set of viable alternatives for sludge retrieval, treatment, and disposal or other options, based on characterization data.

Decisions are numbered to correspond to the problem statements.

DS = decision statement

1.6.2 Decision Rules

The primary action levels of concern are those required to meet environmental, safety, and safeguards regulations applicable to retrieving and disposing of waste in Tank 241-Z-361. These criteria are identified in Tables 2-4 and 2-5. If action levels are exceeded, the following decisions will be made:

1. If the data indicate a potential hazard, the sludge will be removed from the tank under CERCLA authority for early removal. This decision will be based on the following considerations:

   a. If visual observations or load testing results indicate concerns over tank stability, the sludge will be removed from the tank.

b. If the minimum criticality concentration for plutonium is exceeded, a criticality recovery plan will be prepared and implemented. For a tank inventory of 30 kg plutonium or less, the minimum critical concentration was estimated to be greater than or equal to 4.7 g/L of plutonium (Lipke et al. 1997).

c. If analyses indicate hazardous constituents are present in the sludge in concentrations that present a potential for explosion or that would facilitate the migration of other constituents from the tank in the event of a release, the sludge will be removed. These analyses will be performed based on the data collected from vapor samples before and during coring activities, and from preliminary analysis of core sample constituents.

d. Although safeguards action levels themselves do not trigger a removal, concentrations of plutonium will determine the safeguards category for management of the sludge, both in the tank and during remediation. Criteria for categorizing the sludge, as contained in DOE Order 5633.3B and the onsite *Material Control and Accountability Plan* (PHMC 1997a), will be applied based on the analytical results.

2. If the inventory of the tank presents a concern because of potential criticality, chemical hazard, or safeguards associated with the removal, treatment, or disposal processes, procedures will be implemented to eliminate potential hazards. Concerns will be based on the potential for action levels, as described above, to be exceeded during removal.

3. If sludge analysis indicates unanticipated concerns based on radiation levels or chemical constituents, then industrial hygiene procedures will be adjusted to ensure worker safety.

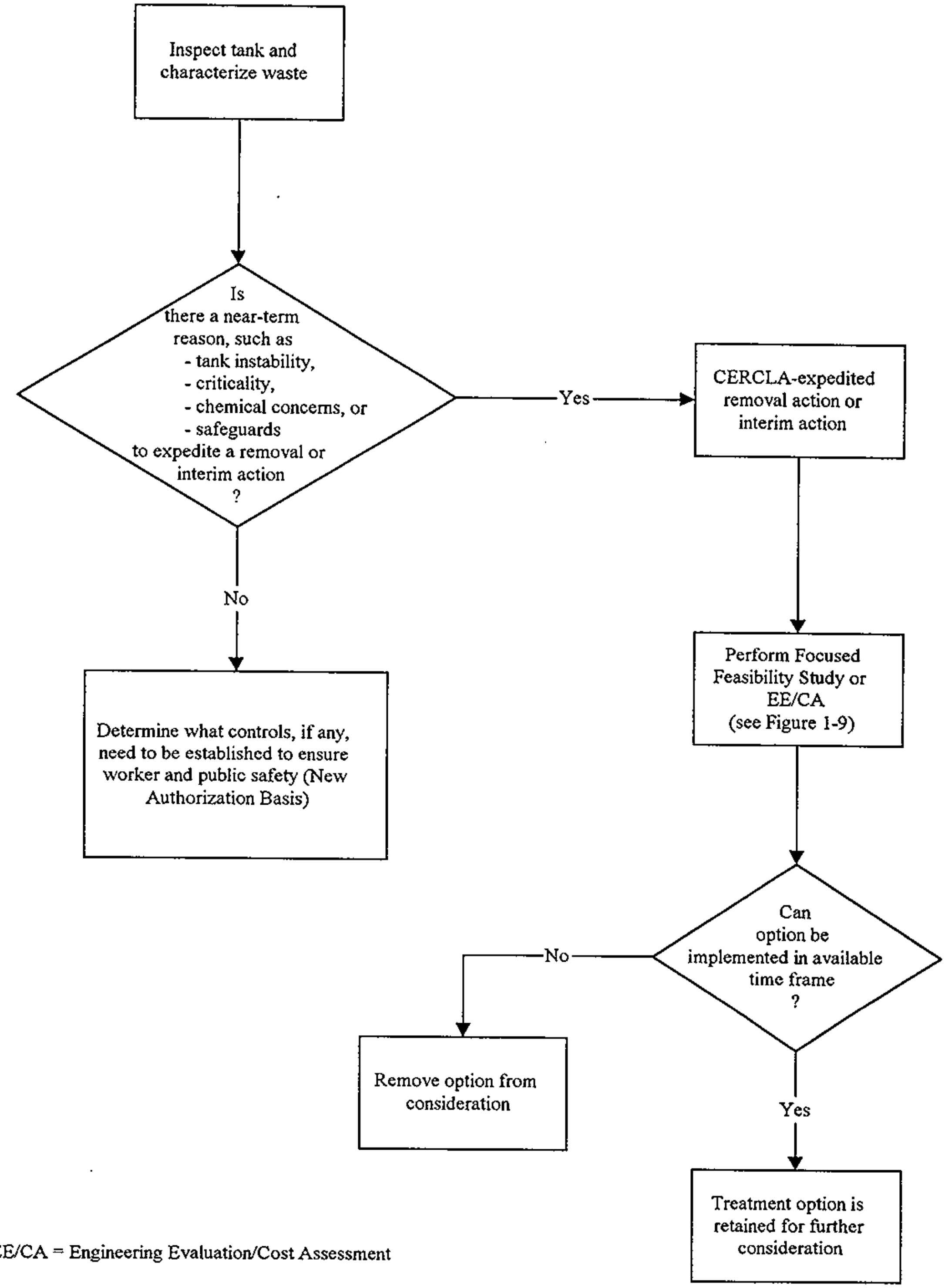
4. a. If dangerous waste limits are exceeded, including requirements for corrosivity or reactivity, the waste cannot be disposed of at the Environmental Restoration Disposal Facility (ERDF) without additional treatment. The type and feasibility of treatment required will depend on the amount by which regulatory action levels are exceeded.

   b. If the TRU material levels in the sludge suggest that the TRU package transporter (TRUPACT-II) fissile gram equivalent quantity limits for shipment will be exceeded, then the removal and treatment process will be adjusted to ensure that shipping criteria are met.

5. If either the analysis for total cyanide or for the determination of total sulfides indicates a concentration above the regulatory thresholds (250 ppm reactive cyanide, 500 ppm reactive sulfide), the BWHC Project Manager will be contacted and a decision will be made on whether to develop the appropriate method for Tank 241-Z-361 specific matrix.

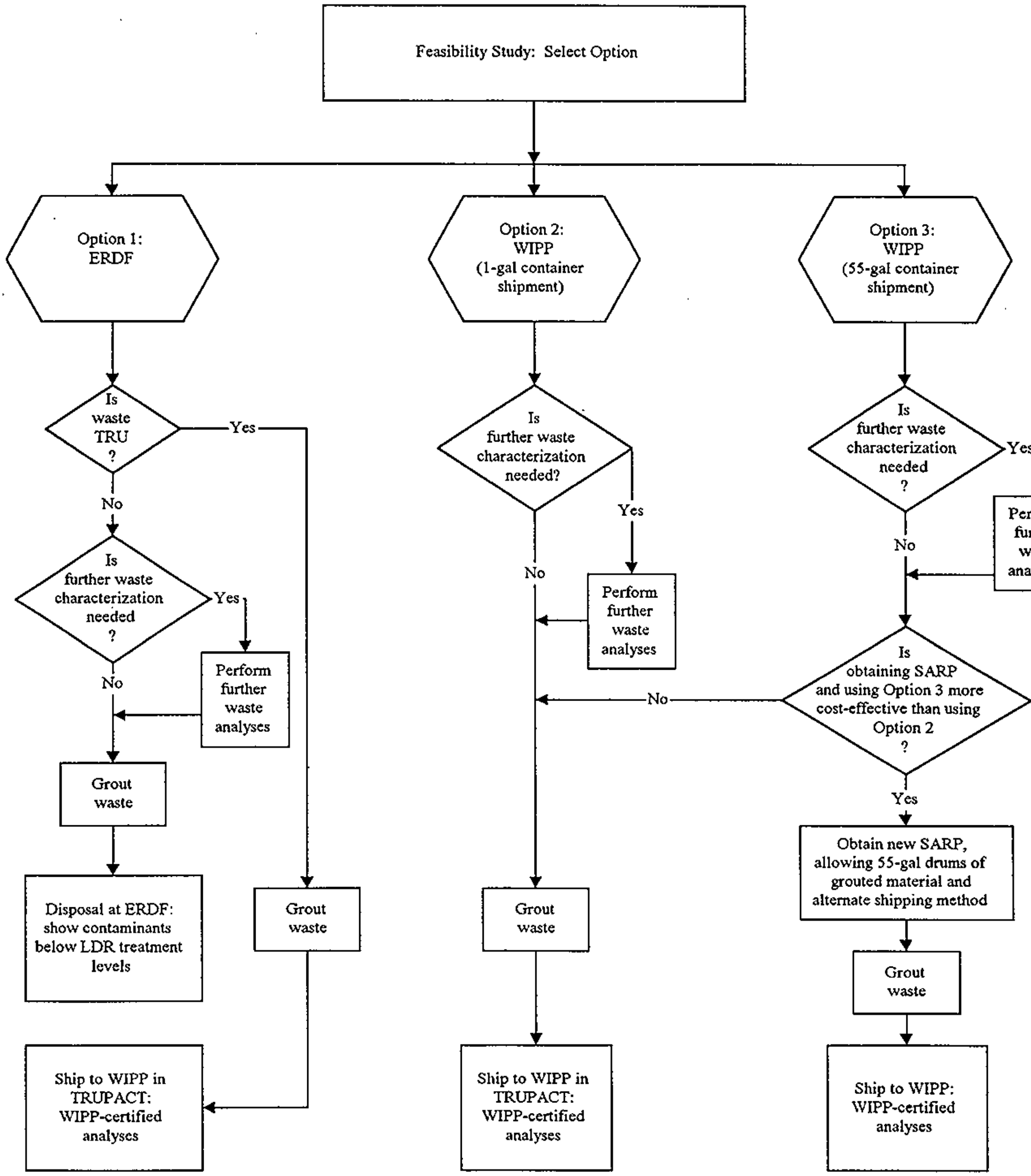
Figure 1-8 presents a logic diagram for determining the need for an early removal action. Figure 1-9 presents the logic for selecting among the disposal alternatives.

Figure 1-8. Logic Control Diagram for Tank 241-Z-361.



EE/CA = Engineering Evaluation/Cost Assessment

Figure 1-9. Disposal/Treatment Options (if removal of tank contents is required).



LDR = land disposal restriction
SARP = Safety Analysis Report for Packaging
WIPP = Waste Isolation Pilot Plant

1.7 REQUIRED DATA

This section describes the data and other information that will be required to address the decisions described above. Table 1-6 presents a summary of this information.

Table 1-6. Decision Inputs.

Decision	Input
#1. Determine whether a CERCLA early removal action is required. Considerations for early removal include, but are not limited to, tank instability, criticality, chemical hazards and safeguards and security issues.	• TRU content (plutonium, americium) • Structural integrity • Mobility of chemicals to and in groundwater • Safeguards category
#2. Determine whether the inventory poses a potential criticality, chemical, or safeguards issue during removal or treatment.	• Concentration of TRU material • Ratio of TRU material to neutron absorbers • Geometry and water content of the sludge and radionuclides • Combination of compounds in sludge that create chemical reactions • Safeguards category
#3. Determine the precautions necessary to ensure worker safety during removal and disposal, based on sludge characterization.	• Activity levels • Flammable gas levels in the tank headspace • Nature and concentrations of chemical constituents • OSHA requirements
#4. Determine the set of viable alternatives for sludge retrieval, treatment, and disposal based on characterization data.	• Plutonium content (weight percent) • pH • % moisture • specific gravity • TDS • total carbon, total organic carbon • titration for hydroxide • particle size/particle size distribution • whole rock analysis • salts • RCRA constituent concentrations • Headspace gas analysis

OSHA = Occupational Safety and Health Administration
RCRA = *Resource Conservation and Recovery Act of 1976*
TSD = total dissolved solids

1.7.1 Regulatory Inputs

The management and disposal of the waste within Tank 241-Z-361 is being addressed under CERCLA as a past-practice facility. Actions taken under CERCLA must comply with the substantive requirements of other laws that are considered to be applicable or relevant and appropriate requirements (ARARs); however, the administrative aspects of ARARs generally are not required to be fulfilled. ARARs for the sludge removal include, for example, characterization and handling of the waste under RCRA and control of emissions of hazardous air pollutants and toxic air pollutants under the *Clean Air Act*. Disposal of TRU radionuclide constituents at the Waste Isolation Pilot Plant (WIPP) are regulated by the U.S. Nuclear Regulatory Commission and managed by DOE; the conditions for disposal of TRU waste are set out in the waste acceptance criteria for WIPP. Overviews of the primary ARARs are provided below

The WIPP has been designated as the location for disposal of TRU wastes generated by atomic energy defense activities. The WIPP waste acceptance criteria (DOE 1996) designate nuclear properties criteria and requirements for materials that are shipped to and disposed at the WIPP. These include, but are not limited to, the following relevant criteria:

- Fissile or fissionable radionuclide content, in terms of plutonium-239 fissile gram equivalent, of contact-handled TRU waste payload containers shall be no greater than 200 g per 55-gal drum or 325 g per standard waste box or 325 g per ten drum overpack maximum. (DOE 1996, §3.3.1.1.)

- Untreated, contact-handled TRU waste shall not exceed 80 plutonium equivalent curies (PE-Ci) of activity per 55-gal drum or 130 PE-Ci of activity per standard waste box. Untreated, contact-handled TRU waste in 55-gal drums may contain up to 1,800 PE-Ci of activity if overpacked in standard waste boxes or ten drum overpacks. Fifty-five-gallon drums containing solidified/vitrified contact-handled TRU waste shall not exceed 1,800 PE-Ci of activity per drum. (DOE 1996, §3.3.2.1.)

- Documentation must show that chemicals, if present, in CH-TRU mixed waste are listed in Tables 5.1 through 5.6 of Appendix 1.3.7 of the TRUPACT-II SARP (DOE 1998). A chemical compatibility analysis has been performed for the chemicals in these tables and ensures that these wastes meet the requirements for operations, TRUPACT-II, and environmental compliance. (DOE 1996, §3.4.3.4.)

In addition, U.S. Department of Transportation regulations for shipping hazardous and radioactive materials are incorporated in the packaging criteria for shipping containers. The packaged sludge must be analyzed to ensure compliance with these criteria. Sludge characterization must provide preliminary data to support these analyses.

The primary issues of concern under RCRA are characterization of the sludge to determine (1) whether it contains listed waste, (2) the presence and concentration of constituents that are regulated under the land disposal restriction (LDR), and (3) classification of RCRA characteristic properties.

If the sludge contains listed waste(s), then retrieved sludge in any form can only be disposed of at a RCRA-regulated hazardous waste disposal facility. If the sludge were to be disposed in place, the presence of listed wastes could present additional regulatory concerns (e.g., permitting of the site for waste disposal). Sludge that is disposed of at ERDF or WIPP does not need to be concerned with delisting because these facilities can accept RCRA waste; however, EPA will require consideration of the listed waste issue as a part of the record of decision (ROD) for this site. DOE has determined that there is a potential for RCRA wastes with the F001, F002, and F003 codes for listed wastes to be present in the sludge.

LDR limits are incorporated in the waste acceptance criteria for ERDF. Therefore, the LDR constituent limits will be a concern for waste that is designated for disposal at that facility. The waste must be characterized to identify the presence of LDR constituents if it is to be shipped to WIPP. As with the listed wastes issue, LDR concerns must be addressed to support EPA documentation for the action memorandum and the ultimate ROD, depending on the selected action.

The process sludge also must be evaluated to determine the appropriate RCRA waste code(s), if applicable, and any RCRA characteristic properties prior to shipment to ERDF or WIPP. The sludge must be evaluated to determine whether it meets the RCRA criteria for toxicity, using the Toxicity Characteristic Leaching Procedure (TCLP) (EPA 1997a). RCRA has established constituent-specific TCLP limits for 40 contaminants.

1.7.2 Inputs Considered and Dismissed

Several potential areas of regulatory authority were considered as ARAR and determined to be not relevant for this project. These include specific aspects of the Washington State air pollution control regulations (*Washington Administrative Code* [WAC] 173-460).

Based on process history, all indications are that the concentrations of any regulated air pollutants will be well below the levels of concern. The activities conducted under Hill et al. (1998) will characterize vapors in the tank headspace before the sample program described in this SAP is implemented. During the collection of samples for sludge characterization, additional vapor samples will be collected and analyzed. If the results of these vapor samples indicate a basis for concern over air emissions, the application of air regulations will be re-evaluated.

Based on process history, the waste is not expected to exhibit dangerous waste characteristics of ignitability, corrosivity, or reactivity. Residual liquids were pumped from the tank in 1975. Operating history for the tank indicates that the wastes received by the tank had pH values well within the range of 2 to 12.5; samples of liquid remaining in the tank in 1974 indicated a pH of 6.0 and a specific gravity of 1.001. Any liquid remaining in the tank is expected to exhibit the same pH characteristics as those liquids previously disposed. Although photographs obtained two years after the tank ceased operation show the tank liner is severely corroded, most of the corrosion likely occurred early in the life of the tank. Due to tank flushing and caustic additions to adjust the pH of the tank, the remaining waste is expected to be less corrosive.

Process knowledge indicates that the waste in Tank 241-Z-361 should not exhibit any of the dangerous waste characteristics. Nevertheless, data will be collected to address some of these issues as part of reactivity safety issues for processing. Corrosivity, for example, could be an issue for shipment to the WIPP; therefore, pH analysis is included in the list of analytical parameters.

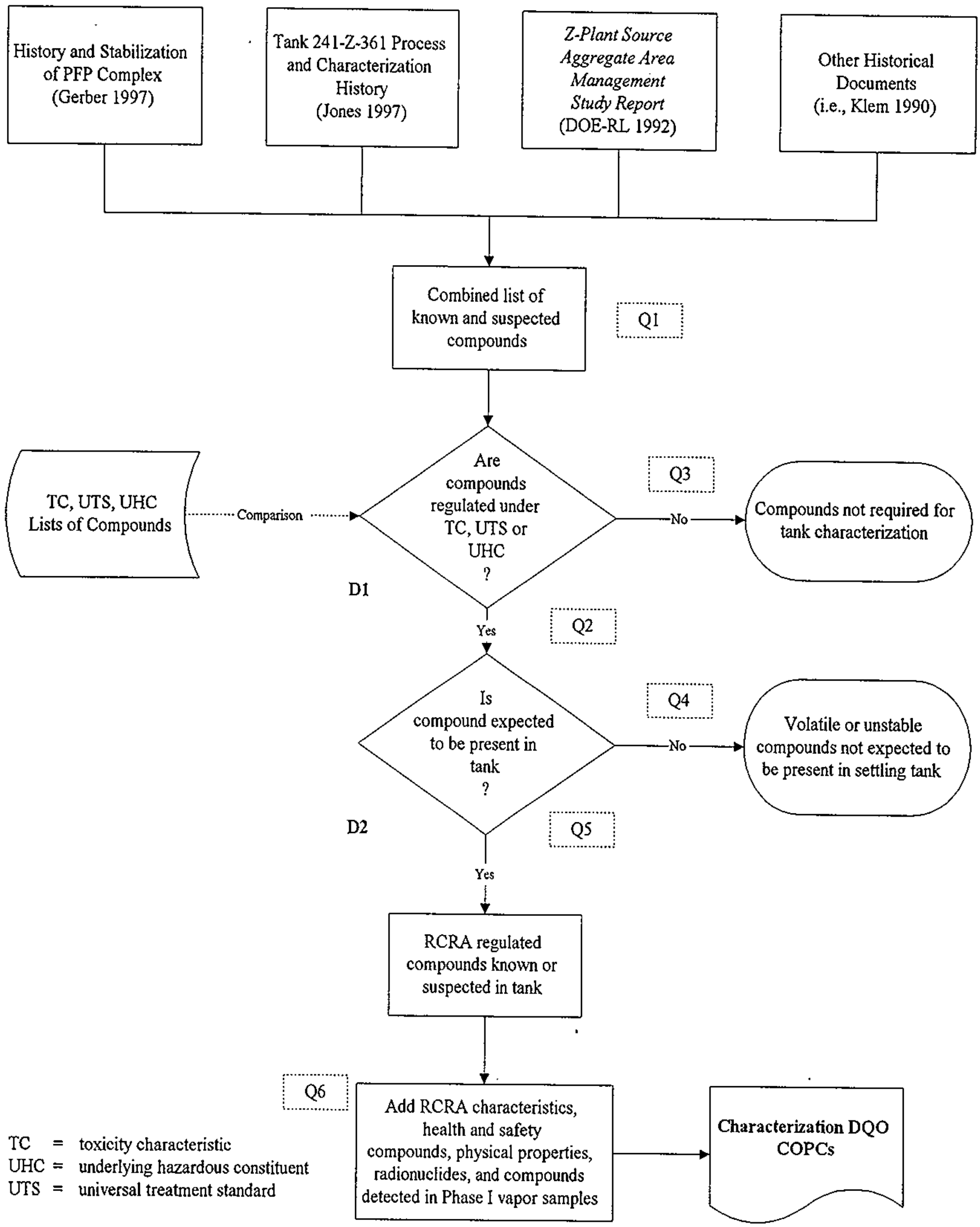
1.7.3 Analyte Selection Process

Historical information was first reviewed, then used as a basis to select analytes; Table 1-1 represents those analytes anticipated to be present in the sludge, based on process knowledge. Additional analyses may be required in order to meet specific regulatory requirements or to provide adequate characterization to meet waste acceptance criteria for disposal facilities. Project staff compiled a database to screen analytes against process knowledge and regulatory needs. Figure 1-10 illustrates the logic process used for evaluating specific candidate analyses. Each decision in the process is identified with a "D" and each database query is identified with a "Q." The figure and following text reference both decisions and queries, as applicable. All comparisons in the database are based on unique identifiers for each compound. Usually, this identifier is the chemical abstract services number (CAS#). In some cases, however, CAS#'s do not exist and a unique identifier was assigned to the compound to enable comparison of compounds. The database tables with the query results are presented in Appendix D (which includes a cross-reference matrix for query numbers and table numbers) of the Tank 241-Z-361 sludge DQO (BWHC 1999).

1.7.3.1 Logic Description. Five basic steps can be identified in the analyte selection process. Each step is described in detail in the following sections:

- Combination of known and suspected compounds (Section 1.7.3.2)
- Consolidation into the associated ions and metals for the inorganic compounds (Section 1.7.3.3)
- Separation of regulated compounds from non-regulated compounds under the criteria of the DQO (BWHC 1999) (Section 1.7.3.4)
- Evaluation of volatility and/or stability of compounds (Section 1.7.3.5)

Figure 1-10. Characterization Data Quality Objective Analyte Selection Process.



TC = toxicity characteristic
UHC = underlying hazardous constituent
UTS = universal treatment standard

Addition of RCRA characteristics, health and safety compounds, physical properties, and radionuclides as necessary for the decision process of the DQO (BWHC 1999) (Section 1.7.3.6).

1.7.3.2 Combination of Known and Suspected Compounds. This step has been described in Section 1.4. Table 1-1 is the result of this combination

1.7.3.3 Ionic Speciation. Organic compounds retain their form in different matrices. Inorganic compounds, however, can be combined in a multitude of chemical structures, and each chemical structure has its own specific CAS#. Nonetheless, analytical methods for an inorganic compound will look for the ionic form. Therefore, to enable the comparison of inorganic compounds in regulatory requirements against tank inventories, the inorganic compounds are identified as their associated ions and metals. This step was applied to the combined compounds and resulted in a unique list of 109 known and suspected compounds (Figure 1-10, Q1).

1.7.3.4 Comparison. The original 109 compounds from Figure 1-10 (Q1) were compared against regulated compounds from the toxic characteristics, underlying hazardous constituent, and universal treatment standard lists. This comparison identified 86 compounds that are not regulated (Figure 1-10, Q3), leaving 23 compounds that are regulated for further evaluation.

1.7.3.5 Stability Evaluation. The next evaluation step was to consider the environment for these regulated compounds and how these compounds were transferred to the settling tank. Transfer occurred via jet-steaming through the transfer lines. When the tank was initially opened in 1975, one could observe steam rising from the tank. It is very likely that the highly volatile organic compounds, such as Freon, were lost during transfer. Less volatile compounds and volatile compounds that are heavier than water could remain in the tank sludge.

The compound dichlorodifluoromethane (a Freon) was removed from further consideration due to the high volatility of this compound (Figure 1-10, Q4). Freon has a boiling point of –29.8 °C. This left 22 RCRA compounds known or suspected to be present in the settling tank sludge.

1.7.3.6 Constituents of Potential Concern. From the analyte selection logic, 22 organic compounds remained. Analyses required to evaluate for RCRA characteristics, health and safety concerns, to meet WIPP waste acceptance criteria, compounds detected in tank vapor samples collected in Phase I, and required radionuclide and physical parameters were added to create the complete list of COPCs, as presented in Table 1-7. Table 1-7 also identifies the driver for including the compound for analysis.

Table 1-7. List of Contaminants of Potential Concern with Driver for Analysis. (2 Sheets)

CAS #	Constituent	Required by Regulatory Driver	Required for Treatment Options	Required RCRA Parameters	Required for H&S
127-18-4	1,1,2,2-Tetrachloroethene[a]	X			
120-82-1	1,2,4-Trichlorobenzene	X			
67-64-1	2-Propanone (Acetone)[a]	X			
71-43-2	Benzene[a]	X			X
56-23-5	Carbon tetrachloride[a]	X			X
67-66-3	Chloroform[a]	X			
78-46-6	Dibutylbutylphosphonate				X
107-66-4	Dibutylphosphate				X
75-09-2	Dichloromethane	X			
71-36-3	n-Butanol[a]	X			X
76-01-7	Pentachloroethane[a]	X			
100-21-0	p-Phthalic acid	X			
108-88-3	Toluene[a]	X			
126-73-8	Tributylphosphate				X
79-01-6	Trichloroethylene	X			
75-69-4	Trichloromonofluoromethane	X			
1330-20-7	Xylene[a]	X			
7429-90-5	Aluminum		X		
7440-38-2	Arsenic	X			
7440-39-3	Barium	X			
7440-41-7	Beryllium	X			
7440-43-9	Cadmium	X			
7440-70-2	Calcium		X		
7440-47-3	Chromium	X	X		
7439-89-6	Iron		X		
7439-92-1	Lead	X			
7439-95-4	Magnesium		X		
7439-96-5	Manganese		X		
7439-97-6	Mercury	X			
7440-02-0	Nickel	X			
7440-07-5	Plutonium		X		
7440-09-7	Potassium		X		
7440-21-3	Silicon		X		
7440-22-4	Silver	X			
7440-23-5	Sodium		X		
63705-05-5	Sulfur			X	
7440-32-6	Titanium		X		
7440-61-1	Uranium		X		
7440-66-6	Zinc	X			

Table 1-7. List of Contaminants of Potential Concern with Driver for Analysis. (2 Sheets)

CAS #	Constituent	Required by Regulatory Driver	Required for Treatment Options	Required RCRA Parameters	Required for H&S
7440-67-7	Zirconium		X		
86954-36-1	Am-241		X		
I102	Np-237		X		
10098-97-2	Sr-90		X		
I125	Pu-238		X		
I127	Pu-239/240		X		
I209	Pu-241		X		
I1661	Tc-99		X		
15117-96-1	U-235		X		
I194	U/Pu-238		X		
7664-41-7	Ammonia[a]				X
16887-00-6	Chloride		X		
57-12-5	Cyanide			X	
16984-48-8	Fluoride	X			
	Nitrite/Nitrate		X		
14265-44-2	Phosphate		X		
14808-79-8	Sulfate			X	
ALK	Titration for hydroxide		X		
PARTDIS	Particle size distribution		X		
PARTSIZ	Particle size		X		
MOIST	percent moisture		X		
PH	pH			X	
TDS	Total dissolved solids		X		
SPG	Specific gravity (SpG)		X		
TOTALA/ TOTALB	Total Alpha (AT)/Total Beta (TB)		X		
TC	Total carbon		X		
TOC	Total organic carbon (TOC)		X		
WRA	Whole rock analysis[b]		X		

[a]Vapor sample will be checked for analyte; if detected listed analysis will be performed.
[b]The metals necessary for the Whole Rock Analysis are included in this table.

H&S = Health and Safety

Physical properties of the waste, for example, particle size, particle size distribution, pH, percent moisture, and specific gravity were added to support process evaluation. In addition, because vitrification has been proposed as a treatment option, the following compounds and parameters were added to the list of COPCs:

- aluminum,
- calcium,
- chloride,
- chromium,
- iron,
- manganese,
- nitrate,
- potassium,
- silicon,
- sodium,
- titanium,
- total carbon,
- total organic carbon, and
- whole rock analysis.

The whole rock analysis is a geological analysis of the oxide concentration for a range of metals.

The Health and Safety Plan (Hill et al. 1998, Appendix C) requires analyses for specific volatile compounds, such as the following:

- dibutylphosphate,
- dibutylbutylphosphonate,
- tributylphosphate,
- n-butyl alcohol, (n-butanol)
- benzene,
- carbon tetrachloride, and
- ammonia.

Should any of these compounds be detected during the vapor sampling, then the detected compound will be added to the final list of COPCs and will be analyzed for in the sludge sample.

It is known that the tank sludge will contain uranium, plutonium, and americium. For the purpose of criticality evaluation and worker safety, the following radionuclides and parameters were added:

- americium-241,
- plutonium-238,
- plutonium-239/240,
- uranium-235,
- uranium-238/plutonium-238,
- technetium-99,
- total plutonium,
- total uranium,
- total alpha, total beta
- neptunium-237,
- strontium-90, and
- plutonium-241.

Although the WIPP waste acceptance criteria include analysis for isomers of xylene, total xylene analysis of headspace gases and supernate is already being conducted to meet the other regulatory requirements. If the total xylene analysis indicates levels of concern, analysis will be performed for the individual isomers.

The tank sludge and tank supernate will be evaluated for reactivity. This procedure requires analyses for reactive cyanide and reactive sulfide; however, these methods are sensitive to concentrations of hydroxide, which exist in large amounts in Hanford Site tanks. Therefore, the waste will be analyzed for total cyanide, total sulfur and sulfate. By subtracting the detected concentrations of sulfate from the concentration of the total sulfur, the remaining concentration is an indication of the amount of total sulfide. If the total sulfide is below the regulatory requirement of 500 ppm, then the concentration of reactive sulfide also will be below the required level. The same approach is taken with reactive cyanide: if the total cyanide concentration is below the limit of 250 ppm, then reactive cyanide is well below the limit.

1.8 DATA UNCERTAINTY

The available historical data are not of the required data quality to support a statistically based sampling design for this project. Random selection also is not possible because the sampling locations available are limited to the locations of the risers. Therefore, the sampling design is not statistically based.

Once the data are collected, the degree to which the conceptual model is supported by data can be assessed. Summary statistics and confidence intervals, or other statistics may be calculated to support the expedited action, criticality, and worker safety decisions. This data collection effort will provide information to determine the feasibility of certain retrieval and treatment options. Additional data may be required to support a retrieval and/or treatment alternative. The types of error and their relation to the statistical analyses that will take place once data are collected are summarized below.

There are two types of decision error associated with hypothesis testing. One is mistakenly concluding that the action limits have been met, the other is mistakenly concluding that the action limits have not been met. Mistakenly concluding that the action limits have been met is, in other words, deciding that the sludge is "acceptable," when, in fact, it is not acceptable. Mistakenly concluding that the action limits have not been met is the converse position. Clearly, assuming the sludge is "acceptable" when it is really unacceptable is the more severe error for all of the decisions put forth in this SAP.

Once an acceptable probability of error is specified, an appropriate confidence interval can be calculated so that the probability of error is no greater than the acceptable level. A 10% error tolerance for mistakenly concluding the wasted is acceptable, as established in SW-846 (EPA 1997a), will be used, along with 90% upper confidence limits for the means. If either the sample mean or the 90% upper confidence limit for an analyte is greater than the action limit, the waste will be determined as unacceptable.

Sampling error and variance between strata normally contribute a larger portion of error than the laboratory error. No data are available to assess the variance between strata and to assess the contribution of laboratory versus sampling/stratum error components. An evaluation at 40% of the action limit was selected for initial evaluation and may be altered, depending on the actual error results measured.

Table 1-8 summarizes the acceptable error tolerance rates associated with this project.

Table 1-8. Summary of Acceptable Error Tolerance Rates.

Type of Error	Tolerable Error Rate	Concentration where Error Rate is Evaluated
Mistakenly concluding action limits are not met.	10%	The sample mean for each COPC
Mistakenly concluding action limits are met.	20%	40% of the action limits, as stated in Tables 2-2 through 2-5.

1.9 CORE AND VAPOR CORE SAMPLING DESIGN

Based on the previous steps, core sampling and analysis will be performed. The following sections present basic information regarding the design of the sampling and analysis strategy. Details of the sampling methods (e.g., specific procedure numbers, air sampling, and added details of analysis) will be presented in this SAP.

1.9.1 PUSH CORE SAMPLING

Based on the available information on the internal configuration of Tank 241-Z-361, the scope of sludge characterization to be completed during Phase II activities include the following activities:

1. Collect a minimum of one full depth core sample from Riser E, located in the approximate center of the tank. One additional core will be collected from either riser F or G.

2. Supplement the full depth core sample with the following investigative techniques as found appropriate following examination of the tank risers:

   a. Non-destructive analysis techniques if the pipes extending into the sludge are confirmed to be dry wells and are in an acceptable condition for insertion of down-hole probes.

   b. Supplemental partial core samples collected through the other risers if the pipes are determined to be movable such that they can be displaced to allow insertion of the core sampling equipment.

   c. Supplemental partial core samples collected through the pipes extending into the sludge if it is determined that the pipes are open at the bottom and do not extend through the full thickness of the sludge in the tank.

The need for any further characterization of the tank sludge will be evaluated based on the criteria shown in Figures 1-11 and 1-12. The decision to collect more data in the immediate future will be based on the level of confidence in the concentration and distribution of radionuclides in the sludge provided by the Phase II characterization. The logic behind this decision is that the primary environmental and safety issue for the contents of Tank 241-Z-361 is resolution of the concern for the potential for a criticality event related to the tank contents. Other issues (e.g., hazardous waste characteristics, and the presence of hazardous waste constituents) are secondary to the criticality assessment and supplemental data needs related to these other issues could reasonably be filled at a later date (e.g., during actual removal of the sludge from the tank).

The core segments are 48 cm (19 in.) long with a 6.5 cm^2 (1 in^2) diameter cross-section, which results in approximately 320 mL (480 g) of sample volume/mass. For purposes of planning, five segments are estimated full depth. This will be adjusted depending on the actual depth of the waste. The sludge will be cored to the bottom of the tank or to refusal. Previous sampling in 1975 and 1977 indicated that the sludge had a consistency similar to peanut butter; therefore, it is unlikely refusal will occur before reaching the tank bottom.

1.9.2 Potentially-applicable Non-destructive Analyses

BWHC has identified several down-hole logging techniques that are available at Hanford and are directly applicable to examination of Tank 241-Z-361 if the pipes are, in fact, dry wells. These techniques include the following:

1. Passive Gamma Logging. This analytical technique can detect low concentrations of plutonium-239 and americium-241.

2. Thermal Neutron Capture Gamma Logging. This technique can detect and quantify several elements of interest, including hydrogen, nitrogen, aluminum, iron, calcium, sodium, chlorine, cadmium, and plutonium.

3. Neutron-Neutron Moisture Logging. This technique can quantify moisture content of the sludge.

By collecting logging data in a series of small depth increments, a relatively high-resolution profile of sludge characteristics may be generated using a combination of all three available down-hole techniques. The ability to apply these tools to Tank 241-Z-361 will be confirmed after the risers are opened and inspected. The requirements for application of the down-hole techniques are as follows:

1. The pipes must be clean and dry and closed at the bottom; and
2. The pipes must have an inside diameter of at least 10.16 cm (4 in.).

Combined with at least one full-depth core sample, this approach could potentially provide a higher confidence in the description of the nature and distribution of critical constituents within the sludge than the collection of a smaller number of full thickness core samples.

Following examination of the risers and internal pipe configuration, the BWHC Project Manager and DOE will prepare a detailed recommendation for use of supplemental investigation techniques. This recommendation will be submitted to EPA.

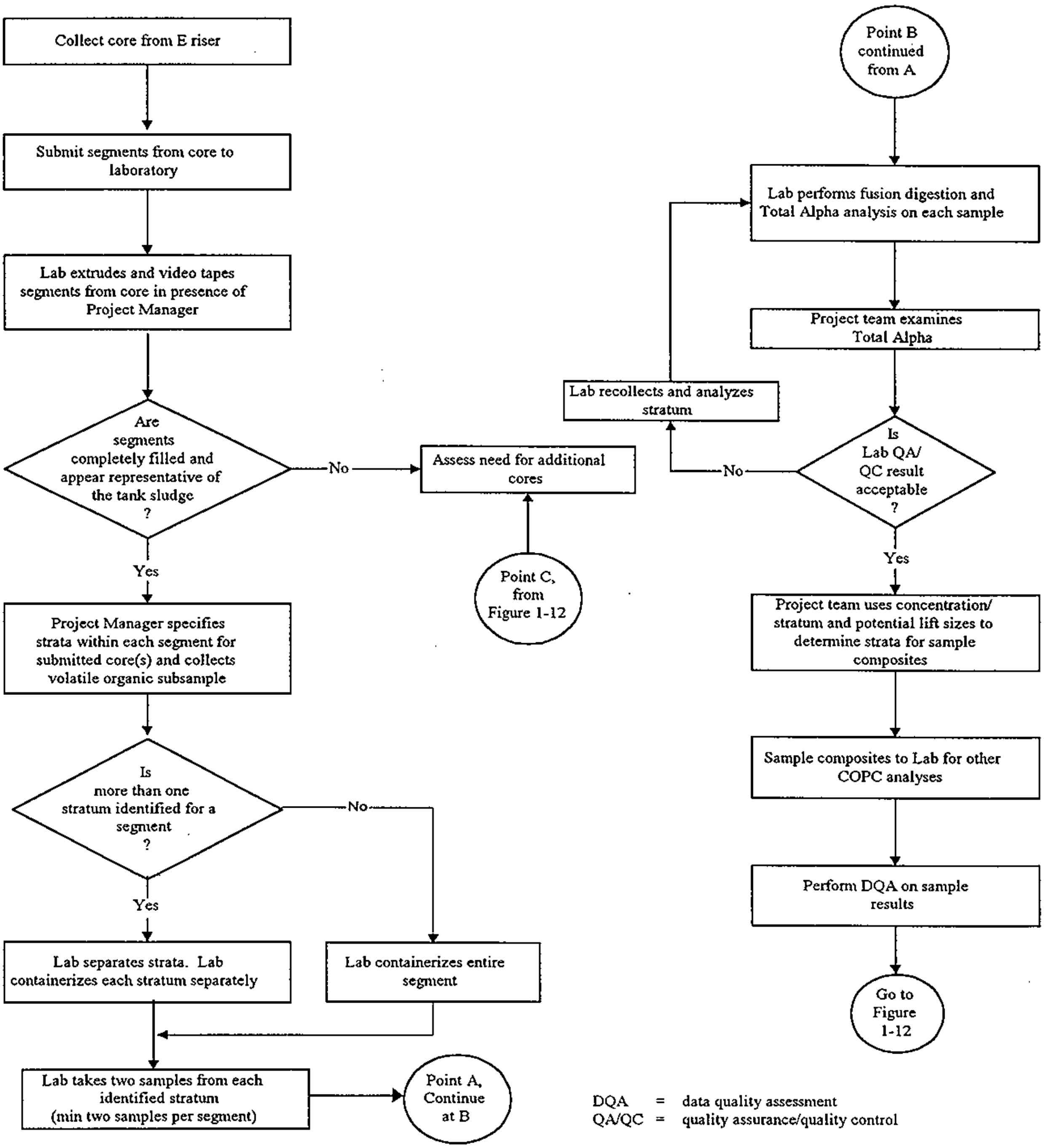
1.9.3 Initial Alpha, Tank Headspace, and Volatile Analyses of Sludge and Supernate

Two subsamples from each stratum established for two cores will be collected for total alpha analysis. The total alpha result will be used to determine whether significant TRU material exists in any given stratum and to answer the USQ (Wagoner 1997). The information will also be used to guide compositing of the visual strata for subsequent additional radiological and non-radiological analyses. For planning purposes, four strata from each segment are assumed, with five segments per core for two cores and two total alpha analyses per stratum, for a total of 80 samples.

Tank vapor samples will be collected from two sampling events: (1) the initial opening of the tank, described in the Hill et al. (1998), and (2) during the core sampling process. For any analytes for which a positive detection is observed in the tank headspace analysis from either event, a volatile purge and trap analysis of the sludge will be performed in the laboratory. The volatile purge and trap analysis was selected as opposed to the actual sludge analysis or extraction because the high plutonium activity would require significant dilution of the sludge to allow it to be analyzed; this would increase detection levels to a degree that makes the results useless. Plutonium can extract into many organic solvents and a methanol extraction prior to volatile analysis is the SW-846 methodology (EPA 1997a) often used. This extraction does not selectively separate the organics from the plutonium; therefore, the headspace analysis is the best approach. Details of the method are presented in this SAP.

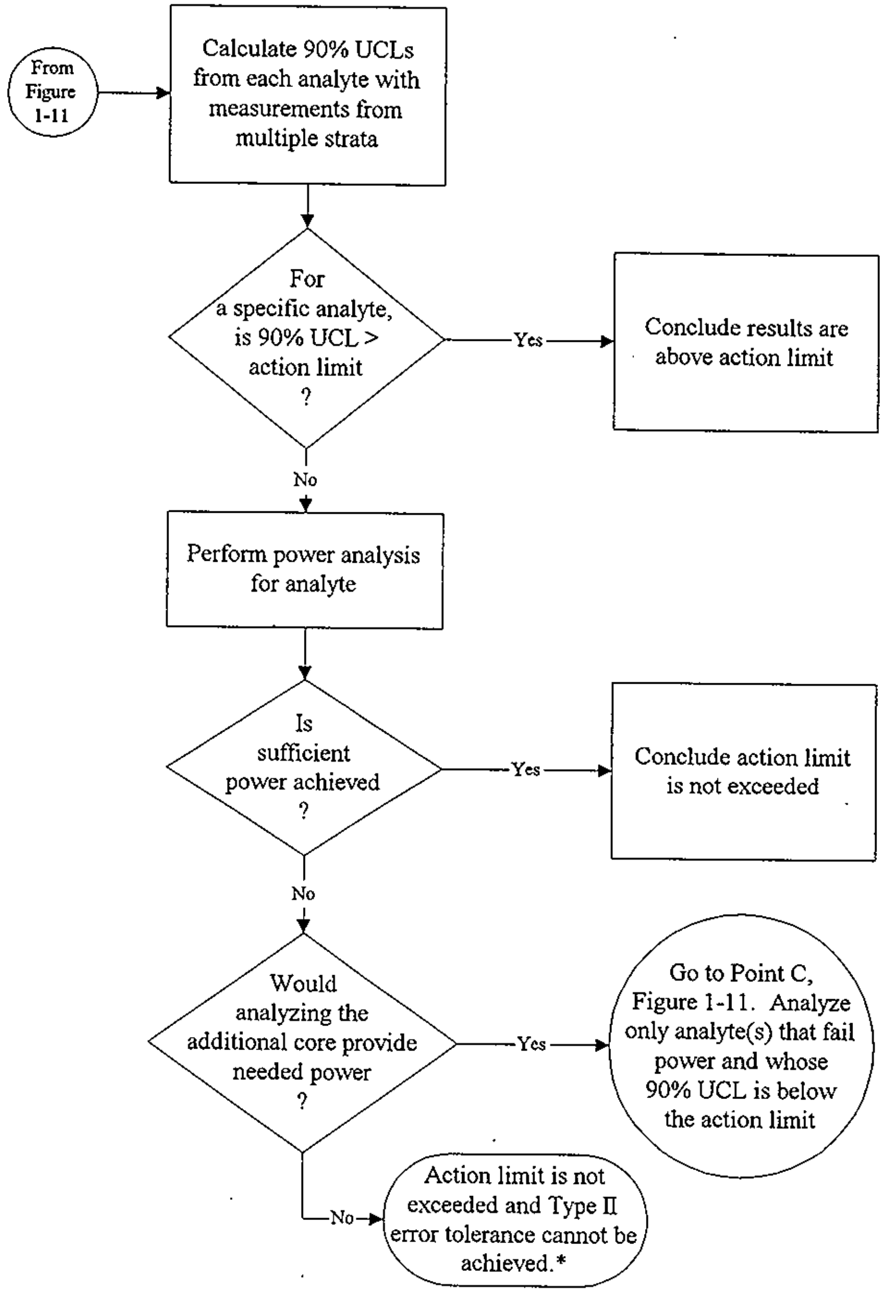
One volatile analysis per segment will be performed if the tank vapor analysis indicates detectable volatiles. Volatile headspace analysis will be performed of aliquots from any visible stratum that may appear oily or likely to contain organics. In addition to the volatile analysis of the sludge samples, volatile headspace analyses will be performed on one supernate sample from each core for a total of two headspace analyses. If multiple bottles of supernate are collected, one will be randomly selected for volatile analyses before compositing. Section 2.0 describes the sampling and analysis design in detail.

Figure 1-11. Stratum Identification Compositing Approach.



DQA = data quality assessment
QA/QC = quality assurance/quality control

Figure 1-12. Decision Error Assessment



*The null hypothesis is that sludge exceeds the action limit. If the statistical analysis determines that the action limit is not exceeded, then the null hypothesis is rejected. Enough samples were collected to detect a difference, given the sample mean and action limit. Type II error is generally not evaluated in this instance because enough information has been collected to make a decision. If the sample mean is less that the concentration at which Type II error should be evaluated, the achieved Type II error can be calculated; however, it is not necessary.

2.0 FIELD AND LABORATORY ACTIVITIES

Field activities to support the characterization of the contents of Tank 241-Z-361 include the following:

- Collection of Sample Cores
- Collection and Analysis of Vapor Samples Taken During Coring
- Packaging and Transport of Sample Cores to Laboratory
- Analysis of Samples.

2.1 TASK OBJECTIVES

The objectives of this SAP are to collect data that will allow an assessment of the presence and concentration of radioactive, organic, and inorganic contaminants of concern within the sludge that is currently located in Tank 241-Z-361. Objectives for specific subtasks are described in the following sections.

2.2 FIELD WORK AREA AND RISER PREPARATION

Field work area and riser preparation will be accomplished before the initiation of the tasks described in this SAP. The activities required to complete these tasks are described elsewhere and are outside the scope of this SAP.

2.3 CORE SAMPLING

It is estimated that five 48-cm (19 in.) segments will be collected for a full depth core. Cores will be collected by push method using River Protection Project (RPP) sampling truck number 1. Setup and core sampling at Tank 241-Z-361 will be conducted using new procedures TO-020-454 and TO-080-505. The push mode core sampling method developed for use in the Hanford tanks under the RPP program is functionally analogous to the collection of split spoon soil samples from a hollow stem auger. Although the sampling trucks and associated equipment are sophisticated systems that have been designed specifically for this application and are fabricated to very tight tolerances, the basic principle is similar to typical soil sampling practices. This section describes the steps in the collection and transport of samples. The preferred method for core sample collection closely follows the current tank farm sampling practices (Section 2.3.1). An alternate, but similar, approach may be implemented if field conditions indicate the need for additional contamination control measures (Section 2.3.2).

2.3.1 Core Collection

Figure 2-1 shows a generalized schematic drawing of the truck, bridge, riser, and push mode sampling equipment in place over the tank. A wind break constructed from plastic sheet may be used around the truck and ramps as needed. The sequence of events planned to collect sample core segments from Tank 241-Z-361 using the preferred method is presented conceptually in the simplified schematic drawings in Figures 2-1 through 2-5 and is described in the following narrative. Figure 2-6 shows schematic drawings of the operation of a typical waste sampler.

The truck that will be used at Tank 241-Z-361 is capable of rotary core sampling; however, for this activity, it will be operated in the push mode only. This practice differs from typical soil sampling. Instead of rotating the drill string, as with a hollow stem auger, the entire drill string, with the sampler in place at the lead end of the string, is pushed straight down into the material being sampled. As the sampler is advanced into the waste material, the pintle rod, and piston assembly (see Figure 2-6) is held static as the sampler is filled with the waste material. When the desired depth is reached (i.e., the length of the sampler or up to 48 cm [19 in.]), the ball valve at the lower (i.e., inlet) end of the sampler is closed by withdrawing the pintle rod which causes the ball valve to rotate to the closed position. The sampler is then slowly withdrawn from the tank through the hollow drill string pipe using the remote latching unit. The waste sample is kept enclosed within the sampler by the closed ball valve on the inlet end and the piston in the upper portion of the sampler.

As noted above, the sampler is withdrawn slowly to reduce the likelihood of drawing sludge into the drill pipe as the sampler is withdrawn. In addition, an aqueous solution of lithium bromide (LiBr) in a specified concentration (nominally 0.3M) is typically added to the inside of the drill string to maintain hydrostatic head inside the drill pipe and minimize intrusion of the tank waste material into the drill string while the sampler is removed. The objective of adding the fluid is to maintain a head of liquid in the drill string sufficient to counterbalance the hydrostatic pressure of the waste to minimize migration of waste into the drill string. If used, a sample of the LiBr solution will be collected prior to core sampling and again whenever a new batch of solution is prepared, and submitted to the laboratory for analysis with the samples. The results of the LiBr solution analysis will be used to account for the possible presence of the solution in the waste sample by comparing the relative concentration of lithium and bromide in the solution to the lithium and bromide concentrations in the samples.

The sampler is withdrawn from the drill string directly into a shielded sample receiver on the truck. The sample receiver was designed for use in sampling high level radioactive waste tanks at Hanford to minimize exposure to the high levels of beta and gamma radiation typically associated with those wastes. The waste material in Tank 241-Z-361 is not expected to exhibit significant beta/gamma activity. The truck deck rotates to align the receiver with the onsite transfer cask (OTC) and the receiver then mates directly to the OTC which is used for sample

Figure 2-1. Simplified, Preferred Method Schematic of Sampling Truck in Place Over Tank 241-Z-361. Ready to Push First Sample (not to scale).

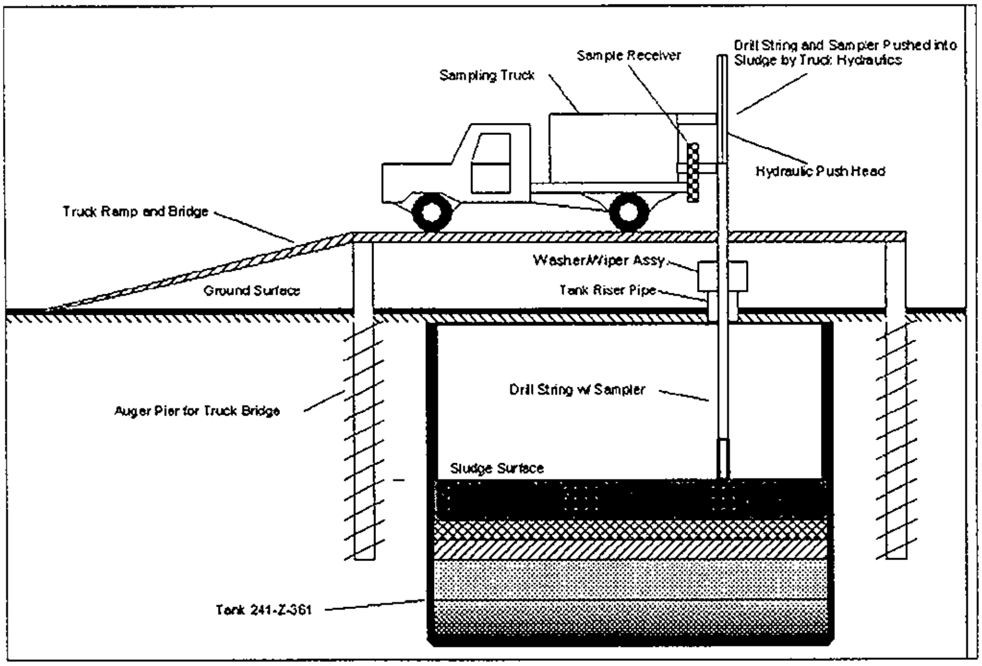


Figure 2-2. Simplified, Preferred Method Schematic of Sampler with First Sample Being Removed from Tank (not to scale).

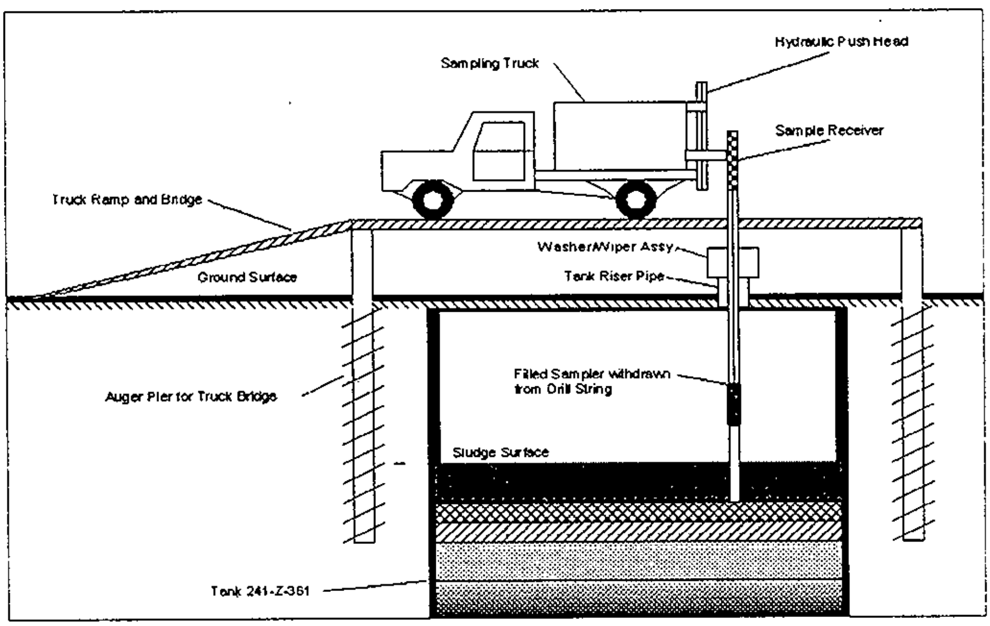


Figure 2-3. Simplified, Preferred Method Schematic of Drill String with New Sampler Ready to Push Second Sample Interval (not to scale).

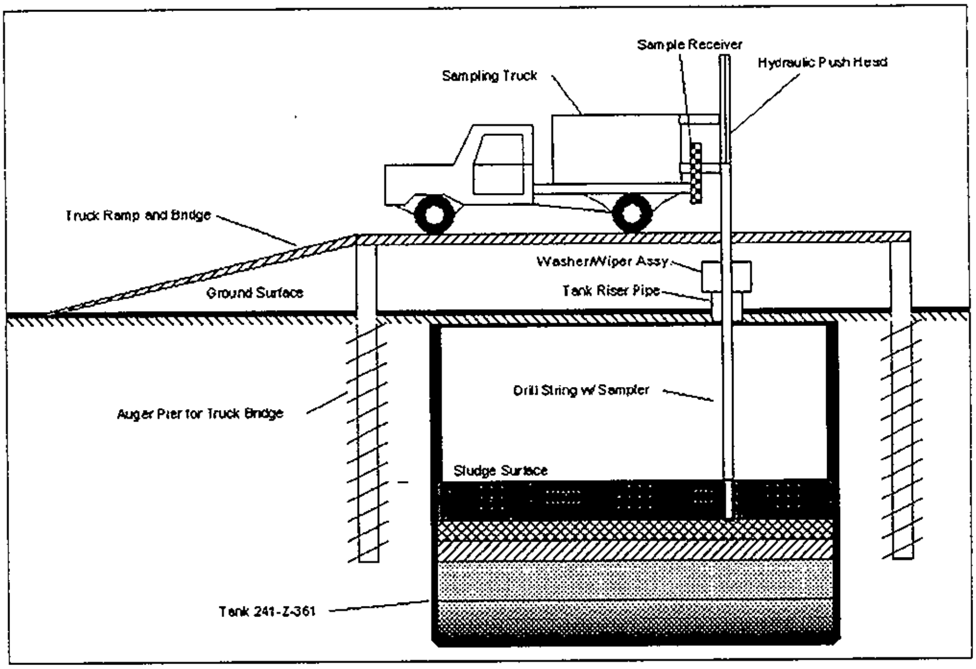


Figure 2-4. Simplified, Preferred Method Schematic of Sampler Being Pushed into Sludge for Second Sample (not to scale).

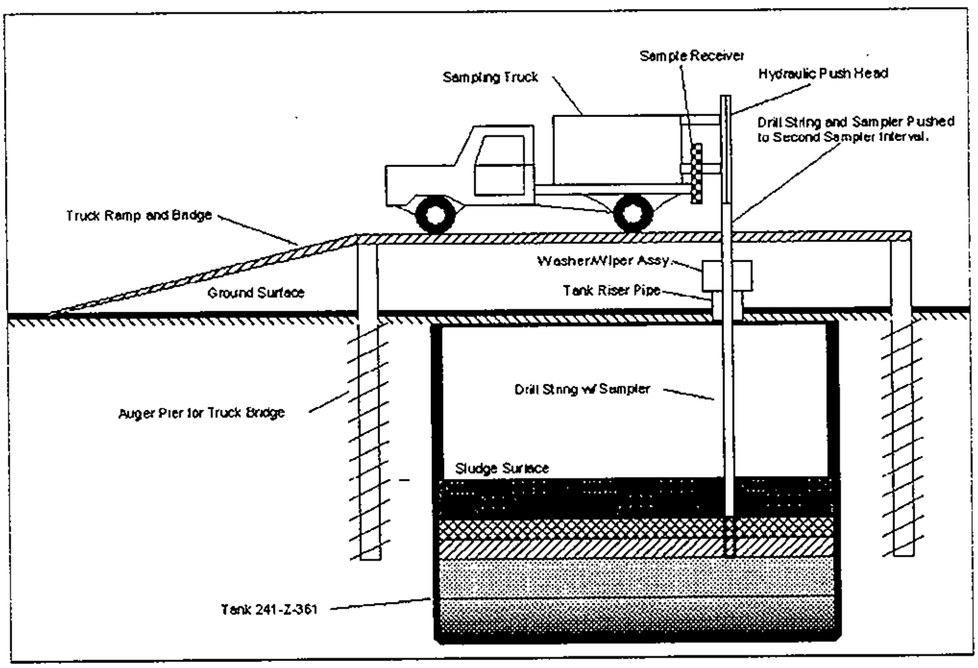


Figure 2-5. Simplified, Preferred Method Schematic of Second Sample Being Removed from Tank (not to scale).

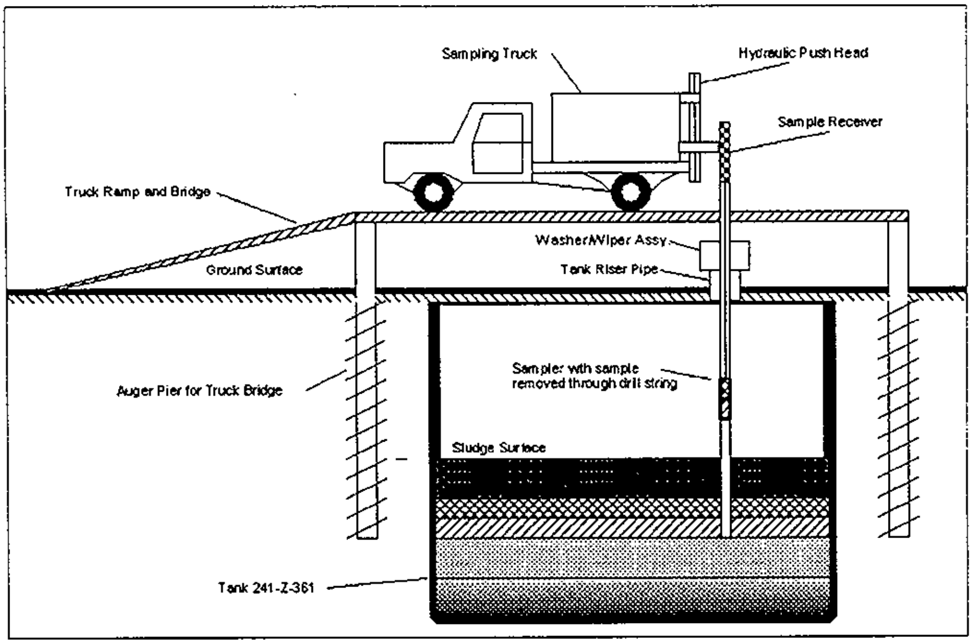
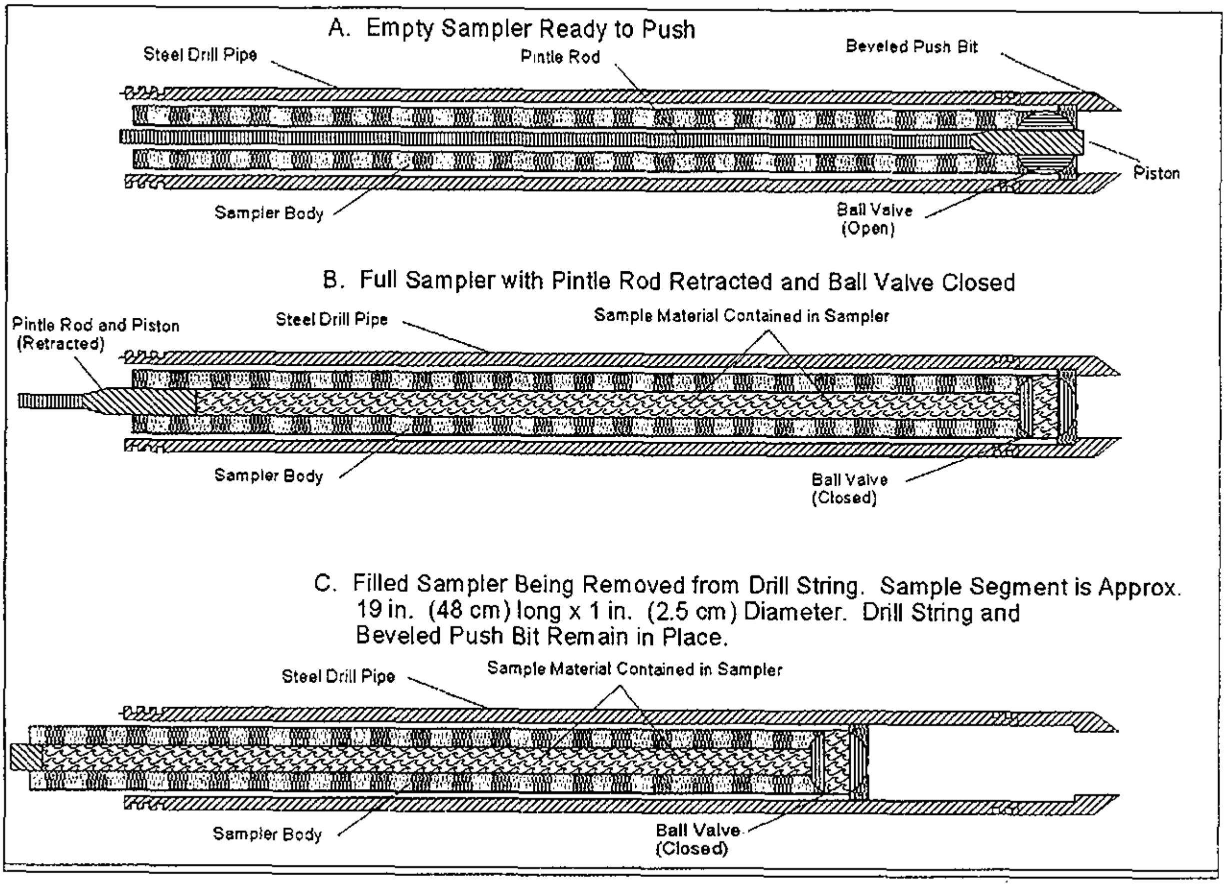


Figure 2-6. Schematic of Waste Sampler (not to scale).



containment during transport to the laboratory. A new clean sampler is slowly inserted to the lead end of the drill string and another sample segment is then collected. As the sampler is slowly inserted into the drill pipe, the LiBr solution will be displaced around the sampler within the drill pipe. For additional operational details of the push mode core sampling procedure, refer to the procedure itself.

After collection of all of the sample segments for the full depth core at the selected riser location, the drill string will be withdrawn from the riser. The washer/wiper assembly, which the drill string passes through into the riser, is attached to the top of the tank riser pipe (prior to beginning the tank sampling activities). This assembly contains a series of spray nozzles below a snug-fitting rubber wiper ring (known as the "frisbee"). As the drill string is removed from the riser, it is cleaned by the pressure wash and rubber wiper assembly attached to the top of the riser. As the string emerges from the riser, it is washed prior to being enclosed in a plastic sleeve. The wash solution and any waste material removed from the drill string drains back into the tank. The same aqueous solution of LiBr used for hydrostatic head maintenance during sampler removal is usually used for drill string washing during removal. The 0.3M LiBr solution has been selected and approved for use in Hanford tanks because it is easily detected analytically and can be used as a tracer to account for the presence of the fluid in the sample(s). After removal, the drill string will be disassembled and disposed of as contaminated waste.

Once all segments from a given core are collected, the core sampling system equipment will be removed from its position over the tank. The truck will be removed from the ramp and the bridge will be moved and repositioned at the next tank riser. The number and order of the risers to be sampled will be established and provided to the sampling team and the laboratory after riser preparation is completed.

The following important features of this sampling procedure, as intended for application to Tank 241-Z-361, should be considered.

- Each sample segment collected from the tank is entirely contained within the stainless steel sampler assembly by the closed ball valve on the inlet end and by the steel piston at the upper end.
- The sampler assembly will be contained in the shielded receiver until placed directly into the OTC.
- The drill pipe is pressure washed and wiped as it is withdrawn from the tank into a plastic sleeve and each pipe segment is disassembled and immediately placed in a waste container to minimize the potential for spread of contamination from the tank contents.

This procedure was selected because of its demonstrated successful operating history at Hanford Site Tank Farms.

2.3.2 Alternative and Optional Sampling Techniques

The preferred approach to collection of the sludge core samples from Tank 231-Z-361 is the established technique described in Section 2.3.1. Lockheed Martin Hanford Corporation (LMHC) staff have also considered selected optional and alternative techniques for use during sampling at Tank 231-Z-361 in the event that the preferred approach does not perform optimally, or site conditions (e.g., sludge consistency, moisture content, etc.) require different approaches.

The personnel performing the core sampling have extensive experience in the procedures developed by LMHC for similar work in the Hanford Site radioactive waste Tank Farms. The procedures are rigorous and the equipment used is highly specialized to protect workers and to minimize the potential for spread of tank contaminants away from the tank riser. LMHC personnel following the existing procedures for sampling waste from other Hanford tanks, have documented through field monitoring that fugitive radionuclides are typically not a problem during tank core sampling. When fugitive radionuclides have been detected during sampling events at other tanks, the radionuclides have been confined to within a few feet of the riser.

The decision to implement supplemental contamination control techniques or to use an alternative core sampling approach will be made by the LMHC project staff based on their assessment of field monitoring results and observations of conditions in the field. Selected optional actions and approaches are described in the following sections.

2.3.2.1 Optional Contamination Control Techniques. The LMHC staff associated with the RPP tank sampling program have identified the following optional techniques for minimizing and containing possible fugitive radionuclides during sampling. These techniques are in addition to the rigorous contamination control actions associated with the sampling procedures.

- Constructing a wind break around the riser and/or sampling truck. Although the established procedures limit sampling activities to periods when wind speed is below 15 miles per hour, in some situations, a plastic wind break placed around the work area can provide supplemental control of air movement around the riser. The exact location and configuration of a wind break at the Tank 241-Z-361 site would be determined based on actual site conditions.

- Operating a high efficiency particulate air- (HEPA) filtered air exhauster with the intake near selected work areas (not connected to the tank). LMHC maintains a number of HEPA-filtered exhausters for use during tank farm operations. These devices are capable of capturing up to 1,000 cubic feet of air per minute. LMHC will keep the same exhaust unit specified for Phase I tank venting activities available for use during sampling activities at Tank 241-Z-361. The exhauster will not be connected to the tank, but will rather be used, at the discretion of the field staff, to capture air and associated particulate material from selected work area locations and during selected activities. The flexible intake hose of the exhauster can be placed at the desired location to provide effective air collection during operations. Examples of the potential use of the exhauster include (1) capture of air and particulates immediately following removal of the sampler from the drill string, when a small quantity of potentially-contaminated liquid may drip from the bottom of the shielded receiver, (2) capture of air and particulates when separating the cam lock fitting at the top of the drill string prior to removing or inserting the sampler, after the system has been idle for 12 hr or more and the internal components may have become dry, and (3) capture of air and particulates during any activity if field monitoring detects fugitive contamination in the work area. Other applications for the exhauster may be identified during field operations.

2.3.2.2 Alternative Core Sample Removal Technique. The preferred core sampling technique described in Section 2.3.1 is expected to perform satisfactorily at Tank 241-Z-361. If, however, actual conditions observed during the initial core sampling activities indicate an increased potential for generation of fugitive contaminants, an alternative core recovery approach may be used. This approach may be implemented at the discretion of the LMHC Project Manager, based on evaluation of site conditions and the results of on-site monitoring.

The alternative approach uses the same sampling equipment as the preferred approach described in Section 2.3.1. Rather than leaving the drill pipe in place and retrieving the filled sampler through the drill string, however, the alternative approach allows the entire drill string, with filled sampler in place at the end of the string, to be removed from the tank intact. Using this approach, the entire drill string with the filled sampler would be contained in a plastic sleeve as it is removed from the tank. The covered drill string would then be lifted by a crane and moved away from the riser. The string subsequently would be placed within a free-standing glove box with a HEPA filter attached wherein the sampler would be removed from the lower end of the drill pipe and placed into an OTC. The entire drill string would be disassembled and disposed of as contaminated waste and a new, unused drill string and sampler would be assembled and inserted into the tank to collect the next core segment.

The advantage to this approach is that all of the in-tank sampling equipment is enclosed in a plastic covering as it is removed. The alternative has several disadvantages, however, including the following concerns.

- A supplemental crane is required for lifting the drill string.
- The entire drill string must be handled for those steps between removal from the riser through placement into and separation of the sampler.
- A larger volume of investigation-derived waste is generated with the requirement to replace the entire drill string for each core segment, and the glove box must be disposed at the completion of the project.

2.3.3 Sample Identification, Storage and Venting

The core segments collected from Tank 241-Z-361 will be assigned sample identifiers using the scheme described below.

Core 1 = 263-0*n*-RE-Z-361

where:

n = sequential segment number from Riser E.

Core 2 = 264-0*n*-R*?*-Z-361

where:

n = sequential segment number from second riser.
? = alphabetical identification of riser selected for second sample.

For example, the first segment collected from Riser "E" would be identified as "263-01-RE-Z-361."

Each segment will be stored in an OTC. Each OTC will be transported to the laboratory for analysis per the schedule in Section 2.8. Cores will be transported to the laboratory within a time period following sealing of the OTC required by the SARP. If longer storage periods are required, the OTCs will be vented prior to transport by taping a filtered plastic bag to the top of the cask and slowly venting the lid. The sample will be extruded by the laboratory, as described in Section 2.4. Segments will be stored in the casks until extrusion. The sample cores will be stored at ambient temperature and in a manner consistent with the laboratory's safety practices for storage of TRU material. The sample(s) will be maintained in the casks placed in the cask stand(s) at the tank site. The cask covers will be closed, bolted, and tightened to specified torque per the sampling procedure. Tamper-indicating custody seals will be placed over the covers. The OTCs for any stored cores will be inspected bi-weekly by PFP project personnel to ensure that the casks are in good repair and that custody seals are in place. Each OTC weighs approximately 182 kg (400 lb) and is not subject to pilferage from within the secured and guarded PFP enclosure.

2.3.4 Transport of Cores to the Laboratory

Procedures TO-060-003 and TO-080-090 are the current procedures for loading the OTC, taking field blanks or decontamination solution blanks, and operation of the sampling truck. These procedures will be modified for application to 241-Z-361 sampling, but the steps will be essentially the same. No field blank will be collected, with the exception of a sample of the decontamination solution used.

Samples will be kept under chain-of-custody from collection of each segment through extrusion and analysis. The appropriate chain-of-custody requirements are specified in both sampling procedures and the OTC procedure.

The laboratory will establish the proper Radiation Work Permits for handling the core samples in the laboratory. It is estimated that the sludge has an average concentration of 0.5 g/L plutonium and concentrations could be as high as 1 g/L for an individual stratum of sludge within the tank. The expected plutonium content would allow for all core samples to be stored at the laboratory.

2.3.5 Laboratory Storage

The separated strata, composite samples, and supernate from the cores will be stored at the analytical laboratory. If the plutonium concentration is higher than the limit of safe storage at the analytical laboratory, then some core segments from Tank 241-Z-361 may be stored at the 241-Z-361 work-site, packaged in an OTC container with a tamper-indicating evidence seal. Venting, if required, will be as described in Section 2.3.3. A final assessment of the plutonium concentration can be made after the first core has been extruded and measured for total alpha.

The storage of the samples, aliquots, and composites shall follow LMHC- and laboratory-established procedures and shall remain under chain of custody. Any sample amounts remaining after analyses shall be released from the laboratory and disposed of in accordance with the laboratory's waste management procedures not sooner than 1 yr after the final analytical report is submitted to the project manager.

Should the project decide to keep sample amounts in long-term archival storage, the laboratory will be informed of this decision and given specific instructions not later than 20 days after the final analytical report is received.

2.4 CORE EXTRUSION

Before extrusion of a core segment, the laboratory will generate an extrusion work plan to record data during sample extrusion. The laboratory project coordinator will be readily available for critical decisions during the extrusion process. The laboratory procedures shall be specific enough to ensure strict compliance with the QA requirements outlined in this SAP and give detailed instructions for processing each core segment. A controlled laboratory notebook shall be used to record all operations concerning the core segmenting process.

The procedure for processing core segments for laboratory analysis follows procedure LO-160-103 or equivalent. Core segments will be extruded in a hot cell equipped with manipulators. Core segment samplers will be loaded into the hot cell according to established procedures, such as LO-160-101, *Core Segment Receipt and Preparation*, LO-161-172, *Perform Complex 11A Hot Cell Operations*, or an equivalent procedure.

The sampler is designed to contain liquid, solid, and/or gas samples, or a mixture of all three, as they are present in the segment. The internal volume of the waste sampler is approximately 320 mL (see Figure 2-6). The purpose and goal of the core segment extrusion are to remove the segment from the sampler without distorting the physical orientation of the sample. It is important to minimize the mixing of the waste material until all photographs and subsamples of the extruded segment have been collected.

A video record is started at the time the sampler valve is opened and continues until the core has been extruded. The extrusion device removes the segment by forcing a push rod into the sampler and against the piston. The segment is pushed out through the valve at the bottom end of the sampler and laid out on a tray. The tray temporarily contains the segment for observation and sample breakdown (i.e., subsampling and/or separation). A hole at the far end of the tray allows any drainable liquid to be collected in the drainable liquid collection jar. Before the extruded segment is disturbed for any subsampling or separation, the analyst performs a visual examination of the material. The inspection includes the recording of the following:

- color (per color reference chart),
- liquid (presence, volume, color, etc.),
- solids (presence, volume, weight, homogeneity, etc.),
- texture (per stratum), and
- any other pertinent information.

A ruler with metric increments and a color comparison chart are placed next to the extruded core material and a color photograph is taken of the segment for future reference.

Moisture loss to the sample will be minimized by performing critical steps in the extrusion process without unnecessary delays. Critical steps begin when the sampler valve is opened and proceed until the sample has been contained in sample jars. The elapsed time shall be documented in the hot cell work plan once the samples have been secured in jars.

Any drainable liquid collected during the extrusion of each segment will be collected in glass containers. The supernate will not be centrifuged, suspended solids will stay with the liquid. Depending on the amount of liquid recovered, aliquots will be taken for the individual analyses as described in Section 2.5. If liner liquid is observed during extrusion and the liquid is of sufficient quantity to collect, the liquid may be retained and analyzed at the discretion of the BWHC Project Manager. If there is insufficient quantity of liner liquid to collect, it will not be retained.

The extruded segment will be evaluated for distinct strata. This process will be performed in the presence of the laboratory project coordinator or an appointed project representative. Based on past sampling experiences of the waste material from Tank 241-Z-361, several strata are expected per segment. Each stratum may be distinguished by color and/or consistency. An oily sheen may indicate the presence of organics and shall be noted. In accordance with the Tank 241-Z-361 Sludge DQO (BWHC 1999), each stratum will be separated and contained in a glass sample container. Each container shall receive unique identification and be documented in the chain-of-custody records.

Core samples may be taken from Tank 241-Z-361 through some of the same risers that were sampled 24 yr ago. It is possible that the waste did not fill the void from these previous sampling events or that only supernate and sludge filled the holes. Should a core segment be filled incompletely, or the consistency be drastically different than the other segments or the expected appearance, these observations must be brought promptly to the laboratory and BWHC Project Manager's attention, because these conditions could trigger the need to collect additional cores.

2.5 ANALYTICAL REQUIREMENTS

2.5.1 Order of Priority

As discussed in the sludge DQO (BWHC 1999), only a limited number of risers have sufficient diameter to allow sampling of the sludge from Tank 241-Z-361. The sample devices themselves are capable of collecting only a limited volume of sample material. If coring does not achieve full recovery from each of the sample locations, there may be insufficient sample volume to allow the full suite of analyses for each sludge interval of interest. Therefore, the analyses have been prioritized in case a low recovery of sample amount occurs.

Sludge samples will be screened for the toxicity characteristic by comparing the results from the total metals analysis versus the regulatory TCLP limits. In order to make a comparison, the total leachable metals concentration is calculated. EPA allows one to measure the concentration in the sample without leaching. EPA allows one to take the total number divide by 20 and adjust the result for percent moisture. This number accounts for a 20-to-one ratio of leachate to sample. This result is compared to the number in the Action Limit Total column in Tables 2-2 through 2-5. By taking this approach, total metals will be measured. If TCLP limits are exceeded, the project will discuss whether a TCLP leach will be needed. The "Action Limit Total" column indicates the concentrations resulting from this conversion, the "Action Limit TCLP" column provides the regulatory limit without conversion.

The priority of analyses is based on the priority of the decisions listed in Table 1-4. The order of priority for sludge composite is as follows:

1. pH
2. Radionuclides, total alpha
3. Metals and mercury from acid digestion
4. Anions by ion chromatography (IC), ion-selective electrode (ISE), cyanide
5. Semivolatiles
6. Volatile organic analytes (VOAs), if required
7. Dissolved solids
8. Hydroxide

9. Total organic carbon, total carbon
10. Specific gravity, particle size/particle size distribution.

The priority for the supernate is as follows:

1. pH
2. Radionuclides, total alpha
3. Metals and mercury
4. Anions by IC, ISE, cyanide
5. Semivolatiles
6. VOA, if required
7. Dissolved solids
8. Hydroxide
9. Total organic carbon, total carbon
10. Specific gravity, particle size/particle size distribution.

The following sections describe the analytical requirements. The logic diagram for the analytical process is presented in Figures 2-7 through 2-9.

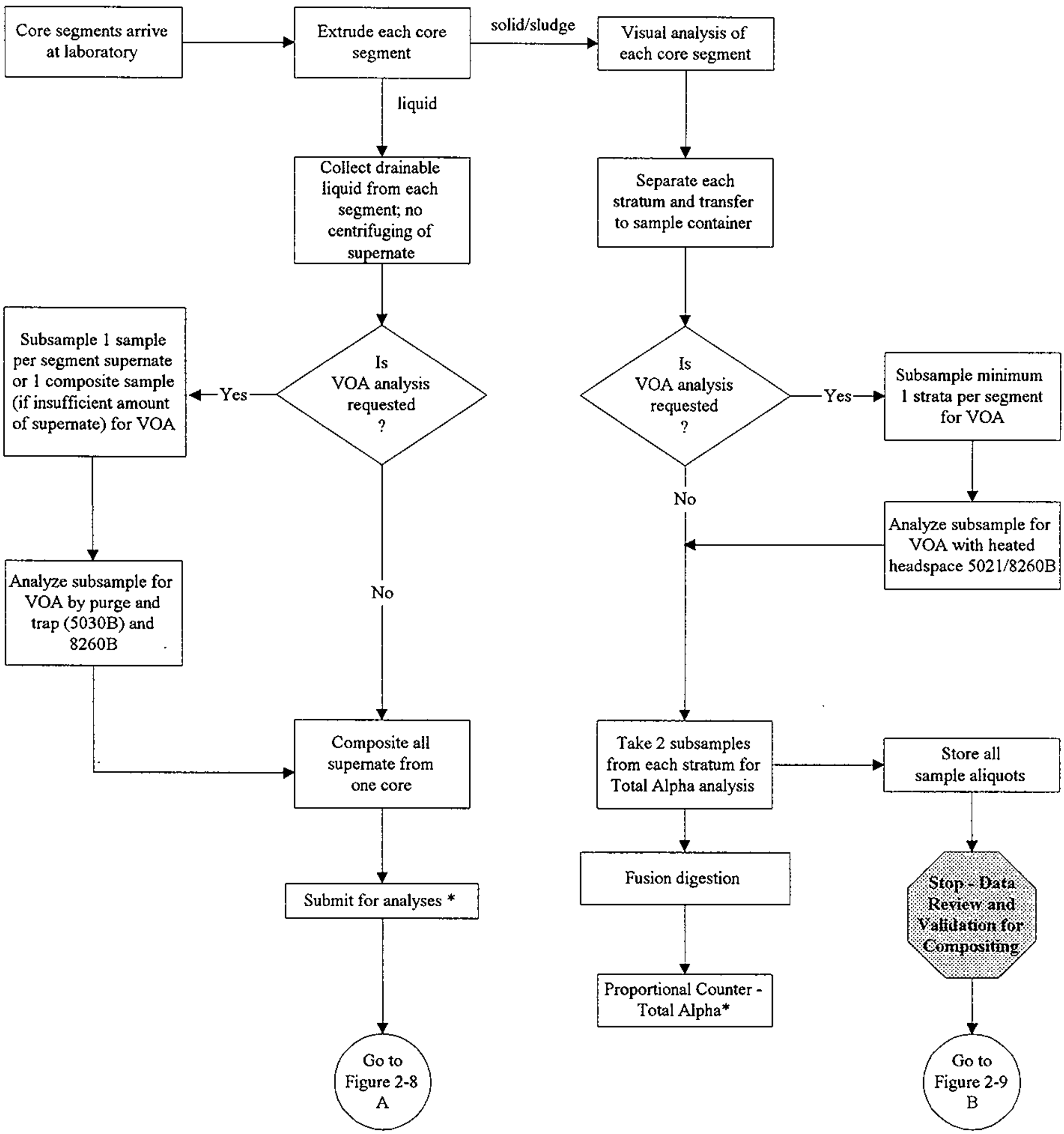
2.5.2 Volatile Analyses

The supernate from each segment shall be collected. If vapor samples collected during the sampling process indicate the presence of volatiles in SUMMA® canister samples, as discussed in Section 2.6, volatile organic analyses of the sludge and supernate are required. If multiple bottles of supernate are collected, one bottle will be randomly selected for the volatile analysis before compositing the supernate for the remaining analyses. Laboratory personnel must not allow any headspace in sample containers for the aliquot selected for VOA analysis and avoid excessive stirring of the supernate sample. The supernate sample will be used as is; no centrifuging and separation from solids will be performed.

For the volatile analysis of the sludge (if required), any stratum that appears oily or likely to contain organic compounds should be selected for analysis. Otherwise, one stratum per segment will be selected for VOA analysis. Tables 2-2 and 2-3 list the volatile compounds and sample amounts necessary for the volatile analysis of sludge and supernate, respectively.

The VOA analysis of the sludge and supernate will be performed in accordance with SW-846 Method 8260B; calibration standards will be run for all the COPCs. For the supernate, the sample will be purged and trapped (Method 5030B) and analyzed. The sludge samples will be treated in accordance with Method 5021 for heated headspace analysis and analyzed. Method 5021 specifies the addition of matrix modifier before the sample is treated and purged; this approach shall be taken with samples from Tank 241-Z-361 for VOA analysis.

Figure 2-7. Core Receipt at Laboratory, Initial Analytical Process.



* If analyses have to be performed sequentially due to continuous radiological control technician coverage, Total Alpha analyses shall be completed before supernate analyses are performed.

Figure 2-8. Supernate Analyses.

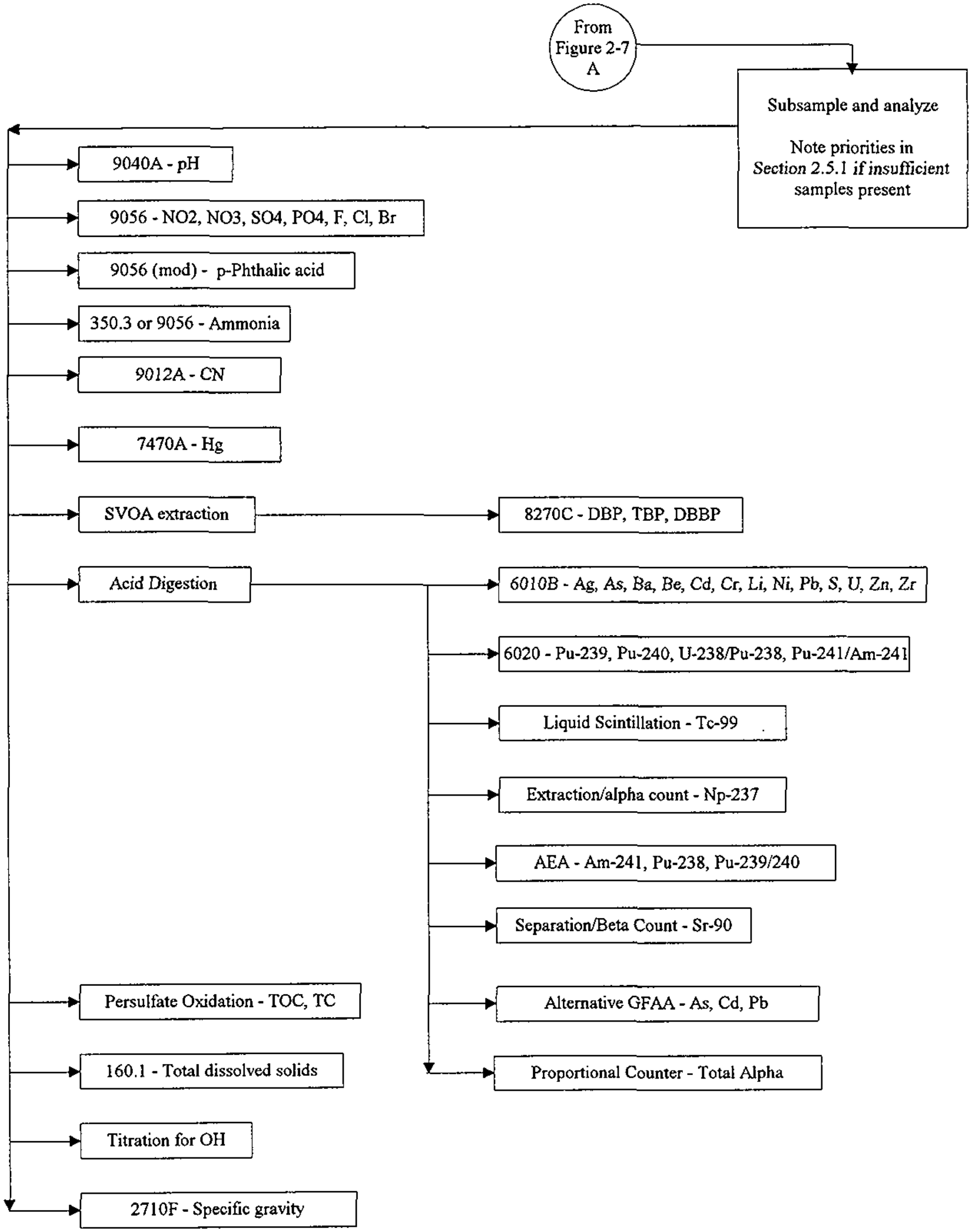
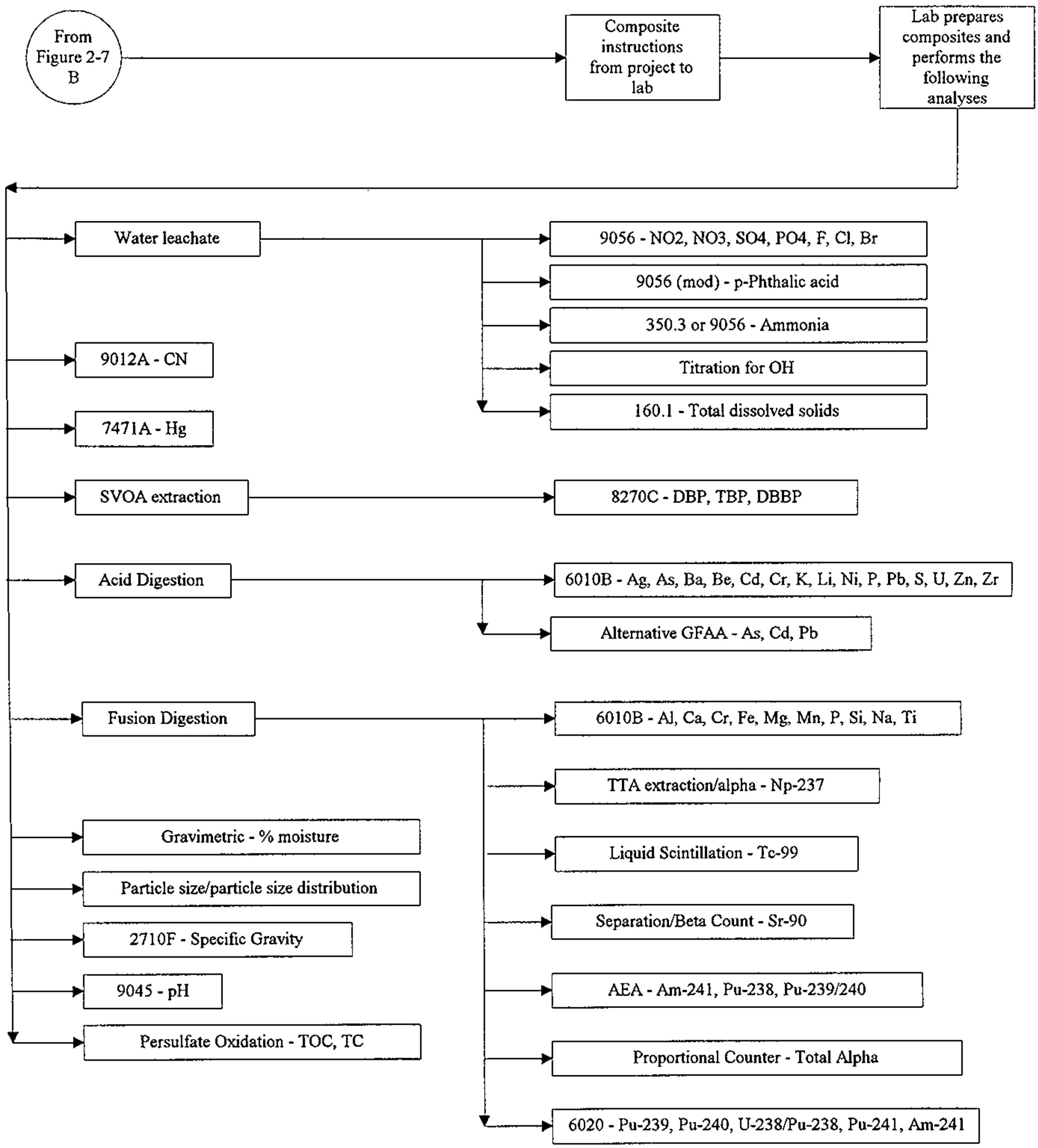


Figure 2-9. Composite Sludge Analyses.



If VOA is performed on the strata, no moisture determination will be done for the individual stratum. The percent moisture result obtained from the composite sample that contains the stratum in question will be used for the VOA concentration calculations.

2.5.3 Supernate Analyses

After supernate sample is selected for the volatile analysis, if so required, the remaining supernate shall be composited for analysis. The required analyses and sample amounts for the supernate are listed in Table 2-5.

2.5.4 Sludge Subsampling for Gross Alpha Analyses

After sludge subsamples are collected for the volatile organic analyses (if required), additional subsamples are prepared for the initial total alpha analyses. For the total alpha analyses, each stratum is kept separate, homogenized, and two subsamples are taken. These subsamples shall be submitted for fusion digestion and a total alpha analysis by proportional counter.

Homogenization is the thorough mixing of the extruded segment material. This is accomplished by methods dependant on the physical make-up of the samples. Sludge is mixed using spatulas (spatulating). Salt cake and crystalline material is crushed with a mortar and pestle or blended with a mechanical homogenizer. Liquid samples and predominately liquid samples with fine solids are usually stirred or shaken, then transferred to sample vials by pipettor or pouring.

The results from the gross alpha analyses shall be reported as specified in Section 3.5. The project will evaluate the data per Section 3.6. Based on results of the assessment, the project will provide the laboratory with directions for creating composite samples for the remaining required analyses of the sludge. This review and assessment step is expressed with "Stop-Data Review and Validation for Compositing" in Figure 2-7.

The intent of the alpha assessment is to identify strata of similar appearance and alpha activity to be composited for detailed analysis. Strata of substantially different qualitative appearance, based on visual observation, and substantially different alpha activity will be analyzed individually.

2.5.5 Sludge Composite Analyses

Based on the results from the initial gross alpha analyses, the project team will create a plan for compositing solid/sludge materials from the separate strata. This plan will be submitted to the laboratory, as specified in Section 3.5. The compositing plan will include consideration for similar strata in the different cores, plutonium concentrations, and potential stratum depths that may influence recovery of sludge from the tank. It is the intention to combine as many strata as possible, while still meeting all the requirements for the different potential treatment options.

The laboratory will create the composite by taking the same volume percentage of samples from each stratum and combining them for a weighted average composite sample. The composite sample then will be homogenized and subsamples will undergo the required preparation steps for the analyses listed in Table 2-4.

Given the likelihood of high salt content and the high activity of the waste, the samples may initially be analyzed at high dilutions. These dilutions may result in reporting limits that are higher than the action limits. The laboratory should plan to allow up to two additional dilutions/repreparations to achieve practical quantitation limits (PQLs) below the regulatory action limits. Should a PQL below the action limit not be achieved, this will be documented in the narrative with results on the dilutions/repreparations.

2.5.6 Semi-volatile Analysis

Table 2-1 shows the overall approach for analysis of specific semivolatile analytes. Several of the specified organic compounds are not routinely analyzed by methods from SW-846 (EPA 1997a); therefore, modifications and special requirements are warranted. In the case of dibutylphosphate, Method 8270C does not perform satisfactorily. Pacific Northwest National Laboratory (PNNL) has authored numerous papers presenting an analytical method using derivatization of the compound followed with gas chromatography/mass spectroscopy (GC/MS) analysis (Campbell et al. 1996). PNNL also has analyzed tributylphosphate and dibutylbutylphosphonate by Method 8270C and has standards of these compounds which can be used for the instrument calibrations. The compound p-phthalic acid is extremely difficult to analyze by GC/MS due to its acidic nature. A better approach is to analyze directly by IC. No SW-846 method exists for p-phthalic acid; therefore, use of an existing IC method modified by calibration with p-phthalic acid will be used.

The extraction of the sludge composite sample for Method 8270C analysis will be performed in accordance with Method 3540C or 3541 for soxhlet extraction. The extraction of the supernate will be performed by Method 3520C for continuous liquid-liquid extraction, if sufficient sample amount is available for the laboratory's semi-micro liquid-liquid extraction unit. Calibration standards will be run for all of the COPCs for the Method 8270C analysis.

2.5.7 Metals

The supernate and sludge composite will be analyzed for the metals that are of regulatory concern, such as silver, arsenic, barium, beryllium, cadmium, chromium, nickel, lead, uranium, zinc, and zirconium. The sludge composite and the supernate will undergo an acid digestion and the digestate will be analyzed by Method 6010B for inductively coupled plasma (ICP). Lithium was added to this list due to the LiBr solution used during coring. Sulfur has been added to obtain an evaluation of reactive sulfides, and potassium has been added due to the potassium interference caused by the preparation method for whole rock analysis.

Table 2-1. Semivolatile Compounds Analyzed with Modifications.

CAS #	Constituent	Based on EPA Method	Method Type	Type of Modification
100-66-4	p-Phthalic acid	9056	IC	IC analysis.
107-66-4	Dibutylphosphate	8270C	GC/MS	Derivatization of compound, followed with GC/MS analysis.
126-73-8	Tributylphosphate	8270C	GC/MS	Calibration standard mix will include this compound.
78-46-6	Dibutylbutylphosphonate	8270C	GC/MS	Calibration standard mix will include this compound.

The estimated PQLs for arsenic, cadmium, and lead are very close to the action limits as specified by the LDR. If the sample matrix allows it, the laboratory has the option to analyze these three metals by their respective graphite furnace atomic absorption (GFAA) methods (Methods 7060A, 7131A, 7421) to obtain a lower detection limit. The GFAA analyses will be performed from the acid digestate.

The sludge composite samples will undergo analysis for whole rock to support one of the treatment options. The whole rock analysis provides the oxide concentrations in the sample of the following metals: aluminum, calcium, chromium, iron, magnesium, manganese, phosphorous, silicon, sodium, and titanium. The sludge composite sample will undergo potassium hydroxide (KOH) fusion and the digestate then will be analyzed by Method 6010B (ICP) for the actual metals. The oxide concentration is calculated from the determined elemental concentrations and the results are reported as the metals' oxides. The whole rock analysis is not of concern for Tank 241-Z-361 supernate. Potassium is a metal of concern for the whole rock analysis, but cannot be detected if the sample undergoes KOH fusion. Therefore, potassium will be analyzed from the acid digestate followed by ICP.

Mercury analysis will be performed on the sludge composite and the supernate using Method 7470A. The preparation steps of the aqueous and solid samples are included in the laboratory's analytical method. A comparison table to show any method alterations from the EPA method, including an explanation why the procedure is equivalent to the EPA method, is included in the laboratory's procedure.

2.5.8 Radionuclides

The sludge composite and the supernate will be analyzed for several radionuclides. Total plutonium and uranium-238/plutonium-238 will be analyzed from the KOH fusion prepared for the metals analysis and analyzed by ICP/MS (Method 6020). Technetium-99 will be analyzed from the fusion digestate for the sludge composite, by liquid scintillation. For the supernate sample, technetium-99 will be analyzed from the acid digestate. For the sludge, the strontium-90 analysis will be performed using the KOH fusion preparation followed by separation of the strontium-90 and beta counting. For the supernate, strontium-90 analysis will be performed using the acid digestion preparation followed by separation of the strontium-90 and beta counting. For the sludge, the neptunium-237 analysis will be performed using the KOH fusion preparation followed by separation of the neptunium-237 using 2-thenoyltrifluoroacetone (TTA) and alpha counting. For the supernate, neptunium-237 analysis will be performed using the acid digestion preparation followed by separation of the neptunium-237 and alpha counting. Americium-241, plutonium-238, and plutonium239/240 will be analyzed by alpha energy analysis (AEA) from the KOH fusion digestate for the composite and from the acid digestate for the supernate. The total alpha analyses will be performed by proportional counter, from the fusion digestion for the sludge composite and from the acid digestate for the supernate.

The isotopic distribution of plutonium in the sludge samples will be determined by applying a combination of analytical techniques. This approach is required because the isotopic mix of plutonium in the tank is not known with certainty and the mix may have varied substantially between processing campaigns. AEA will provide results for plutonium-238, plutonium-239/240, and americium-241. ICP/MS analysis will provide results for plutonium-240, plutonium-239, and plutonium-241/americium-241. The plutonium-241 will be estimated by subtracting the AEA results from americium-241 (converted to grams) from the grams of plutonium-241/americium-241 determined by the ICP/MS. The plutonium-239 data from the ICP/MS will be converted to activity and subtracted from the AEA results for plutonium-239/240. This will provide adequate estimates of all plutonium isotopes (i.e., plutonium-238, -239, -240, and -241) for subsequent determination of the grams of plutonium-239 equivalent fissile material in the tank contents.

2.5.9 Anions

Analyses for reactive cyanide and reactive sulfide are required for regulatory purposes. The high content of hydroxide within the sludge, however, interferes with the methods for these reactive analytes. Therefore, the laboratory will be permitted to analyze for total cyanide and, if the concentration is below the regulatory limit of 250 ppm, the requirement will be considered met. For reactive sulfides, the laboratory will be allowed to analyze for total sulfur and sulfate. The concentration of total sulfides is obtained by subtracting the concentration of the sulfates from the total sulfur. If this concentration is below the regulatory limit of 500 ppm, the requirement will be considered met. Should either of these approaches result in concentrations above the regulatory limits, the laboratory will discuss the options for further analyses with the BWHC Project Manager, who will assess the merit of additional analyses for the actual reactive cyanide and reactive sulfide, respectively, in the sample.

Cyanide will be analyzed in accordance with Method 9012A. The sample preparation steps for aqueous and solid waste matrices are included in the laboratory method; an additional water leachate for the sludge composite sample is not necessary.

The anions nitrite, nitrate, sulfate, phosphate, fluoride, chloride, and bromide will be analyzed by IC in accordance with Method 9056. The analyte p-phthalic acid was added to this list due to its acidic nature. For the supernate, the IC analysis is performed directly on the filtered sample.

The sludge composite sample undergoes a water leaching, and the filtered leachate is used for the analysis.

Ammonia analysis will be conducted by either IC (Method 9056) or with ISE (Method 350.3). The selection of the method is at the discretion of the laboratory, based on the matrix interference observed with the sludge composite and the supernate. Either method will be performed on the supernate sample directly or on a water leachate from the sludge composite.

Samples of LiBr solution from the coring process will be analyzed in the laboratory. The lithium concentration will be determined by Method 6010B and the bromide by Method 9056 (see previous descriptions).

2.5.10 Physical Parameters

The samples will undergo an evaluation for hydroxide content. The supernate will be titrated for the hydroxide concentration; the sludge composite undergoes a water leachate that will be titrated. The procedure has been developed for use on double-shell tanks (DSTs) with high hydroxide content and high salt content. It is expected that Tank 241-Z-361 will show the same properties of high hydroxide and high salt content.

The pH of the supernate and sludge composite will be determined following Methods 9040A and 9045C, respectively. Method 9040A is not included in the most recent SW-846 update but is included in Update II, September 1994 (EPA 1995). No method is included for pH of water in the current SW-846 methods.

The total organic carbon and total carbon concentrations are needed to evaluate treatment options. These analyses will be performed in a manner consistent with Method 9060, which is written for water only. The persulfate oxidation method of carbon analysis is preferred over the combustion oxidation method due to its higher accuracy and reproducibility. The analysis of solids by the persulfate method can be performed directly on solid material without any preliminary sample preparation.

The sludge composite will be evaluated for particle size and particle size distribution. These procedures are outlined in Method 2560 (APHA 1995).
The specific gravity of the sludge composite will be determined in accordance with Method 2710F (APHA 1995).

The moisture content of the sludge composite will be determined gravimetrically. This requires drying a weighed sample amount to constant weight at 105 °C. This is the only acceptable method for determining percent moisture under this SAP. The laboratory will report the percent moisture. The results from this determination are used for the volatile, semivolatile, and metals results to calculate the final dry weight concentrations. Dry weight calculations will be performed during Data Quality Assessment (DQA) external to the laboratory.

Analysis for specific conductance was initially requested to allow assessment of the corrosion potential of the waste on various metals that the waste may contact during storage or process. The waste is expected to have very high salt content. It has been the experience on the DSTs that the high salt content produces conductivity readings that far exceed normal electrode measurements for environmental samples. The results of TDS analysis, when combined with the previously measured anion content from IC, will allow the same information to be presented as conductivity. This approach will be more reliable than performing large dilutions to obtain direct conductivity measurements (the alternative to the proposed method). The TDS will be measured gravimetrically on a filtered aliquot of the supernate or water leachate of the sludge composite. The method is based on Method 160.1 from the EPA Water and Waste Methods (EPA 1997b). The method will be modified to allow use of smaller sample size to accommodate for the high activity and high salt content. The method currently is used by the laboratory for DST and single-shell tank waste.

2.6 TANK VAPOR SAMPLING

The purpose of the vapor sampling component in this SAP is to determine whether organic constituents are released in vapor form during the disturbance of sludge while sampling. If organics are released, additional analyses for volatiles in the sludge and supernate will be required. If no positive results are detected in the headspace of the tank during coring, no additional analyses for volatile organics will be performed. Collection of samples for tributylphosphate and dibutylphosphate in the headspace was considered. Because the Tank Waste Information Network System database indicates sporadic appearance of low concentrations of these compounds in the single-shell tank headspace, because of the low volatility of these analytes, and because the sludge is being analyzed for these constituents, the analysis will not be performed on the headspace samples. Ammonia and methane were not detected on health monitoring equipment during the venting of the tank; therefore, these analytes are not included in the headspace analyses. SUMMA® canister samples will be collected using work instructions based on this SAP. One canister sample will be collected during sampling of each core segment.

Table 2-2. Chemical Analytical Requirements for Volatile Analysis of Sludge.

Analytical Method	CAS #	Constituent	Action Limit Total [ppm]	Action Limit[a] TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount	PQL Low [ppm]	PQL High[e] [ppm]
8260B	127-18-4	1,1,2,2-Tetrachloroethene	6		5021		GC/MS, 8260B	1-2 g	0.5	[b]
	120-82-1	1,2,4-Trichlorobenzene	19						0.5	[b]
	67-64-1	2-Propanone (Acetone)	160						0.5	[b]
	71-43-2	Benzene	10	0.5					0.5	[b]
	56-23-5	Carbon tetrachloride	6 [c]	0.5					0.5	[b]
	67-66-3	Chloroform	3 [d]	6.0					0.5	[b]
	75-09-2	Dichloromethane							0.5	[b]
	71-36-3	n-Butanol							0.5	[b]
	76-01-7	Pentachloroethane	6						0.5	[b]
	108-88-3	Toluene	10						0.5	[b]
	79-01-6	Trichloroethylene							0.5	[b]
	75-69-4	*Trichloromonofluoromethane*							0.5	[b]
	1330-20-7	Xylene	30						0.5	[b]

[a] Limit in leachate from TCLP. TCLP will only be performed if total concentration exceeds limit.
[b] A determination will be made after samples are received.
[c] Total limit is based on LDR and not TCLP because LDR action limit of 6 ppm is below total (10 = TC x 20; 10 = 0.5 x 20) per TC regulations.
[d] Total limit is based on LDR not TCLP because LDR limit is lower as compared to total based on TCLP as total contaminant (6 x 20 = 120 ppm).
[e] Due to the potential for higher plutonium content, increased dilutions or smaller sample sizes may result in higher PQLs. Every effort will be made to obtain PQLs at or below action limits.

Table 2-3. Chemical Analytical Requirements for Volatile Analysis of Supernate.

Analytical Method	CAS #	Constituent	Action Limit[a] Total [ppm]	Action Limit TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount	PQL Low [ppm]	PQL High[e] [ppm]
8260B	127-18-4	1,1,2,2-Tetrachloroethene	6		5030B		GC/MS, 8260B	1-5 mL	0.5	[b]
	120-82-1	1,2,4-Trichlorobenzene	19						0.5	[b]
	67-64-1	2-Propanone (Acetone)	160						0.5	[b]
	71-43-2	Benzene	10	0.5					0.5	[b]
	56-23-5	Carbon tetrachloride	6 [c]	0.5					0.5	[b]
	67-66-3	Chloroform	6 [d]	6.0					0.5	[b]
	75-09-2	Dichloromethane							0.5	[b]
	71-36-3	n-Butanol							0.5	[b]
	76-01-7	Pentachloroethane	6						0.5	[b]
	108-88-3	Toluene	10						0.5	[b]
	79-01-6	Trichloroethylene							0.5	[b]
	75-69-4	Trichloromonofluoromethane							0.5	[b]
	1330-20-7	Xylene	30						0.5	[b]

[a] Limit in leachate from TCLP. TCLP will only be performed if total exceeds limit and sufficient sample exists.
[b] A determination will be made after samples are received.
[c] Total limit is based on LDR and not TCLP because LDR action limit of 6 ppm is below total (10 = TC x 20; 10 = 0.5 x 20) per TC regulations.
[d] Total limit is based on LDR not TCLP because LDR limit is lower as compared to total based on TCLP as total contaminant (6 x 20 = 120 ppm).
[e] Due to the potential for higher plutonium content, increased dilutions or smaller sample sizes may result in higher PQLs. Every effort will be made to obtain PQLs at or below action limits.

Table 2-4. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Sludge Composite. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit[a] Total [ppm]	Action Limit TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount	PQL Low [ppm]	PQL High[i] [ppm]
Titration	ALK	Titration for hydroxide			Water leachate	LA-211-102	Titration	[c]	2,500	8,400
% solids determination	MOIST	% moisture/% solids				LA-564-101	Gravimetric	0.25 g	N/A	N/A
160.1	TDS	Total dissolved solids			Water leachate	LA-510-115	gravimetric	[h]	10	10
2560	PARTDIS	Particle size distribution			None	LT-519-101	Laser diffraction	0.25 g	N/A	N/A
	PARTSIZ	Particle size						0.25 g	N/A	N/A
2710F	SPG	Specific gravity (SpG)			None	LA-510-112	Gravimetric	0.25 g	N/A	N/A
350.3	7664-41-7	Ammonia[g]			Water leachate	LA-631-001	ISE	[c]	660	3,000
6010B	7440-38-2	Arsenic	100	5	3050A/3051	LA-505-161	ICP	[b]	100	8,000
	7440-39-3	Barium	420	21					50	4,000
	7440-41-7	Beryllium	24.4	1.22					5	400
	7440-43-9	Cadmium	2.2	0.11					5	400
	7440-47-3	Chromium	12	0.6					10	800
	7439-92-1	Lead	15	0.75					100	8,000
	7440-02-0	Nickel	220	11					20	1,600
	7723-14-0	Phosphorous							200	16,000
	7440-09-7	Potassium							500	40,000
	7440-22-4	Silver	2.8	0.14					50	4,000
	63705-05-5	Sulfur	500						1	50
	7440-61-1	Uranium							100	8,000
	7439-93-2	Lithium							10	800

Table 2-4. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Sludge Composite. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit [e] Total [ppm]	Action Limit TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount	PQL Low [ppm]	PQL High [i] [ppm]
6010B	7429-90-5	Aluminum			KOH fusion	LA-505-161	ICP	[b]	50	4,000
	7440-70-2	Calcium							100	8,000
	7440-47-3	Chromium							10	800
	7439-89-6	Iron							50	4,000
	7439-95-4	Magnesium							100	8,000
	7439-96-5	Manganese							10	800
	7440-21-3	Silicon							50	4,000
	7440-23-5	Sodium							100	8,000
	7440-23-5	Titanium							10	800
	7440-66-6	Zinc	86	4.3	3050A/3051	LA-505-161	ICP	[b]	10	800
	7440-67-7	Zirconium							10	800
6020	I127	Plutonium-239/240			KOH fusion	LA-506-101	ICP/MS	[b]	PQLs are being determined	
	I210	Plutonium/Americium-241								
	15117-96-1	Uranium-235				LA-506-101	ICP/MS	[b]	2.4	2.4
	I208	Uranium/Plutonium-238							2.4	2.4
	I209	Plutonium-241							2.4	2.4
7060A	7440-38-2	Arsenic	100	5	3050A/3051	LA-505-102	GFAA	[b]	6.2b	480b
7131A	7440-43-9	Cadmium	2.2	0.11	3050A/3051	LA-505-102	GFAA	[b]	0.2b	16b
7421	7439-92-1	Lead	15	0.75	3050A/3051	LA-505-102	GFAA	[b]	4b	320b
7471A	7439-97-6	Mercury	0.5	0.025	7471A	LA-325-106	CVAA	0.25 g	0.04	0.04
8270C	78-46-6	Dibutylbutylphosphonate			3540C or 3541	Method under development	GC/MS	[f]	[f]	[f]
	126-73-8	Tributylphosphate							[f]	[f]
	107-66-4	Dibutylphosphate			Derivitazation		GC/MS	[f]	[f]	[f]
9012A	57-12-5	Cyanide	250		9013	LA-695-103	Microdist/ Spec	[c]	8,000	80,000

Table 2-4. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Sludge Composite. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit [a] Total [ppm]	Action Limit TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount	PQL Low [ppm]	PQL High [i] [ppm]
9045B	pH	pH			9045B	LA-212-105	pH electrode	0.25 g	2 –12 pH	2 -12 pH
9056	16887-00-6	Chloride			Water leachate	LA-533-105	IC	[c]	200	2,000
	7664-41-7	Ammonia [g]							15	75
	16984-48-8	Fluoride							200	2,000
	NO2/NO3	Nitrite/Nitrate							1,600	16,000
	14265-44-2	Phosphate							4,000	40,000
	24959-67-9	Bromide							2000	20000
	14808-79-8	Sulfate							4,000	40,000
	100-21-0	p-Phthalic acid	28			LA-533-115			Under development	
9060	TC	Total carbon			none	LA-342-100	Persulfate oxidation	0.25 g	40	2,000
	TOC	Total organic carbon (TOC)						0.25 g	40 (for low Carbon)	2,000
9310	TOTALA/ TOTALB	Total Alpha (AT)/ Total Beta (TB)			KOH fusion	LA-508-101	Proportional counting	[d]	0.2 µCi/g	0.2 µCi/g
AEA	86954-36-1	Americium-241			KOH fusion	LA-953-104	AEA	[d]	0.02 µCi/g	0.02 µCi/g
	I127	Plutonium-239/240							0.02 µCi/g	0.02 µCi/g
	I125	Plutonium-238				LA-943-101			0.02 µCi/g	0.02 µCi/g

Table 2-4. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Sludge Composite. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit[e] Total [ppm]	Action Limit TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount	PQL Low [ppm]	PQL High[i] [ppm]
Alpha Counting	I102	Neptunium-237			KOH fusion	LA-933-141	TTA extract, alpha count	[d]	0.3 µCi/g	0.3 µCi/g
Beta Counting	10098-97-2	Strontium-90			KOH fusion	LA-220-101	Extraction, beta count	[d]	0.02 µCi/g	0.02 µCi/g
Liquid Scintillation	I1661	Technetium-99			KOH fusion	LA-438-101	Solv. extract, scintillation cocktail	[d]	0.02 µCi/g	0.02 µCi/g
See metals	WRA	Whole rock analysis			KOH fusion	[c]	ICP	[d]	[a]	[a]

CVAA = cold vapor atomic absorption
N/A = not applicable.

[a] The necessary metals ions and limits for the whole rock analysis are included in the metals section.
[b] Total of 0.25 g sample required; compound will be analyzed from digestate.
[c] Total of 0.5 g sample required for 100 mL water digestion; 2.5 mL of digestate will be used for analysis. (Digestion with water = leaching with water.)
[d] Total of 0.5 g sample required; compound will be analyzed from digestate.
[e] Limit in leachate from TCLP. TCLP will only be performed if total exceeds limit and sufficient sample exists.
[f] Determination in progress.
[g] Either ISE or IC method will be used for ammonia.
[h] Total of 0.5 g sample required for 100 mL water digestion; 10 mL used for analysis.
[i] Due to the potential for higher plutonium content and interferences from high salt content (e.g., sodium and nitrates), increased dilutions or smaller sample sizes may result in higher PQLs. Every effort will be made to obtain PQLs at or below action limits.

Table 2-5. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Supernate. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit [f] Total [ppm]	Action Limit [c] TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount [mL]	PQL Low [ppm]	PQL High [g] [ppm]
titration	ALK	Titration for hydroxide content			no prep	LA-211-102	titration	1	125	25,000
160.1	TDS	Total dissolved solids			filtration per method	LA-510-115	gravimetric	10	10	10
2710F	SPG	Specific gravity (SpG)			no prep	LA-510-112	gravimetric	0.1	N/A	N/A
350.3	7664-41-7	Ammonia [e]			no prep	LA-631-001	ISE	0.5	25	250
6010B	7440-38-2	Arsenic	100	5	3010A/3015	LA-505-161	ICP	[a]	1	50
	7440-39-3	Barium	420	21					0.5	25
	7440-41-7	Beryllium	24.4	1.22					0.05	2.5
	7440-43-9	Cadmium	2.2	0.11					0.05	2.5
	7440-47-3	Chromium	12	0.6					0.1	5
	7439-92-1	Lead	15	0.75					1	50
	7439-93-2	Lithium							0.1	5
	7440-02-0	Nickel	220	11					0.2	10
	7440-09-7	Potassium							5	250
	7440-22-4	Silver	2.8	0.14					0.1	5
	63705-05-5	Sulfur	500						1	50
	7440-61-1	Uranium							5	250
	7440-66-6	Zinc	86	4.3					0.1	5
	7440-67-7	Zirconium							0.1	5

Table 2-5. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Supernate. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit [f] Total [ppm]	Action Limit [f] TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount [mL]	PQL Low [ppm]	PQL High [g] [ppm]
6020	I127	Plutonium-239/240			3010A/3015	LA-506-101	ICP/MS	[a]	0.001	0.02
	I210	Plutonium/Americium-241							0.001	0.02
	15117-96-1	Uranium-235							0.05	0.24
	I208	Uranium/Plutonium-238							0.05	0.24
	I209	Plutonium-241							0.05	0.24
7060A	7440-38-2	Arsenic	100	5	3020A	LA-505-102	GFAA	[a]	0.3	15
7131A	7440-43-9	Cadmium	2.2	0.11	3020A	LA-505-102	GFAA	[a]	0.01	0.5
7421	7439-92-1	Lead	15	0.75	3020A	LA-505-102	GFAA	[a]	0.2	10
7470A	7439-97-6	Mercury	0.5	0.025	7470A	LA-325-106	CVAA	0.5	0.02	0.2
8270C	78-46-6	Dibutylbutylphosphonate			3520C	Method under development	GC/MS	[d]	[d]	[d]
	126-73-8	Tributylphosphate							[d]	[d]
	107-66-4	Dibutylphosphate			3520A/ Derivitization				[d]	[d]
9012A	57-12-5	Cyanide	250		9012A	LA-695-102	Microdist/ Spec	1.0	1	20
9040A	PH	pH			9040A	LA-212-105	pH electrode	1.0	2-12 pH	2-12 pH

Table 2-5. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Supernate. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit [f] Total [ppm]	Action Limit [c] TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount [mL]	PQL Low [ppm]	PQL High [g] [ppm]
9056	16887-00-6	Chloride			9056	LA-533-105	IC	[b]	5	100
	7664-41-7	Ammonia [e]							15	75
	24959-67-9	Bromide							10	200
	16984-48-8	Fluoride							6	120
	NO2/NO3	Nitrite/Nitrate							10	200
	14265-44-2	Phosphate							10	200
	14808-79-8	Sulfate							10	200
	100-21-0	p-Phthalic acid	28			LA-533-115			PQLs are being determined	
9060	TC	Total carbon			9060	LA-342-100	Combustion	2.0	5	500
	TOC	Total organic carbon (TOC)						2.0	5	500
9310	TOTALA/ TOTALB	Total Alpha (AT)/ Total Beta (TB)			3010A/3015	LA-508-101	Proportional counting	[b]	0.1 µCi/mL	0.2 µCi/mL
AEA	86954-36-1	Americium-241			3010A/3015	LA-953-104	AEA	[a]	0.002 µCi/mL	0.004 µCi/mL
	I125	Plutonium-238							0.004 µCi/Ml	0.004 µCi/mL
	I127	Plutonium-239/240							0.004 µCi/mL	0.004 µCi/mL
Liquid Scintillatio n	I1661	Technetium-99			3010A/3015	LA-438-101	Solv. extract, scintillation cocktail	[b]	1.0 µCi/mL	1.0 µCi/mL
Alpha Count	I102	Neptunium-237			3010A/3015	LA-933-141	TTA Extract, Alpha count	[a]	0.05 µCi/mL	0.05 µCi/mL

Table 2-5. Chemical and Radiological Analytical Requirements for Non-volatile Analysis of Supernate. (4 Sheets)

Analytical Method	CAS #	Constituent	Action Limit [f] Total [ppm]	Action Limit [c] TCLP [ppm]	Prep Method	Lab Method	Method Description	Sample Amount [mL]	PQL Low [ppm]	PQL High [g] [ppm]
Beta Count	10098-97-2	Strontium-90			3010A/3015	LA-220-105	Separation, Beta count	[a]	0.003 μCi/mL	0.003 μCi/mL

[a] Total of 10 mL supernate required for acid digestion; compound will be analyzed from digestion.
[b] Total of 10 mL supernate required for ten-fold water digestion; compound will be analyzed from digestion.
[c] Limit in leachate from TCLP. TCLP will only be performed if total exceeds limit and sufficient sample exists.
[d] Determination in progress.
[e] Ammonia will be analyzed by either IC or ISE
[f] Limits from TCLP limit x 20 for total metals or reactivity for cyanide and sulfur per Section 2.5.9.
[g] Due to the potential for higher plutonium content and interferences from high salt content (e.g., sodium and nitrates), increased dilutions or smaller samples sizes may result in higher PQLs. Every effort will be made to obtain PQLs at or below action limits.

2.6.1 Preparation of Sampling Containers

All SUMMA® canisters and in-line particulate filters will be prepared for sampling by the laboratory in accordance with Procedure LO-080-406. The canisters will be given to the LMHC sampling team under chain-of-custody. LMHC will collect samples and return them to Waste Management Laboratory (WML).

2.6.2 Vapor Sampling Activities and Quality Control Samples

Vapor samples will be collected through a Teflon® sampling tube which will extend from the breather filter assembly down to approximately 30 cm (12 in.) from the sludge surface. This tube was emplaced during Phase I sampling activities. A "T" fitting with ball valves will allow monitoring for combustible gases from the same tube used for sampling. Sampling and monitoring equipment will be connected to the sample tube via a Swage Lok® fitting (see Figure 2-1 of Hill et al. [1998]). Vapor samples shall be collected during the sampling of each segment of cores. During monitoring, the ball valve to the canister port will be closed and the valve to the instrument port will be open. For vapor sample collection, the instrument port ball valve will be closed and the sample port valve opened.

Table 2-6 shows the sequence of sampling activities for the system, along with sample collection times and flow rates. Cleanliness of the system shall be checked and verified in accordance with the work instruction that specifies collection of a field blank. The field blank will include all sampling components up to the connection to the ball valve on the "T' fitting and will consist of ambient air collected through the sampling components into the canister. One ambient vapor SUMMA® sample shall be taken per core as a field blank. Table 2-6 shows the collection of six discrete SUMMA® canisters during the sampling event.
Vapor samples collected during sludge sampling will be assigned unique sample identifiers using the following format:

V9xxx-ccc-yyyyyy

where:

V9xxx	=	the project tracking number assigned by the laboratory,
ccc	=	the canister number assigned by the laboratory,
yyyyyy	=	a unique, site-specific identifier, such as
F-01	=	Riser F, core segment 1, or
Amb-01	=	Ambient air/system blank number 1, or
B-03	=	Riser B, core segment 3.

SUMMA is a trademark of Moletrics, Inc., Cleveland, OH
SWAGELOK is a trademark of Crawford Fitting Co.

TEFLON is a registered trademark of E.I. DU PONT DE NEMOURS and Company

Table 2-6. List of Samples and Quality Control for the System.

Sample Code	Sample/Activity Description	Sampler Position During Collection	Gas Flow Rate	Sample Duration
Amb-01	Collect one ambient field blank per core	At riser, not connected to tank riser port	N/A	1 min
Riser # -01 through -05	Collect SUMMA® during collection of 5 segments from selected risers	riser port	N/A	1 min

2.6.3 Field Monitoring

All field activities will be accomplished with continuous Health Physics and Industrial Hygiene Technician support, as required by the sampling procedures and the Health and Safety Plan (Appendix C). Radiological monitoring of surfaces and workplace air will be performed using alpha and beta/gamma survey instruments and continuous air monitors for workplace alpha contamination. No mixed fission products entered Tank 241-Z-361; nevertheless, radiological monitoring will include both alpha and beta/gamma.

Industrial Hygiene Technicians will monitor for the presence of flammable gases in the tank headspace and workplace air using a combustible gas meter, such as the Industrial Scientific Corporation Model LTX 310.

In addition to flammability monitoring, a photoionization detector (PID) will be used to monitor for volatile organic compounds and Draeger tubes will be used to monitor carbon tetrachloride and chloroform vapor. A direct reading instrument will be used to monitor ammonia.

2.6.4 Radiation Release and Screening

Radiological screening of vapor samples will be performed at two times during the sampling/analytical sequence. The first screening will be at the tank riser. RPP Characterization Project Radiological Control will release the SUMMA® canisters and particulate filters from the jobsite by direct measurement and smearing. Radiation and contamination surveys will be performed in accordance with HNF-IP-0718, Section 6.1, "Release Surveys for Materials and Equipment."

The second evaluation will be the analysis of the particulate filters by onsite, fixed laboratories at the Waste Sampling and Characterization Facility (WSCF) for total alpha and total beta. The reason for the particulate filter radiological testing is to document that no particulate radioactivity was introduced into the sample train media. If the results meet the WML acceptance criteria (<5 pCi/g alpha and <15 pCi/g beta-gamma), this will be evidence that the particulate filtration was effective and the samples will be released to the vapor analysis laboratory for analysis as non-radioactive material. If the filters exceed the limits, the samples will be allowed to decay for 3 to 5 days to ensure that the source of contamination is indeed radon/daughters. When the radon/daughters have decayed, the sorbent train samples can be accepted into the WML for analysis. If the samples do not decay consistently with radon/daughter contamination, the RPP Characterization Program will provide guidance for sample media handling (e.g., dispose and resample, label, and treat as radioactive material, etc.).

Analysis of the particulate filters will be performed by WSCF in accordance with Procedure LA-508-415. Alpha counts will be converted to pCi/cc by conservatively assuming the decay constant of amercium-241. An appropriate assumption for beta-specific activity will be assigned at the time of analysis, and will likely be based on the beta emission from cesium-137. All radiological screening results will be included in the final sampling/analysis report issued by WML vapor analysis laboratory.

2.7 LABORATORY ANALYSIS OF TANK VAPOR SAMPLES

Vapor samples collected from Tank 241-Z-361 will be analyzed for selected compounds as shown in Table 2-7.

2.8 SCHEDULE FOR CORE SAMPLING

Figure 2-10 provides a summary schedule for collection of cores, sampling and analysis of sludge/supernate, and vapor sample collection and analysis. The preliminary assumptions for the schedule include:

- Use of existing resources.
- The laboratory assumes that this is a high-risk task with respect to radioactivity.
- Total alpha analyses from cores 1 and 2 are required before a compositing plan can be generated.
- The preliminary vapor data from a given core must be available to allow the determination of whether to analyze the sludge/solid and supernate for volatiles.

The activity durations shown in Figure 2-10 are estimates only and assume no lost time for equipment repairs or resolution of other issues. Changes in start dates for any activities will result in changes throughout the balance of the schedule. The elapsed time for a given activity, however, should remain constant.

The high probability that the Enhanced Rad-Con screening of the analytical work-scope will result in the project being designated as a high risk is the main driver that controls the duration of this analytical project. The laboratory radiological control technician (RCT) management has agreed to make one RCT available to support this project, as a function of the priority of this project. Because only one laboratory RCT will be assigned to the project full time, analyses

Table 2-7. Chemical and Radiological Analytical Requirements.

Analyses					Criteria			Report Format
Analysis Method	Primary Analyte	Procedure	Prep	Container	Notification Limit	Precision*	Accuracy	
GC/MS	See VOAs ONLY IN Table 2-2	LA-523-404	Direct	SUMMA®	20% LFL and/or 50% IDLH	±25%	70-130%	I, VI
Total alpha Total beta	Radon Daughters	LA-508-415	Direct	Particle filter	N/A	N/A	N/A	I, VI
Total alpha Total beta	Radon Daughters	LA-508-101	Direct	Particle filter	N/A	N/A	N/A	I, VI

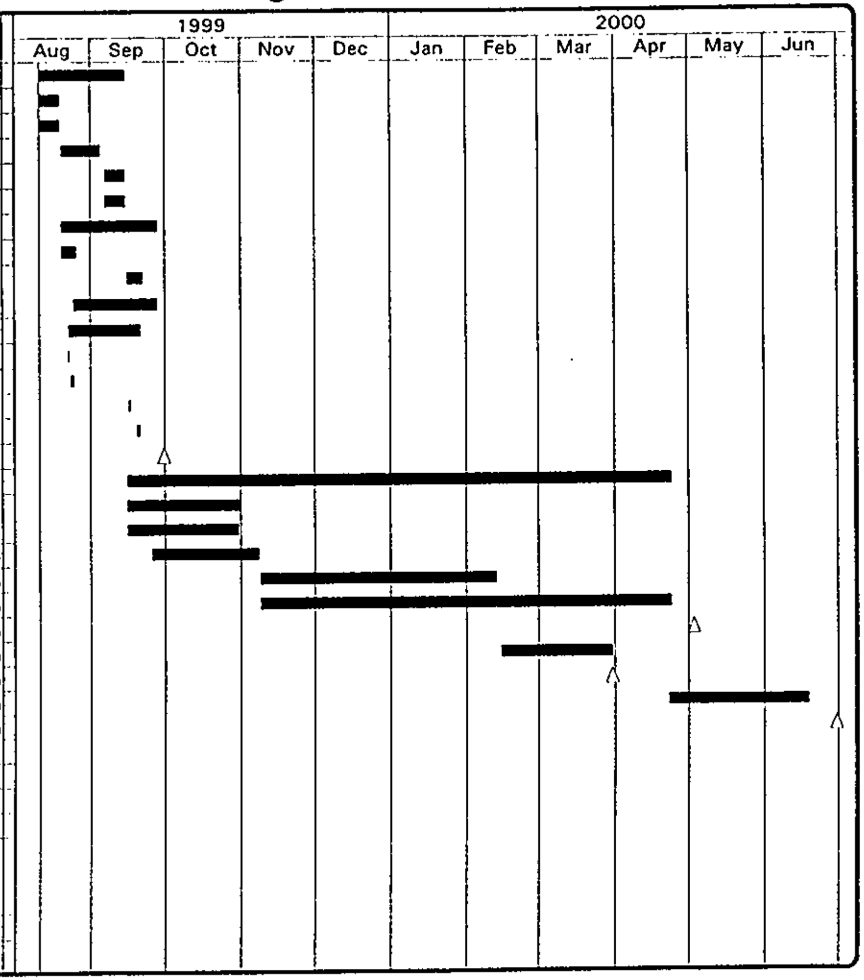
IDLH = immediately dangerous to life and health workplace level.
LFL = lower flammability limit

*Precision is defined here as relative percent difference between replicate analyses, or as relative standard deviation of continuing calibration verification results if replicate analyses are not possible.

Figure 2-10. Sample 241-Z-361 Sludge.

Sample 241-Z-361 Sludge

Row #	Task Name	Duration	Start	End
1	Sample Collection	35.00 d	Aug/11/99	Sep/15/99
2	Core #1	9.00 d	Aug/11/99	Aug/19/99
3	Core #1 SUMMA Samples	9.00 d	Aug/11/99	Aug/19/99
4	Setup for Core #2	17.00 d	Aug/20/99	Sep/05/99
5	Core #2	9.00 d	Sep/07/99	Sep/15/99
6	Core #2 SUMMA Samples	9.00 d	Sep/07/99	Sep/15/99
7	SUMMA Canister Analyses	39.00 d	Aug/20/99	Sep/28/99
8	#1 Preliminary Report	7.00 d	Aug/20/99	Aug/26/99
9	#2 Preliminary Report	7.00 d	Sep/16/99	Sep/22/99
10	Final SUMMA Report	34.00 d	Aug/25/99	Sep/28/99
11	Core Extrusion	29.00 d	Aug/23/99	Sep/21/99
12	Receive Core #1 Target Date	1.00 d	Aug/23/99	Aug/23/99
13	Extrude/Subsample Core #1	2.00 d	Aug/24/99	Aug/25/99
14	Receive Core #2 Target Date	1.00 d	Sep/17/99	Sep/17/99
15	Extrude/Subsample Core #2	2.00 d	Sep/20/99	Sep/21/99
16	Proposed Milestone: Samples to Lab	0.00 d	Sep/30/99	Sep/30/99
17	Laboratory Analysis of Cores	216.00 d	Sep/16/99	Apr/24/00
18	VOC Analysis (See Note 1)	47.00 d	Sep/16/99	Nov/01/99
19	Alpha Analysis of Strata	46.00 d	Sep/16/99	Oct/31/99
20	Review Alpha Data, Prepare Composite Samples	44.00 d	Sep/26/99	Nov/08/99
21	Perform Pu, Am, U Analyses, Provide Letter Rpt.	92.00 d	Nov/09/99	Feb/13/00
22	Perform Remaining Analyses, Compile and Rpt.	162.00 d	Nov/09/99	Apr/24/00
23	Proposed Milestone: Data Package Delivery	0.00 d	May/03/00	May/03/00
24	Prepare Recommendation for Path Forward	45.00 d	Feb/15/00	Mar/31/00
25	Proposed Milestone: Recommendation to EPA	0.00 d	Mar/31/00	Mar/31/00
26	Data Validation	57.00 d	Apr/23/00	Jun/19/00
27	Proposed Milestone: Validated Data Pkg.	0.00 d	Jun/30/00	Jun/30/00



Page 1 of 1
Note 1: Tasks 17 through 22 include Cores #1 and #2.
Z_361_5.tlp

Milestone △ Summary ▬
Fixed Delay -

must be performed in sequence without undue delay between activities. Parallel activities will require additional RCT resources. The assumption that few activities can occur in parallel will be altered if the activity of the samples upon receipt is lower than has been calculated, based on the plutonium content estimated to be 0.5 g/L up to 1.0 g/L. If the Enhanced Rad-Con screening of the analytical work-scope results in a lower designation, the laboratory may be able to perform various analysis steps in parallel, resulting in a shorter schedule. Additional schedule acceleration may be achieved by assignment of additional RCTs to support the project.

Once samples are received into the laboratory, Rad-Con support for the laboratory will evaluate whether the high risk applies. If it does not apply, every effort will be made to shorten the delivery time and BWHC will be notified should this occur. The laboratory schedule also assumes the following.

- Enhanced Rad-Con screening will require full time RCT coverage.
- Full time RCT coverage will be available and assigned to this job at a rate of 40 hr per week.
- The Z-361 core analyses will be assigned top DOE analytical priority.
- Project will not be impacted by other site performance assessment requirements or facility activities.
- Analytical re-runs will be performed as overtime activities or with additional RCT resources and are not included in the production schedule.
- Schedule assumes resources will be available for required overtime.
- Analytical support for this project will be available 40 hr per week.

The Hanford Federal Facility Agreement and Consent Order guidance indicates that this type of work should not exceed 216 calendar days from the time the sample is taken until the data are reported (Ecology et al. [1996], Section 9.6.6). The current interpretation is that tank samples that require collection via coring are allowed 216 calendar days to complete and report the analyses from the day the last segment of the second core is received by the laboratory. Based on this assumption, the current schedule as to the delivery of the data is within the Hanford Federal Facility Agreement and Consent Order laboratory performance requirement as shown in Figure 2-10.

2.9 DEMOBILIZATION AND WORK AREA CLEANUP

Waste will be disposed as described in Section 2.10 of this document. On an as-needed basis, a tent may be placed over specific work areas during demobilization. If an exhauster is used, it will be similar to the system used for removal of the glovebag during the breather filter installation as described in Appendix A of Hill et al. (1998). Procedure TO-080-453 will be used for demobilization. Demobilization will essentially follow the reverse of the site preparation and set-up described in a letter from DOE to EPA. (NOTE: EPA verbally has agreed to cover site preparation via a letter to be written by May 30, 1999. This letter will be referenced in this document in the final version.)

2.10 WASTE CONTROL PLAN

Most waste generated during the sludge sampling effort is anticipated to be nondangerous radioactive waste and will be designated for disposal at ERDF or WIPP, depending upon the TRU contamination levels and provided that the individual disposal unit's waste acceptance criteria are met. In the event that sampling and analysis or process information confirm that waste generated during this activity should be designated as radioactive mixed waste, the substantive requirements for storage and management of dangerous waste in accordance with WAC 173-303 will apply where relevant and appropriate. The federal and state regulatory requirements for management of dangerous waste containers are established at 40 Code of Federal Regulations (CFR) 264 Subpart I, WAC 173-303-630 and WAC 173-303-160. Wastes generated during the characterization of Tank 241-Z-361 will be treated as CERCLA investigation derived waste (IDW). Project wastes will include both liquid and solid field-generated wastes (contaminated and un-contaminated), samples, and analysis-related wastes generated in the laboratory. The wastes generated during the sludge core sampling field activities at Tank 241-Z-361 are expected to be similar in nature and volume to those generated during other sampling efforts at Hanford tanks. The following sections present a discussion of the types of wastes typically generated during Hanford waste tank core sampling activities and the practices for managing these wastes.

2.10.1 Projected Waste Types

The estimated waste volumes presented in this section are preliminary estimates only, based on past experience. The actual volume of waste materials generated during any particular sampling event depends on the actual range of activities performed (including alternative or contingent actions) and the potential need to dispose of failed equipment. The types of waste generated will include contaminated compactible, non-compactible wastes, uncontaminated solid wastes, and liquid wastes:

- Contaminated Compactible Wastes. Contaminated compactible wastes generated during this activity consist primarily of plastic sheeting, tape, rags, glovebags, wind screen material, and disposable personal protective equipment (e.g., gloves, caps, etc.). The quantity of compactible waste generated varies with the crew size and the time required to collect the sample(s). Previous experience suggests the likely generation of about 1,130 to 1,410 L (40 to 50 ft^3) of compactible waste per core. These materials are assumed to be radiologically contaminated.

- Non-compactible Wastes. The non-compactible waste generated in the field consists primarily of drill string pipe and pintle rods. This waste category may also include asbestos gasket material from riser flanges, and cut off riser pipe segments. Occasionally failed equipment must be disposed as field-generated waste. The proposed sampling approach for Tank 241-Z-361 should produce wastes in a volume similar to other previous tank sampling activities and should range from approximately 280 to 425 L (10 to 15 ft^3) per core. These materials are assumed to be radiologically contaminated.

- Uncontaminated Wastes. Unregulated wastes include waste paper, packaging, food containers, etc. These wastes are typically generated during routine activities in the support area outside the exclusion zone. The volume of such material is not expected to exceed 75 L (20 gal) per day.

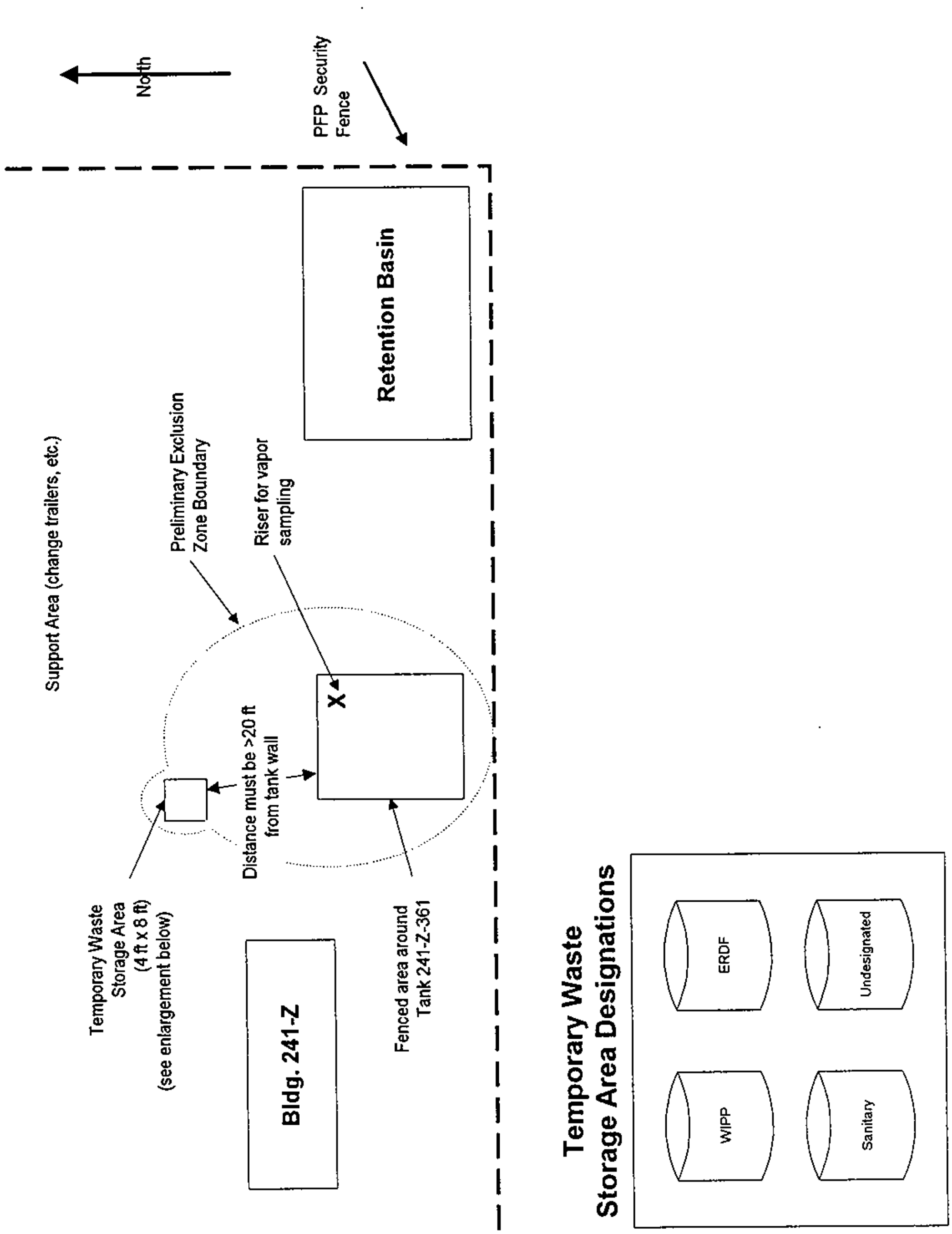
- Liquid Wastes. The primary contaminated liquid waste will be water and/or LiBr solution used to decontaminate the sampling string as it is removed from the tank. This material, estimated at about 114 L (30 gal) per core, is typically drained directly to the tank. Some small volumes of decontamination solutions from personnel and tool and equipment decontamination may also be produced.

With the exception of the above-described uncontaminated waste, the waste generated during sampling is assumed to be contaminated with trace levels of plutonium-239/240 and americium-241. To the extent practical, considering economics and the need to maintain radiation exposures as low as reasonably achievable, tools will be decontaminated and re-used (with the exception of samplers and drill rods).

2.10.2 Waste Handling Process

A temporary waste storage area for IDW will be set up within the exclusion boundary at the 241-Z-361 work area. Figure 2-11 shows the location of the temporary waste storage area. Physical barriers (e.g., ropes and fencing) will be used around the active portion of the waste storage area with warning signs posted on at least two sides of the area. All contaminated waste will be segregated to the extent practicable from noncontaminated waste. Waste management determinations for contaminated waste will be based on results obtained from characterization activities. Waste will be double plastic bagged and transported into the PFP to have the waste analyzed by Non-Destructive Analysis so that it may be designated for disposal as either TRU waste or non-TRU waste. After the PFP has completed non-destructive analysis and radioactivity analysis, the waste will be labeled appropriately and returned to the 241-Z-361 temporary waste storage area for interim storage pending disposal. While at the temporary waste storage area, the waste will be placed in the properly designated waste container, as shown in Figure 2-11.

Figure 2-11. Location of Temporary Waste Storage Area with Respect to Tank 241-Z-361.



Upon receipt of the analytical results, IDW will be properly designated. All IDW will be packaged and labeled based on the designation and in accordance with the requirements of the receiving disposal unit. If applicable, packages will be neatly labeled with the words "hazardous waste" or "dangerous waste" marked on them. U.S. Department of Transportation hazard class labels will also be included, where applicable.

The designated disposal sites for regulated wastes sites are ERDF for non-TRU waste, and the WIPP for TRU waste. An Explanation of Significant Differences to the ERDF Record of Decision, and a subsequent clarification letter issued to the Administrative Record, states that CERCLA IDW may be placed in ERDF, provided regulatory approval is gained and the waste acceptance criteria are met. EPA has granted regulatory approval for ERDF disposal of IDW generated from characterization of the 241-Z-361 Settling Tank through approval of this SAP for Phase II activities.

2.10.3 Samples and Associated Waste

Some waste materials will be generated during chemical analysis of the samples collected from Tank 241-Z-361. In addition, project staff anticipate that some residual sample material may be left after analyses are completed. All waste materials generated in the laboratory will be managed and disposed in accordance with laboratory practices and procedures. The samplers will be evaluated after completion of the analytical work to determine whether they can be disposed as radiologically-contaminated waste, TRU waste, or mixed waste, following the same logic described in Section 2.10.2 for evaluation of field-generated IDW. Residual sample material not consumed during analysis will be archived for 1 yr and then returned to Tank 241-Z-361. Residual sample material will be transported to the tank in the same manner as the original sample was handled when shipped to the lab.

3.0 QUALITY ASSURANCE PROJECT PLAN

This section includes descriptions of plans and programs to assure the quality of the information generated through this SAP. It includes discussions of Project Management, quality, objectives, date acquisition, reporting, data review, and DQA. This section includes a discussion of the various organizations and documentation responsible for management of SAP activities.

3.1 PROJECT MANAGEMENT

Figure 3-1 provides the organization chart for activities associated with the remediation of Tank 241-Z-361. BWHC will retain the overall program and project responsibility for implementation of this SAP, while LMHC is responsible for the tasks required to conduct set up and sampling of the sludge in Tank 241-Z-361. In general, BWHC will implement the elements of the *241-Z-361 Characterization Program Plan* (BWHC 1997), while LMHC will implement the elements identified in the engineering task plan, *Engineering Task Plan: Cleanup of Miscellaneous Underground Storage Tank 241-Z-361* (HNF 1997).

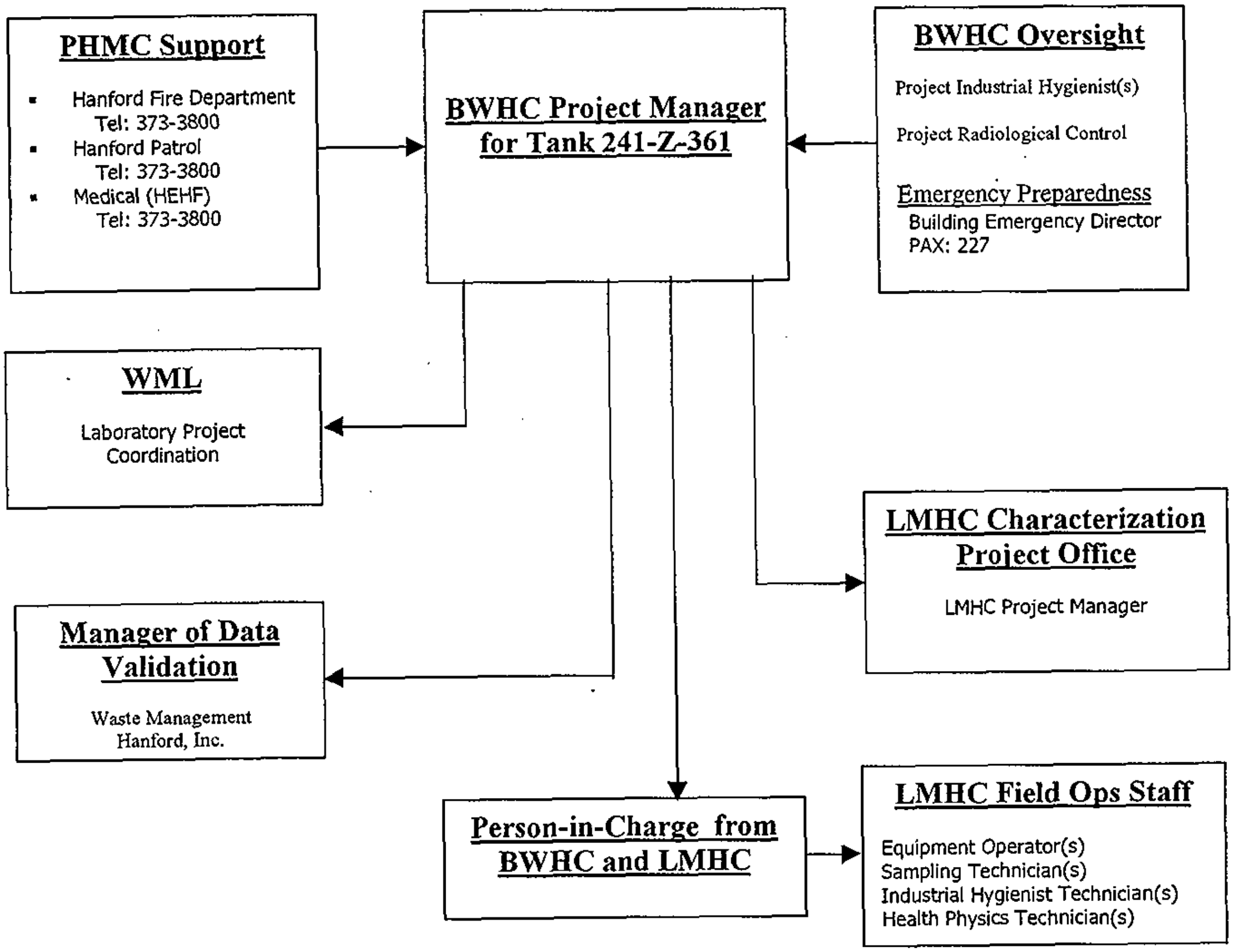
All LMHC planned work will be reviewed by the BWHC Plant Review Committee (PRC) and released within the existing BWHC work control system. LMHC's work planning and performance of work relative to Tank 241-Z-361 must be within the existing BWHC contract and authorization basis.

Preparation and maintenance of the work site will be the responsibility of BWHC, in support of LMHC. In this context, BWHC must prepare the work site to meet the reasonable needs and requirements of LMHC. This arrangement will remain in effect for the work site while LMHC is on site and performing work.

The safety basis and work authorization will be maintained by BWHC for all work associated with characterization of Tank 241-Z-361. All work (BWHC or LMHC performed) will be conducted utilizing the controls identified in the current Tank JCO (PHMC 1999), as approved by the U.S. Department of Energy, Richland Operations Office (RL), and this SAP (approved by RL and EPA).

Subject to BWHC's approval, LMHC assigned a Project Manager to the BWHC PFP Z-361 Project Manager for this characterization task. The LMHC Project Manager is responsible for the management and successful completion of LMHC work, work assignments, and work performance within agreed-to schedules and costs. LMHC shall assign sufficient resources in a timely fashion to achieve the planned work, as approved by BWHC.

Figure 3-1. Organization Chart.



Prior to initiating physical work on the tank, BWHC will conduct a contractor Standard Startup Review, per HNF-PRO-055, to ensure all prerequisites have been met and all assigned organizations and individuals are adequately trained and prepared for their assigned tasks. It is anticipated that FDH will perform a focused, limited sample standard start-up review before sludge/solid sampling.

The BWHC Project lead will work with a BWHC planner to complete the PFP work package. This includes providing the as low as reasonably achievable review, Job Hazards Analysis, and waste management sheet, etc., including those prepared by LMHC. The PFP PRC will review and approve the work approach and controls prior to release of work, to assure that this work is within the authorization basis (PHMC 1999). The work will be released through the standard BWHC work control system.

3.1.1 Emergency Preparedness/Response

LMHC will provide BWHC a formal lay-down plan and work process that they will use for sludge sampling. In addition, LMHC will provide a daily listing, during the sampling events, of all LMHC Characterization project staff who will be inside the PFP fence. LMHC will provide procedures and provide an overview of the planned steps for sludge sample collection to the BWHC PRC, Operations and emergency preparedness staff.

BWHC will limit access to the sampling site during sampling activities. The only staff allowed inside the exclusion zone will be Characterization Project Office (CPO) staff, unless the LMHC person in charge requests specific external assistance. BWHC will also provide any necessary crowd control to minimize any unnecessary staff from being near the immediate tank area during the field operations.

A project-specific contingency plan, which incorporates existing PFP emergency procedures, is presented in Appendix C, Attachment C2, as part of the site-specific health and safety plan.

BWHC will provide facility orientation training to the LMHC and contractor staff for PFP facility and Tank 241-Z-361-specific emergency response actions. Facility orientation and emergency training will take between 4 and 8 hr and will be provided at the PFP training facility (trailer outside secured compound) at no additional cost (other than staff time) to LMHC and contractor staff. BWHC will maintain the official training records and will provide the LMHC Project Manager with a copy of the records.

3.1.2 Engineering

All engineering for sludge sampling systems will be the responsibility of the LMHC CPO. All existing LMHC CPO review requirements for sampling apparatus reviews will be met.

All work packages will be initiated and prepared by the RPP Characterization engineering organization, in concert with the CPO staff. These work packages will be developed consistent with all CPO requirements. The CPO work package will be inserted into a PFP Work Package; the overall work package will be reviewed by the PFP PRC prior to release.

BWHC will provide training for LMHC engineers or managers to qualify the trained staff to perform USQ reviews against the Tank JCO (PHMC 1999). LMHC will prepare the necessary USQ evaluations of procedures and work packages to support sludge sampling and sample preparation, transfer, and storage activities. The final work scope and controls will be reviewed by the PFP PRC to assure that the work is all within the controls specified by the RL-approved Tank JCO.

3.1.3 Industrial Safety and Health

BWHC is responsible for the job-specific Health and Safety Plan for the core sampling activities. The Health and Safety Plan is included as Appendix C to this SAP, consistent with CERCLA requirements. BWHC and LMHC key staff participated in the planning/scoping meetings for this document. Supplemental job hazards analysis documents will be prepared as required by the organizations responsible for specific tasks.

3.1.4 DQO/SAP/Laboratory Analysis

BWHC will provide overall project planning and control of all laboratory analysis requests.

The WML will provide or coordinate all necessary analytical support. This support will include determining the location of analyses (e.g., 222-S, WSCF, PNNL). The laboratory has provided a Ph.D. scientist as project coordinator. The WML will also assure that the procedures used meet the requirements of the DQO as well as the *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD) (DOE-RL 1998). The 222-S laboratory will perform the core sample analysis, unless otherwise recommended by WML and agreed to by BWHC.

3.1.5 Nuclear Safety

BWHC will prepare or coordinate the preparation of any necessary criticality analysis work as part of the Tank JCO (PHMC 1999). Any special nuclear safety requirements, beyond the standard radiological control requirements, will be defined as part of the Tank JCO. LMHC is responsible to assure that all procedures and work plans are consistent with the Tank JCO and that all work complies strictly with all applicable nuclear safety requirements. Criticality concerns regarding the sludge remaining in Tank 241-Z-361 will not be fully resolved until the characterization activities described in this SAP are complete. Project personnel will, therefore, conduct field operations in a manner consistent with the procedures described in this plan to prevent disruption of the sludge beyond that required for collection of the planned core samples.

Supplemental assessment of the potential for a criticality event relating to the contents of Tank 241-Z-361 will be made following this characterization and before implementation of any action that would significantly change the form or configuration of the tank contents.

3.1.6 Operations

All operations staff, including BWHC and FDH PFP support staff, within the designated sampling area will be under the direction and control of the LMHC CPO manager. The BWHC and LMHC person in charge will perform all necessary duties including conducting a pre-job briefing.

LMHC CPO will identify in advance the specific laydown area for the work and any specific service requirements and other materials that BWHC PFP is to provide. The details regarding quantity and location of service and materials will be specified in advance of the job mobilization. This information may be provided through informal (e-mail, meeting minutes) communications between the CPO Project Manager (or delegate) and the PFP Project Manager and must be mutually agreed to.

3.1.7 Program Management

BWHC will have overall programmatic responsibility. This includes preparing any change requests and special presentations. LMHC will designate a project manager to assist in the management of the characterization portion of this work. The program management has the lead in defining and implementing all readiness review actions required prior to implementing this work. This will include scheduling necessary PRC meetings to review the final work packages.

3.1.8 Radiation Control

BWHC will perform the initial site survey of site radiation levels (after the load test has been completed and any personnel or load restrictions have been established and implemented). These data will be shared with the LMHC RPP Characterization radiological control group. BWHC and LMHC radiological control groups will perform a joint pre- and post-sampling activity radiological survey to assure that agreement is reached between the groups relative to pre- and post-sampling radiological conditions. BWHC will provide calibrated, portable continuous air monitors for use by the LMHC Radiological Control Organization while they are at the Tank 241-Z-361 site.

3.1.9 Regulatory (Environmental)

BWHC is responsible for all environmental approvals. LMHC will support this effort via document reviews, providing process descriptions or other information on work techniques, as requested. This work will be performed under CERCLA regulations. BWHC is responsible for formal submittal of the SAP to EPA. LMHC shall be responsible for timely advising BWHC of site conditions that may trigger the need for any environmental permit or approval.

3.1.10 Laboratory Services/Data Validation

The WML includes the WSCF, 222-S, and Vapor Analysis Laboratories. The laboratory project coordinator will serve as the single point-of-contact for all analysis. The data validation manager will serve as contact for data validation by third-party firms.

3.1.11 Scheduling

BWHC will prepare and maintain a detailed working schedule. The schedule will be reviewed each week by the PFP Z-361 Project Manager. The 241-Z-361 Characterization Project Manager will provide weekly status reports against this schedule. The PFP Business Manager will determine which of the dates need to be tracked on the official baseline schedule. Statused schedules will be provided by BWHC to FDH and RL as requested.

3.1.12 Security

BWHC will provide security escorts as required for all CPO staff. The bulk of the CPO staff do not need to obtain security level "2s", nor do they need to obtain a permanent "Z" access on their badge.

3.1.13 Training

BWHC will provide LMHC engineering staff any necessary training to the levels specified in the Tank 241-Z-361 JCO (PHMC 1999). BWHC will also provide or authorize access to any facility specific training that is necessary to support sampling crew access to the 241-Z-361 site, as well as provide any specified facility and emergency planning training to the CPO staff. CPO must provide the names of the crew in advance of the sampling event so that appropriate training may be scheduled.

LMHC is required to provide operating and support crews for the 241-Z-361 characterization work that have the work training necessary to be qualified to perform the work (example: RadWorker II), including any specialized training regarding use of the basic characterization equipment.

3.1.14 Quality Assurance

Detailed QA reviews will be performed, as required, by BWHC QA staff. Quality assurance of the laboratory analysis process, including assuring that the analytical work will meet the requirements of the HASQARD (DOE-RL 1998) and the DQO (BWHC 1999), is the responsibility of BWHC and the WML Operations. The BWHC QA organization will provide oversight as necessary.

3.1.15 Work Control

All work related to Tank 241-Z-361 will be planned and conducted under the auspices of detailed work packages prepared by the responsible organizations. The work packages prepared by the respective organizations will be submitted to the BWHC Project Manager for inclusion in the PFP Work Package folder. The PFP PRC will review all work packages to confirm compliance with the Tank 241-Z-361 JCO (PHMC 1999). Following this review, the work packages will be released to BWHC Work Control for implementation.

3.2 TRAINING

The activities described in the Health and Safety Plan (Appendix C) provide workers with the knowledge and skills necessary to safely execute assigned duties. A graded approach is used to ensure that workers receive a level of training commensurate with their responsibilities which also complies with applicable DOE orders and government regulations. Specialized employee training includes pre-job briefings, on-the-job training, emergency preparedness, plan of the day, and facility/work site orientations; all members of the Building Emergency Response Organization must receive the specialized project training. Table 3-1 presents the training and qualifications applicable for facility work and activities. The Health and Safety Plan in Appendix C describes training requirements in greater detail.

Before initiation of any activities, BWHC will conduct project-specific facility orientation and emergency preparedness training. In addition, BWHC will conduct a standard startup review per HNF-PRO-055. This formal review will ensure all work prerequisites have been met and all assigned individuals and organizations are adequately prepared and trained for their assigned tasks.

Table 3-1. Radiological Entry Requirements (Summary Table).

Visitor Requirements	
All areas within the tank sampling area (behind the fence).	No visitor entries allowed.
Workers	
All areas within the tank sampling area (behind the fence).	1) RadWorker II 2) Task-specific training as delineated in the governing work packages (Training Matrix) and applicable activity hazard analyses, and Appendix C, Section C3. Pre-Job Safety and Plan-of-the-Day briefings including updates on ongoing activities and changing field conditions.
Entries into RBA and RA. Entries into CA, HCA, HRA, or ARA.	24-hr Hazwoper and RadWorker I Training 40-hr Hazwoper and RadWorker II

Note: DOE Facility Reps may act as the Escort for all DOE business and tours.

ARA = airborne radiation area
CA = contamination areas
HCA = high contamination area
HRA = high radiation areas
RA = radiation area
RBA = radiological buffer area

Each employee's training records are maintained and continuously updated by the PHMC. Current training status for any PHMC employee is accessible via computer database. More detailed information on this database is included the Health and Safety Plan in Appendix C.

3.3 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A DQO process to support this SAP was conducted in accordance with Guidance for the DQO Process (EPA 1994), as implemented according to *Data Quality Objectives for Sampling and Analyses* (LMHC 1997). Input to the DQO process was provided by members of PFP (engineering, environmental, and laboratory personnel), RPP Characterization, and WML. A summary of the contaminants of concern for Tank 241-Z-361 sludge is presented in Table 1-6. Potential action levels, required estimated quantitation limits (EQLs), and analytical measurement methods are presented in Tables 2-2 through 2-5.

Data generated as part of this sampling and analysis project must be credible and withstand technical scrutiny by individuals and organizations interested in Tank 241-Z-361 safety issues, safeguards issues, sludge characterization issues, sludge retrieval issues, air emission control issues, and CERCLA remedial activities.

Sampling activities will be performed using procedures that have been developed for Hanford tank sampling and analysis. In general, these methods are based on EPA analytical methods, adapted for use at Hanford. For example, the GC/MS method for air analysis, LA-523-404, is based upon Method TO-14 (Winberry et al. 1990). Similarly, the ammonia analysis of the sorbent train scrubber solution, LA-533-402, is based on the SW-846 (EPA 1997a) Method 9056. These procedures have been in use and have generated vapor data of known quality for a number of years.

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by representativeness, comparability, accuracy, precision, and completeness. Definitions of these parameters, applicable guidelines, and level of effort are provided below. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. The fixed laboratory parameters are presented in Tables 2-2 through 2-5.

Representativeness is a measure of how closely the results reflect the actual concentration distribution of the chemical and radiological constituents in the matrix sampled. Sampling plan design, sampling techniques, and sample handling protocols, discussed in other sections of this document, provide documentation to establish that sample identification and integrity are ensured.

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures, consistent methods, and equivalent units.

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is normally assessed by spiking samples with known standards and establishing the recovery. A matrix spike (MS) is the addition to a sample of known amounts of a standard compound similar to the compounds being measured. Surrogates are deuterated compounds spiked in the organic matrix and are also used to assess accuracy. Table 3-2 lists the accuracy requirements for fixed laboratory analyses for this project.

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements. Laboratory duplicates are included in the project design, enabling estimates of laboratory precision. Precision requirements for fixed laboratory analyses are listed in Table 3-2.

Completeness is a measure of the amount of valid data obtained from the analytical measurement process and the complete implementation of defined field procedures. Completeness is set at 90% for field survey and fixed laboratory analyses. Completeness will be calculated as the number of valid analytical results divided by the number of analyses requested, multiplied by 100.

The EQL is the lowest concentration of an analyte that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is determined by methods per Chapter 1 of SW-846 (EPA 1997a) and HASQARD (DOQ-RL 1998). EQLs are functions of the analytical method utilized to generate the data and the quantity of sample available for analyses. The term EQL is synonymous with PQL. Radionuclide EQLs are expressed as minimum detectable activity (MDA) and can be reduced by extending the counting time of a measurement point to improve counting statistics. MDAs are determined per Volume 4 of HASQARD.

3.4 MEASUREMENT/DATA ACQUISITION

The data acquired from QC procedures are used to estimate the quality of analytical data, to determine the need for corrective action in response to identified deficiencies, and to interpret results after corrective action procedures are implemented. Method-specific QC procedures are not applied universally, but are incorporated in the individual methods.

This section identifies the minimal QC components that should be used in the performance of sampling and analyses, including the QC information that should be documented.

3.4.1 Sample Collection Methods and Requirements

The samples from Tank 241-Z-361 will be collected using one of RPP's specially-designed sampling trucks. The core sample collection procedures are described in Section 2.3 of this SAP.

3.4.2 Sample Management

All required records pertaining to sample management shall be maintained and updated regularly. These include chain-of-custody forms, sample receipt forms, and sample disposition records. All samples obtained during the course of this project will be controlled from the point of origin to final disposal in accordance with established custody procedures. The laboratory shall provide unique sample identification numbers on the sample containers. The laboratory shall pre-label all sample containers before filling the container. The laboratory records shall allow the correlation of the sample to the core, segment, depth in segment for grabs and to strata for composites. Several laboratory locations are available for the analytical work, including the following:

- 222-S for extrusion and analysis of highly radioactive samples
- WSCF, for analysis of low-level radioactive samples and extracts
- Vapor Laboratory, now located at WSCF, for the analysis of vapor samples
- PNNL Lab for analysis of organic radioactive samples.

These laboratories will provide analytical services that are in accordance with SW-846 or equivalent approved methods. The laboratories will be informed of the upcoming sampling schedule and will provide back up to each other in case one laboratory cannot perform the analysis. The WML Project Coordinator will assure that analyses are performed and records include the location of analysis and the person performing the analysis.

Cores from the two risers will be transported to the laboratory within two days of obtaining three segments or when one core sample is completed, whichever occurs first (this schedule assumes up to three segments in three OTCs can be transported simultaneously to the laboratory). Onsite and laboratory storage of samples is discussed in Section 2.0. Appendix D provides a detailed discussion of holding times and sample preservation.

3.4.3 Field Sampling Quality Control

The field sampling will not require collection of equipment rinsates because new samplers will be used each time a sample is collected.

Because reentering a riser that has already been sampled may result in a sample that is not representative, no field duplicates will be obtained.

A sample of the LiBr solution will be collected for analysis before sampling begins and each time new solution is made.

3.4.4 Laboratory Analytical Method Requirements and QC

The analytical requirements are discussed in Section 2.5. To assure quality measurements, analytical data are obtained with a stringent set of QA samples. These samples and associated requirements are described below:

- One laboratory method blank for every 20 samples of similar matrix (5% of samples) or preparation batch will be carried through the complete sample preparation and analytical procedure. The method blank consists of analyte-free water and will be used to document contamination resulting from the analytical process.
- One laboratory control sample (LCS) or blank spike will be performed for every preparation batch of up to 20 samples of the same matrix for each analytical method to monitor the effectiveness of the sample preparation and analysis process. The results from the analyses are used to assess laboratory performance.
- An MS sample will be prepared and analyzed for every 20 samples (as applicable to method) of the same matrix or sample preparation batch, whichever is most frequent. An aliquot of the sample is spiked with the analytes of concern and the results of the MSs are used to document the bias of an analytical process in a given matrix.

- Laboratory duplicates or matrix spike duplicates (MSDs) will be used to assess precision and will be analyzed at the same frequency as the MS samples. A laboratory duplicate is an aliquot of the same sample, while a MSD is a second MS of the same sample. To compare two values, the relative percent difference is based on the mean of the two values and is reported as an absolute value. Either a lab duplicate or MSD will be performed for every preparation batch of up to 20 samples of same matrix for each analytical method.

- For metals such as sodium and aluminum, a serial dilution may be performed to assess the accuracy of the analyte measurement. A serial dilution is required for analytes with concentrations that approach the upper limit of the linear range. The serial dilution should be performed on the same sample as the MS analysis. This will allow the assessment of the accuracy of the analysis when spike concentration is insufficient for the analysis due to the high analyte concentration in the sample. The results for the serial dilution must be reported in addition to the MS recovery when the spike recovery falls outside of the acceptance range.

- Tracers are used during the analysis for radionuclides. A tracer is similar to a MS, as the sample is spiked during sample preparation with a radioisotope that chemically behaves similar to the isotope in question. Tracer recovery provides an evaluation as to the effectiveness of the sample preparation process used to isolate the radioisotope of interest. The tracer recovery factor is used to calculate the sample activity, uncertainty, and MDA.

- The sensitivity, better known as EQL as defined in Chapter 1 of SW-846 (EPA 1997a), is specified in Tables 2-2 through 2-5. The EQL is also called a PQL. The EQL or PQL will be determined for non-radionuclides per Chapter 1 of SW-846. If the EQL cannot be met or an EQL below the action limit cannot be determined, the steps described in Section 2.5.5 will be followed.

- Method detection limits, as defined in Chapter 1 of SW-846 (EPA 1997a), will be determined on a water or clean solid matrix for the specific method to verify that the laboratory can successfully perform this method. This information will be kept on file at the laboratory.

- Both the EQL and MDL must be determined in a manner consistent with Volume 4 of HASQARD (DOE-RL 1998)

- For radionuclides, the MDA will be calculated per Volume 4 of HASQARD (DOE-RL 1998). The EQL or PQL and MDA will be reported for the samples in question. The EQLs/PQLs reported for each sample shall take into account the matrix, amount of sample used, and dilutions, and will be reported for each sample.

Table 3-2 provides the QC limits required for the sludge and supernate analyses from the core samples. The QC requirements for the vapor samples are outlined in Table 2-6 and Section 3.6.3. Table 3-3 provides the frequency of these QC samples.

Table 3-2. Analytes for Quality Control Criteria.

Analytical Method	Technique	QC Acceptance Criteria		
		LCS % Recovery	Spike % Recovery	RPD
160.1	TDS – gravimetric	80-120	N/A	<20
350.3	NH4 – ISE	80-120	75-125	<20
2560	Particle size and distribution	N/A	N/A	<30
2710F	Specific Gravity - gravimetric	N/A	N/A	<30
6010B	Metals - ICP	80-120	75-125	<20
6020	Metals - ICP/MS	80-120	75-125	<20
6020	Actinides (Pu, $^{238}U/^{238}Pu$) *	50-150	50-150	<20
7470A/7471A	Mercury – CVAA	80-120	75-125	<20
7060A/7131A/ 7421	Arsenic, Cadmium, Lead - GFAA	80-120	75-125	<20
8260B	Volatile - GC/MS	Analyte specific		
8270C	Semi-Volatiles - GC/MS	Analyte specific		
9012A	Cyanide – microdistillation/colorimetric	80-120	75-125	<20
9040A/9045B	pH – electrode	0.1 pH	N/A	N/A
9056	Anions - IC	80-120	75-125	<20
9060 (mod-solids)	Total organic carbon – Persulfate oxidation	82-106	75-125	<20
Proportional	Gross alpha/beta - proportional	70-130	70-130	<20
AEA	Alpha energy analysis	70-130	70-130	≤20
Titration	Titration for OH	80-120	75-125	<20
Liquid Scint.	Liquid Scintillation	80-120	70-130	<15
Gravimetric	% moisture	80-120	N/A	<30

RPD = relative percent difference

* For the measurement of the actinides, the recovery ranges are a recommendation, not a requirement.

Table 3-3. Lab Quality Control Sample Type and Frequency.

QC Sample Type	Frequency
Laboratory Method Blank & LCS	1 per 20 samples of same matrix, same preparation batch
MS or Tracer	
Laboratory Duplicate or MSD	

The recovery ranges specified in Table 3-2 for the ICP/MS method measuring the actinides is a recommendation, not a requirement. The ICP/MS method measuring the actinides uses as an indirect calibration method mainly because of the difficulty in obtaining two separate sets of elemental and isotopic standards that can be used to verify each other. Currently, the ICP/MS is calibrated indirectly for actinides, using a mass response curve derived from the analysis of a 10 ppb thorium-232 and uranium-238 standard. Chemical separation will be performed before ICP/MS analysis to allow quantitative determination of isotopes of the same mass. The validity of this approximation is checked using an initial calibration verification standard containing thorium-232, neptunium-237, plutonium-239, and amercium-241 at approximately 10 ppb. Typically, the thorium-232 recovery is very good (90% – 100%), because it is, in part, used to build the calibration curve. For the other three isotopes, recoveries ranging from 50% – 150% are not uncommon.

3.4.5 Radiological Surveys

Radiological surveys are an essential part of the characterization of Tank 241-Z-361. Information collected from on-site radiological surveys will be used to determine whether protective equipment action levels have been exceeded and to monitor the effectiveness of radiological contamination control efforts. Note that all intrusive work in the exclusion zone will be conducted using Level C respiratory protection (i.e., air-purifying respirators). Radiological surveys will be conducted in the field by trained health physicists and/or health physics technicians and will include the following activities:

- Source surveys (i.e., surveys at riser openings and at samplers and other equipment removed from inside the tank) for alpha;
- Work area surveys (i.e., in and around the workers in the exclusion zone, including breathing zone monitoring) using hand-held instruments, and continuous alpha air monitor(s); and
- Exclusion zone monitoring (i.e., at the exclusion zone boundary in one location) using a fixed-head air sampler.

Fixed-head air sample will be surveyed using field instruments every 15 minutes. Additional details of radiological survey requirements, including action levels, are presented in the Site Specific Health and Safety Plan (Appendix C of this SAP).

3.4.6 Industrial Hygiene Surveys

Industrial hygiene surveys will be conducted during characterization of Tank 241-Z-361 to ensure the proper use of personal protective equipment and to monitor the effectiveness of contamination control efforts. Industrial hygiene surveys will be performed or directed by industrial hygienists and/or industrial hygiene technicians and will include the following activities:

- Source Surveys (i.e., at riser openings and at drill string openings during sample movement) for volatile organic compounds (using photo-and/or flame-ionization detectors), ammonia (using direct reading ammonia detector), combustible gases and oxygen (using a direct reading CG/O_2 meter), carbon tetrachloride, and chloroform (using colorimetric indicator tubes);

- Work Area Surveys (i.e., in and around the workers in the exclusion zone, including breathing zone monitoring) for the same constituents; and

- Exclusion zone monitoring (i.e., at the exclusion zone boundary in multiple locations) for the same constituents.

In general, industrial hygiene monitoring will be conducted coincidental with radiological surveys in both time and location. Additional details of the industrial hygiene survey requirements, along with protective equipment requirements, are presented in the site-specific Health and Safety Plan (Appendix C of this SAP).

3.4.7 Quality Control Requirements

Field QC is governed by collection procedures discussed in Section 2.3 of this SAP. Each laboratory performing work shall have a QA program that complies with HASQARD (DOE-RL 1998). The QC components of these programs will be applied to activities conducted in support of this SAP.

3.4.7.1 QC for Sludge/Solid and Supernate Analysis. The WML QA programs that apply to sludge/solid and supernate analysis are compliant with HASQARD. These QA Plans are listed below:

- WSCF Laboratory QA Plan (Meznarich 1997)
- 222-S Laboratory QA Plan (Markel 1998)

Any other laboratory performing work shall have an authorized QA Plan that complies with HASQARD.

3.4.7.2 QC for Vapor Analysis. The QA Management plan used for vapor sampling and analysis is compliant with HASQARD (Dormant 1998) and shall be used for 241-Z-361 vapor sampling.

3.4.8 Lab Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Operating Procedures. Laboratory personnel shall follow procedures established in the relevant QA program for testing, inspection, operation and maintenance of all laboratory instruments and equipment. Procedures should be readily available to those performing the task outlined. Any revisions to laboratory procedures should be written, dated, and distributed to all affected individuals to ensure implementation of changes.

Equipment Maintenance Documentation. The maintenance record of each system serves as an indication of the adequacy of maintenance schedules and parts inventory. As appropriate, laboratory personnel should follow the maintenance guidelines of the equipment manufacturer. When maintenance is necessary, it should be documented in either standard forms or in logbooks. Maintenance procedures should be clearly defined and written for each measurement system and required support equipment.

3.4.9 Lab Instrument Calibration Requirements

Calibration is a reproducible reference point to which all sample measurements can be correlated. A sound calibration program should include provisions for documenting frequency, conditions, standards, and records reflecting the calibration history of a measurement system. The accuracy of the calibration standards is important because all data will be in reference to the standards used. A program for verifying and documenting the accuracy and traceability of all working standards against appropriate primary grade standards or the highest quality standards available should be routinely followed. All instrumentation used shall follow established procedures, as specified by methods listed in this SAP and by HASQARD (DOE-RL 1998), for calibration and frequency of maintenance to assure that quality data are obtained during measurements.

3.4.10 Modifications, Deviations, Changes, and Observations

Any modifications made to, or deviations from, the prescribed procedures shall be documented in the project notebooks, laboratory reports, and project records in accordance with the QA/quality control program and project documents. All such modifications, deviations, and observations will be noted and justified, as appropriate, in the final sample analytical reports.

Nonconforming sampling and analytical actions or omissions will be identified, controlled, reported, and dispositioned as required by *Nonconforming Item Reporting and Control* (PHMC 1997b).

3.5 REPORTING

Reporting requirements for data include documentation of activities conducted in the field, as well as laboratory reports. The following discussions present the documentation required for this SAP. All reports shall be delivered to the BWHC Project Manager. The BWHC Tank 241-Z-361 Project Manager will officially submit the reports to FDH and the FDH Program Manager will officially transmit the report to the RL Transition Program Division Director. The RL will officially transmit the report to the EPA Region 10 office in Richland, Washington.

3.5.1 Documentation and Data Packages for Cores

3.5.1.1 Field Documentation. All sampling activities shall be documented in work packages or other controlled documentation packages, maintained by sampling personnel. This documentation for both core and vapor samples must include:

- identification of tank and riser number of the sampling location,
- any observed anomalies, corresponding sample identification numbers, flow rates, pressures, temperatures and other operational parameters potentially affecting the sample,
- any conditions that the sampling team observes during the sampling event (e.g., odors, nearby activities, machinery, electrical anomalies, etc.),
- names and titles of personnel involved in the field activity and their responsibilities, and
- problems and procedural changes potentially affecting the validity of the sample.

3.5.1.2 Laboratory Documentation. Laboratory reports may fall into one of four formats, for the purpose of this SAP:

1. Format I = Analytical results only for vapor sampling only
2. Format V = Analytical results, as well as all raw data, including calibration data (see Appendix E) for core/supernate data.
3. Format VI = See details listed in Table 3-4. Applies to vapor sample data only.
4. Preliminary letter report for total alpha results.

A preliminary letter report will be generated for the total alpha results obtained before compositing. The preliminary letter report will be sent to the BWHC Project Manager from the laboratory within 5 days after completion of total alpha from both cores. The BWHC will provide a copy of this report to those performing the DQA and compositing instructions. The report will include:

- Results with units,
- Details of extrusion, appearance of each segment and strata within each segment,
- Pictures and or video tape of each segment,
- Correlation of the sample result and the location including core, segment and depth in the segment, from the which the sample was collected, and
- QA review results of the total alpha as described in Section 3.6.1.

The required analytical report for analysis of core samples is defined by the laboratory as a Format V report. The contents of the report shall be presented in a manner to allow validation of the data. Appendix E identifies the contents of the report.

The sludge sample data package includes the data for all core samples, visual strata, details of extrusion, including composites, segments, subsegments, drainable liquids, and associated blanks taken and analyzed from the tank during a single sampling activity. This data package shall be issued as a document approved for public release through the document control system. The raw data shall be accessible to the EPA and BWHC until the waste tank is closed or the waste is treated.

The data package should be organized into two major parts: (1) a summary report section, and (2) a raw data compilation. Both data package sections will be organized according to the type of analyses or activity which generated the data. The summary report section should be comprised of two subsections: (1) a narrative describing the methods used and any unusual sample or QC results from each analysis or activity, and (2) summary tables of the sample analyses and QC results. Each raw data activity should be organized by analysis type and batch or by the time period when the activity occurred. For most analytical measurements, the batch arrangement should require the least duplication.

3.5.2 Compositing Plan

After DQA of total alpha results from cores 1 and 2, the project management will provide a compositing plan to WML. The plan will describe the results of the DQA of total alpha analysis, the visual assessment of the strata between cores, and which strata to composite, as described in Section 2.4 of this SAP.

3.5.3 Data Reporting and Schedule for Vapor Samples

Results of the sample team observations and laboratory analytical results will be reported in one of two potential report formats. These report formats are standardized and are known as either "Format I" or "Format VI" reports, an overview of Format VI is provided in Table 3-4.

3.5.3.1 Immediate Notification (Format I). An immediate notification report (Format I) is used to communicate that specific analytes have exceeded an agreed-to threshold specified as a "Notification Limit" in Table 2-7. These thresholds relate to potential safety or notification levels leading to some decision or action. Potential actions may include tank access control upgrades or environmental condition notification to RL. Notification to project management of preliminary results of the analysis of SUMMA® canisters will provide the basis for determining the need to sample core segments for VOA analysis. The Format I report includes immediate verbal notification to the Tank 241-Z-361 Project Manager, followed within three working days by written communication to the PFP Safety Manager and the Tank 241-Z-361 Project Manager at BWHC. It is the responsibility of the Tank 241-Z-361 Project Manager to provide immediate verbal notification to the PFP Safety Manager and the EPA Project Manager. The PFP Safety Manager must notify appropriate personnel of significant health and safety issues.

3.5.3.2 Analytical Results (Preliminary Report and Final Format VI). Preliminary vapor sampling and analytical data are requested for GC/MS analysis within 4 days after receipt of the last sample collected for a given riser. For example, if five segments are collected from a riser, five SUMMA canisters will be analyzed by GC/MS for volatile organics and after receipt of the last vapor sample from that riser, a draft report will be provided indicating whether any detections for the volatile organics are above detection limit. The preliminary report shall provide:

- segment and core associated with air sample,
- results,
- units, and
- sample detection limits.

Positive detections will result in analysis of the sludge for volatiles.

The draft final data report and draft data package shall be submitted to the 241-Z-361 Project Manager by the laboratory project coordinator for review within four weeks after receipt of all the samples and supporting data. Comments shall be provided to WML within one week after receipt of the draft data package and a final data package shall be issued within two weeks of receipt of comments. The final data package is considered a Format VI report and contains the elements listed in Table 3-4, as agreed to by WML.

Table 3-4. Final Vapor Report Contents (Format VI).

Analyses Elements
Analytical case narrative
Analytical procedures identification table
Data qualifier flag translation table
Target analyte and duplicates concentration table
Tentatively identified compound concentration table
Laboratory blank summary
Field blank summary
Mass spectrometer instrument tune report
Target analyte initial calibration table
Target analyte continuing calibration table
Internal standards area counts table
Laboratory control sample results table
Surrogate compound results
Quantitation reports
Chromatograms
Mass spectra of reported tentatively identified compounds
Review Elements
Quality assurance data package review results

3.5.4 Electronic Deliverables

Laboratories shall prepare all data reports in electronic format. The electronic format shall be capable of being electronically down loaded to the Tank Waste Information Network System database and shall be an ASCII, comma-delimited file that is compatible with Excel 1997. PNNL's "Standard Electronic Format Specification for Tank Characterization Data Loader" (Bobrowski et al. 1998) outlines the necessary format for electronic data down loaded to Tank Waste Information Network System.

3.5.5 Data Validation Report

The validation reports will be provided based on WHC (1993), Reporting Requirements. The reports will include:

- Introduction,
- Summary of whether project-specific DQOs were met,
- Major Deficiencies,
- Minor Deficiencies, and
- References.

3.5.6 Data Quality Assessment Reports

The steps in EPA G-9 (EPA 1994) for data DQA will be followed along with the process discussed in Section 3.7 of this report. A letter report will be provided to the BWHC Project Manager from assessors that addresses the following topics:

- Summary of the data,
- Identify data that are missing, incomplete, or are inadequate for decision making,
- Selection and use of statistical tests,
- Results of statistical tests,
- Evaluation of exploratory data analysis,
- Spatial evaluation of the data, and
- Summary of the utility of the data to make the decisions listed in Step 2 of the DQO Process.

3.6 DATA REVIEW AND VALIDATION

3.6.1 Data Review

The laboratory will perform a peer review of all analytical data by a person trained in each particular analytical method being reviewed. This is also called a one-over-one review. HASQARD, Volume 3, Section 8 (DOE-RL 1998) describes the data review that will be performed by the laboratory. The laboratory will also use its own procedures that conform to HASQARD to provide review of the data before reporting the data to BWHC. This review will be performed on all data (sludge/solid, supernate, and vapor samples) before submission of the final report to BWHC.

The initial total alpha analysis of the sludge/solid, which will be used to assess the locations of strata and to determine the strata to composite, will undergo a special QA review by the qualified staff at WML. The QA review will be based on WMH-310, Analytical Report Review. In addition to the procedure previously described, BWHC will provide a list of questions and checks that will be used in the review. The list will be discussed with the reviewers and project laboratory coordinator more than a month before the data review is required. The revised list of questions/checks will be based on WHC (1993) for total alpha analysis. The review will be documented per WMH-310 along with the specified checklist. Copies of the review will be provided to the BWHC Project Manager and staff working with the project manager to perform DQA on the data.

After QA review, the laboratory project coordinator will provide a preliminary report of the total alpha data to the BWHC Project Manager and to the DQA staff. The preliminary report will include:

- Descriptions of the waste during extrusion with pictures/videos,

- Description of visual strata attributed to the core/riser and the depth into the segment the strata were observed,
- A clear association between the strata and the samples,
- The total alpha results, and MDAs and uncertainty,
- Summary of QC data including method blanks, LCS, and tracer/duplicates.

3.6.2 Validation of Sludge/Solids and Supernate

The critical decisions that are to be supported by the output from the sampling program focus on sludge and solid samples with a secondary emphasis on supernate. Total alpha and radionuclides only are specified for validation because the major decisions related to criticality and safeguards require detailed alpha and isotopic information. Once the samples are composited, isotopic analysis will be performed on the sludge/solid and supernate. Data validation is performed by an independent third party that is not part of the laboratory performing the work. Data validation must also be performed on only the following isotopes analyzed by the methods listed in Tables 2-4 and 2-5.

- Plutonium/Americium-241
- Plutonium-238
- Plutonium-239/240
- Technetium-99
- Uranium-235
- Uranium-238 and Plutonium-238
- Plutonium-241
- Neptunium-237
- Strontium-90

Level D validation will be performed per WHC (1993), modified to include the specific QC sample frequencies and limits specified in this SAP. Existing validation contractors that have been routinely providing validation services for radiochemistry for the Hanford site will perform the validation. The aforementioned procedure describes the qualifications of the validators, the procedure for validation, and the report format required from the validation. The Level D validation includes:

- Verification of deliverables versus requirements,
- Verification of transcription errors,
- Evaluation and qualification of results on method blanks,
- Evaluation and qualification of results on tracers, LCS, laboratory duplicates,
- Evaluation of initial and continuing calibration, quench monitoring, and counting resolution checks, and

- Calculation checks of both sample and QC parameters at a frequency of 20%, or at least one sample and one complete QC sample series, will be recalculated, which ever is greater. A QC sample series is defined as initial and continuing calibration standards, method blanks, spike samples, chemical and tracer recovery, duplicates, and LCSs.

Because of the following facts, no third-party validation of the organics and metals is requested.

- Additional sampling may be performed before and/or during treatment.
- Reporting limits or PQLs for organics are likely to exceed the LDR limits because the high activity of the samples will result in significant dilutions. Validation of data that has a reporting limit above LDR will not provide useful information.
- If the waste is treated and shipped to WIPP, and if WIPP succeeds at receiving approval for mixed waste, the organic and metal content will not preclude shipping. A headspace analysis of the drummed, treated waste is required and would be best done after treatment.

3.6.3 Vapor

Vapor sample results will undergo the one-over-one review as previously described in HASQARD (DOE-RL 1998) and in the laboratory's data review procedures. No third-party validation is planned for the vapor samples. Calculations of the emissions for radionuclides were presented in the Phase I Vapor SAP (Hill et al. 1998) and calculations of toxic emissions were presented both in the Phase I Vapor SAP and in a letter from DOE to the administrative record dated April 27, 1999 (DOE-RL 1999). These calculations indicate that the emission rates of toxic air pollutants and/or particulate matter will remain sufficiently low to ensure that the substantive requirements of the applicable air quality standards are met. Therefore, vapor sampling performed in concert with the sampling is not required by regulation, but will be used to augment current information. If the vapor data from the Phase I analyses indicate a need to require sampling to meet emission regulations, the decision not to perform validation will be reevaluated.

3.7 DATA QUALITY ASSESSMENT

The DQA is performed after data validation. The purpose of DQA is to assess whether original project objectives are met, identify data deficiencies that impact data interpretation, and determine whether data is sufficient and of appropriate quality to allow the decisions in Section 1.5 to be made. The DQA process involves the spatial and statistical evaluation of the data. The DQA process will be performed in a manner consistent with EPA (1996) and ASTM (1998). The following steps are included in the DQA.

1. Review the project DQO. This includes review of the conceptual model and any assumptions that are included in the data collection design. Determine whether the data

are consistent with the conceptual model. If the data differ from the model, the decision-makers and technical staff must determine the consequences of using a different model and the impact this has on a decision.

2. Examine the distribution of data. The distribution should be examined both spatially (vertically and horizontally) and numerically. Spatial evaluation should attempt to assess whether similar strata exist horizontally. Numerical evaluation includes determining whether normal distribution or other distribution exists. This includes an exploratory data analysis (Hoaglin et al. [1983]; and Cleveland).

3. Calculate concentrations in terms of dry weight.

4. Examine the data for outliers or anomalous values. This includes identification of statistical outliers and anomalous values. Any anomalous values should be validated and closely examined to assess potential reasons for the anomaly. If no reason can be found to exclude the data in question, they should be included in further analysis. If a reason for exclusion can be found, a detailed but concise explanation for exclusion should be provided.

5. Evaluate the decision error. The target decision errors were presented in Section 1.7. Section 1.9 describes the approach to be taken if the target error limits are not met.

DQA process will be performed on the following three sets of data.

- The total alpha data will be assessed to determine which strata to composite. In order to perform the DQA, the total alpha from cores B and F must be available and validated.

- The results from the VOA analysis will be one data set. These data will only be collected if the vapor samples indicate a positive response for volatile organics.

- The analyses performed on the composite samples.

4.0 REFERENCES

40 CFR 264, 1980, "EPA Regulations for Owners and Operators of Hazardous Waste Facilities," *Code of Federal Regulations*, as amended.

APHA, 1995, *Standard Methods for the Examination of Water and Wastewater*, 19th Edition, ISBN 0-87553-223-3, American Public Health Association, American Water Works Association, and the Water Environment Federation, Washington, D.C.

ARHC, 1968, *Z-Plant Low Level Waste Disposal Facilities FY 1970 Budget Facilities Study*, ARH-500, Atlantic Richfield Hanford Company, Richland, Washington.

ASTM, 1998, *Standard Guide for Data Assessment for Environmental Waste Management Activities*, ASTM D6233-98, American Society for Testing and Materials, West Conshohocken, Pennsylvania.

Bobrowski, S. F. and S. J. Harris, 1998, *Standard Electronic Format Specification for Tank Characterization Data Loader: Version 2.4*, HNF-3638, Rev. 0, Prepared by Pacific Northwest National Laboratory for Lockheed Martin Hanford Corporation, Richland, Washington.

BWHC, 1997, *241-Z-361 Characterization Program Plan*, HNF-1532, Rev. 0, Babcock and Wilcox Hanford Corporation, Richland, Washington.

BWHC, 1999, *241-Z-361 Sludge Characterization Data Quality Objectives*, HNF-4225, Rev. 0, Prepared by Environmental Quality Management for Babcock and Wilcox Hanford Corporation, Richland, Washington.

Campbell, J. A., K. L. Wahl, S. A. Clauss, K. E. Grant, V. Hoopes, G. M. Mong, J. Rau, and R. Steele, 1996, *Organic Tanks Safety Program: Advanced Organic Analysis FY 1996 Progress Report*, PNNL-11309, Pacific Northwest National Laboratory, Richland, Washington.

Clean Air Act, 42 U.S.C. 7401, et seq.

Cleveland, W. S., *Visualizing Data*, AT&T Bell Laboratories, Murray Hill, New Jersey.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE-RL, 1992, *Z-Plant Source Aggregate Area Management Study Report*, DOE/RL-91-58, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

DOE-RL, April 27, 1999, 99-EAP-276, "Tank 241-Z-361 Maximal Emission Rate Estimates," Letter to D.R. Sherwood, U.S. Environmental Protection Agency, from J.E. Rasmussen, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Dormant, C., 1998, *Quality Assurance Management Plan Special Analytical Support*, HNF-SD-WM-QAPP-034, Rev. 2, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1994, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1995, *Test Methods for Evaluation of Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, as amended by Updates I (July, 1992), IIA (August, 1993), IIB (January, 1995), U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1996, *Guidance for Data Quality Assessment*, EPA QA/G-9, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1997a, *Test Methods for Evaluation of Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, as amended by Updates I (July, 1992), IIA (August, 1993), IIB (January, 1995), and III (1997), U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1997b, *EPA Methods And Guidance For Analysis Of Water*, CD-ROM Version 1.0, EPA 821-C-97-001, Engineering and Analysis Division (4303) Office of Science and Technology, U.S. Environmental Protection Agency, Washington, D.C.

Freeman-Pollard, J.R., 1994, *Engineering Study of 50 Miscellaneous Inactive Underground Radioactive Waste Tanks Located at the Hanford Site, Washington*, WHC-SD-EN-ES-040, Westinghouse Hanford Company, Richland, Washington.

Gerber, 1997, *History and Stabilization of the Plutonium Finishing Plant (PFP) Complex, Hanford Site*, HNF-EP-0924, Rev. 0, Prepared for the U.S. Department of Energy Assistant Secretary for Environmental Management under Project Hanford Management Contract DE-AC06-96RL13200, Richland, Washington.

Hill, S., M. Hughey, C. Miller, M. Miller, C. Narquis, 1998, *Tank 241-Z-361 Vapor Sampling and Analysis Plan,* HNF-2867, Rev. 0, and errata sheets data January 5, 1999, Waste Management Hanford Corporation, Richland, Washington.

HNF, 1997, *Engineering Task Plan Cleanup of Miscellaneous Underground Storage Tank 241-Z-361*, Rev. 1, HNF-SD-WM-ETP-208, SG Eurysis Services Corporation, Richland, Washington.

Hoaglin, D.C., F. Mosteller and J.W. Tukey. 1983. *Understanding Robust and Exploratory Data Analysis*. John Wiley and Sons, New York.

Jones, S.A., 1997, *Tank 241-Z-361 Process and Characterization History*, HNF-1989, Rev. 0, Babcock and Wilcox Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

Klem, M. J., 1990, *Inventory of Chemicals Used at Hanford Production Plants and Support Operations (1944-1980)*, WHC-EP-0172, Westinghouse Hanford Company, Richland, Washington.

Lipke, E.J., C.A. Rogers, and E.M. Miller, 1997, *Engineering Study of the Criticality Issues Associated with Hanford Tank 241-Z-361*, HNF-2012, Rev. 0, Duke Engineering & Services Hanford for Fluor Daniel Hanford, Inc., Richland, Washington.

LMHC, 1997, *Data Quality Objectives for Sampling and Analyses*, HNF-EP-0845, IV, "Engineering," Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

Markel, L.P., 1998, *222S Lab QA Plan*, HNF-SD-CP-QAPP-016, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

Meznarich, H.K., 1997, *Waste Sampling and Characterization Facility Laboratory Quality Assurance Plan*, HNF-SD-CP-QAPP-017, Rev. 2, Waste Management Federal Services of Hanford, Inc., for Fluor Daniel Hanford, Inc., Richland, Washington.

PHMC, 1997a, *Material Control and Accountability Plan,* HNF-PRO-502, Rev. 0, Prepared by the Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997b, *Nonconforming Item Reporting and Control*, HNF-PRO-298, Rev. 0, Fluor Daniel Hanford, Inc., Richland, Washington.

PHMC, 1999, *Justification for Continued Operation for Tank 241-Z-361*, HNF-2024, Rev. 2, Prepared by the PHMC Companies and The Chiron Group LLC, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Wagoner, J.D., 1997, *Contract No. DE-AC06-96RL13200 – Unreviewed Safety Question (USQ) Regarding Plutonium Finishing Plant (PFP) Tank 241-Z-361* (letter, 97-TPD-193, October 15), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-460, "Controls for New Source of Toxic Air Pollutants," *Washington Administrative Code*, as amended.

WHC, 1990, *Deactivated Cribs and Settling Tanks*, WHC-SD-SQA-CSA-20240, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993, data validation procedures for radiochemical analysis, WHC-SD-EN-SPP-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

4.1 WASTE MANAGEMENT HANFORD, INC. PROCEDURES

LA-211-102-WSFS, *Determination of Free OH-/OH+ Using Metrohm 682 Titroprocessor*, Rev. D-1, August 19, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-212-105-WSFS, *Caustic Ratio Determination of Waste Analysis*, Rev. C-0, March 16, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-325-106-WSFS, *Mercury Analysis by Cold Vapor Atomic Absorption Using the FIAS 400*, Rev. A-1, January 25, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-342-100-WSFS, *Determination of Carbon by Hot Persulfate Oxidation and Coulometric Detection*, Rev. F-2, March 4, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-438-101-WSFS, *Determination of 99 Technetium by Solvent Extraction and Liquid Scintillation Counting*, Rev. E-3, October 27, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-505-102-WSFS, *Metal Analysis by Graphite Furnace Atomic Absorption (GFAA) Using the Perkin-Elmer 5100PC*, Rev. B-0, October 19, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-505-161-WSFS, *Inductively Coupled Plasma (ICP) Emission Spectrometric Method for the Thermo Jarrell Ash (TJA) Type 61E*, Rev. C-3, July 15, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-506-101-WSFS, *Determination of Trace Elements and Radionuclides by Inductively Coupled Plasma Mass Spectrometry Using TJA Poems*, Rev. A-1, March 10, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-508-101-WSFS, *Alpha and Beta in Liquid Samples*, Rev. G-0, March 25, 1997, Waste Management Hanford Inc., Richland, Washington.

LA-508-415, *Operation of the Protean 2-Inch Alpha/Beta Counting System*, Rev. C-0, May 28, 1997, Waste Management Hanford Inc., Richland, Washington.

LA-510-115-WSFS, *Total Dissolved Solids (TDS) Determination*, Rev. C-2, January 20, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-510-112, *Determination of Specific Gravity for Free Liquid Samples*, Rev. E-0, May 13, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-523-404, *Determination of Volatile Organic Compounds in Hanford Waste Tank Headspace Samples Using SUMMA Passivated Canister*, Rev. A-0, January 13, 1997, Waste Management Hanford Inc., Richland, Washington.

LA-523-428, *Analysis of Semi-Volatile Organic Compounds in Ambient Air and Tank Headspace*, Rev. A-0, August 27, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-533-105-WSFS, *Anion Analysis on Dionex Model 4000i and 4500i*, Rev. F-0, September 2, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-533-115-WSFS, *Ion Chromatographic Analysis of Anions and Cations on Dionex Model 500*, Rev. B-0, January 4, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-564-101, *Percent Solids/Percent Water by Gravimetric Analysis*, Rev. G-1, July 28, 1998, Waste Management Hanford Inc., Richland, Washington.

LA-631-001-WSFS, *Determination of Ammonia by Ion Selective Electrode Using a Double Increment Know Additions Method*, Rev. D-0, March 3, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-695-102-WSFS, *Determination of Cyanide by Microdistillation and Spectrophotometric Analysis*, Rev. H-0, April 6, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-695-103-WSFS, *Determination of cyanide by EDTA/EN Dissolution Followed by Microdistillation and Spectrophotometric Analysis*, Rev. D-0, April 6, 1999, Waste Management Hanford Inc., Richland, Washington.

LA-953-104-WSFS, *Determination of Plutonium and Americium by Extraction with TRU Spec Resin*, Rev. B-1, December 16, 1998, Waste Management Hanford Inc., Richland, Washington.

LO-160-101, *Core Segment Receipt and Preparation*, Rev. H-0, March 23, 1999, Waste Management Hanford Inc., Richland, Washington.

LO-160-103, *Core Segment Extrusion Process and Sample Preparation*, Rev. D-0, March 12, 1998, Waste Management Hanford Inc., Richland, Washington.

LO-161-172, *Perform Complex 11A Hot Cell Operations*, Rev. K-0, April 15, 1999, Waste Management Hanford Inc., Richland, Washington.

LO-080-406, *Cleaning Procedure for SUMMA Canisters*, Rev. A-0, January 14, 1997, Waste Management Hanford Inc., Richland, Washington.

4.2 LOCKHEED MARTIN HANFORD CORPORATION PROCEDURES

TO-020-454, *Setup and Takedown of Core Sample Systems*, Lockheed Martin Hanford Corporation, Richland, Washington.

TO-060-003, *Perform Field Inspection and Loading of On-site Casks During Core Sampling Operations*, Rev. A-7, March 16, 1998, Lockheed Martin Hanford Corporation, Richland, Washington.

TO-080-505, *Push Mode Sampling with Truck #1*, Lockheed Martin Hanford Corporation, Richland, Washington.

TO-080-090, *Transport the Onsite Transfer Cask*, Rev. G-A, August 11, 1998, Lockheed Martin Hanford Corporation, Richland, Washington.

APPENDIX A

TOXIC AIR MONITORING PLAN FOR SAMPLING TANK 241-Z-361 SLUDGE

A1.0 INTRODUCTION

Between 1949 and 1973, Tank 241-Z-361 was used as a settling tank prior to discharging liquid effluent streams to the soil column. Tank 241-Z-361 received inorganic waste from the Plutonium Reclamation Facility (236-Z Building), inorganic waste and laboratory mixed waste from the Plutonium Finishing Plant (234-5Z Building), inorganic and organic waste from the Incinerator Building (232-Z) and from Building 242-Z from the americium recovery process. The low salt aqueous waste stream from the Plutonium Finishing Plant consisted of plutonium-contaminated aqueous solutions (88%), contaminated laboratory waste (7%), and uncontaminated cooling water (5%). Lines into and out of Tank 241-Z-361 were blanked off in 1975, the supernate pumped from the tank in the 1975 - 1977 timeframe, and the tank sealed in 1985. A detailed historical discussion is presented in Section 1.3 of this Sampling and Analysis Plan.

Tank 241-Z-361 has a nominal volume of 45,000 gal (currently containing approximately 20,000 gal of liquid/sludge) consisting of a steel-lined rectangular concrete tank. The dimensions of Tank 241-Z-361 are 7.92 m (26 ft) in length, 3.96 m (13 ft) in width and a depth that slopes from 5.18 to 5.49 m (17 to 18 ft). The tank has an estimated residual liquid/sludge layer approximately 2.44 m (8 ft) deep (WHC 1990). The proposed action entails sampling and characterizing the sludge that exists in Tank 241-Z-361.

Tank 241-Z-361 is an existing emission source per *Washington Administrative Code* (WAC) 173-400 and 173-460 after venting, installing a high efficiency particulate air breather filter on April 28, 1999. The air monitoring plan (Hill et al. 1998), for initially opening the tank to atmosphere was approved by the U.S. Environmental Protection Agency (EPA) in December 1998. Sampling was performed during April and May 1999 for the vapor under Hill et al. (1998) that was approved by EPA in December 1998. Results from the vapor sampling indicated that the total amount of all detected toxic air pollutants (TAPs) in Tank 241-Z-361 were well below the small quantity emission rates of WAC 173-460-080. Table A-1 summarizes the concentration of detected TAPs, the calculated total amount of TAPs in the tank (presented in Attachment A-1,"Calculations for Detected Compounds"), conservative calculations for detected compounds based on Henry's Law for pure aqueous solutions, and the annual small quantity emission rate specified under WAC 173-460-080.

Table A-1. Detected TAP Concentration Summary.

Analyte	TAPs Class	Detected Concentration Milligram/meter^3	Calculated Inventory Pounds	Annual SQE Pounds
Carbon tetrachloride	A	0.99	3.53E-04	20
Chloroform	A	6.1	8.06E-03	10
Dochloromethane	A	.056	8.20E-05	50
Tetrachloroethylene	A	13	5.71E-03	500
Trichloroethylene	A	4.9	3.05E-03	50
Acetic acid	B	0.13	5.31E-00	10,500
Acetone	B	.047	4.84E-03	43,748
Trichlorofluoromethane	B	3.4	7.19E-04	43,748
n-Butane	B	0.28	5.96E-05	43,748
n-Pentane	B	0.016	3.39E-06	43,748
Toluene	B	0.027	2.22E-05	43,748

SQE = small quantity emission

A2.0 REGULATORY EVALUATION

New source review under WAC 173-400-110 is required for the establishment of any new source, modification, or an increase in a plant-wide cap or unit specific emission limit. A new source is considered the construction or modification of a stationary source that increases the amount of any air contaminant emitted by such source or that results in the emission of any air contaminant not previously emitted. A modification is any physical change, or change in the method of operation of a stationary source that increases the amount of any air contaminant emitted by such source or that result in the emissions of any air contaminant not previously emitted. Sampling of the sludge in Tank 241-Z-361 does not require any further action under WAC 173-400-110 because the proposed activity does not meet the definition of a modification.

Similarly, an evaluation of WAC 173-460 applicability for toxic air determined that the sludge sampling activity does not meet the definition of a new toxic air pollutant source (construction or modification). Therefore, Chapter 173-460 does not apply to the sludge sampling activity.

A3.0 REFERENCES

DOE-RL, April 27, 1999, 99-EAP-276, "Tank 241-Z-361 Maximal Emission Rate Estimates," Letter to D.R. Sherwood, U.S. Environmental Protection Agency, from J.E. Rasmussen, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Hill, S., M. Hughey, C. Miller, M. Miller, C. Narquis, 1998, *Tank 241-Z-361 Vapor Sampling and Analysis Plan,* HNF-2867, Rev. 0, Waste Management Hanford Corporation, Richland, Washington.

WAC 173-400, "General Regulations for Air Pollution Sources," State of Washington Department of Ecology, Olympia, Washington.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," State of Washington Department of Ecology, Olympia, Washington.

WHC, 1990, *Deactivated Cribs and Settling Tanks*, WHC-SD-SQA-CSA-20240, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT A

CALCULATIONS FOR DETECTED COMPOUNDS

Estimation of total Toxic Air Pollutants (WAC 173-460) in Tank 241-Z-361based on vapor space sampling results.

$P := 1 \cdot atm \qquad R_{gas} := 82.057 \cdot \frac{atm \cdot cm^3}{mole \cdot K} \qquad T := (273 + 25) \cdot K \qquad mg := 1 \cdot 10^{-3} \cdot gm$

For conservatism assume sludge is 100% by volume of low salt strength water:

$Volume_{liquid} := 20000 \cdot gal \qquad Volume_{vapor} := 25000 \cdot gal$

For Carbon Tetrachloride (CCl4), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{CCl4} := 153.82 \cdot \frac{gm}{mol} \qquad H_{CCl4} := 2.76 \cdot 10^{-2} \cdot \frac{atm \cdot m^3}{mol} \qquad C_{CCl4\_vapor} := .99 \cdot \frac{mg}{m^3}$

$$moles_{CCl4\_vapor} := \frac{C_{CCl4\_vapor} \cdot Volume_{vapor}}{MW_{CCl4}}$$

$moles_{CCl4\_vapor} = 6.091 \cdot 10^{-4} \cdot mol$

$P_{CCl4} := \frac{moles_{CCl4\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{CCl4} = 1.574 \cdot 10^{-7} \cdot atm$

$C_{CCl4\_liquid} := \frac{P_{CCl4}}{H_{CCl4}} \qquad C_{CCl4\_liquid} = 5.702 \cdot 10^{-6} \cdot \frac{mol}{m^3}$

$moles_{CCl4\_liquid} := C_{CCl4\_liquid} \cdot Volume_{liquid}$

$Wt_{CCl4\_total} := MW_{CCl4} \cdot (moles_{CCl4\_liquid} + moles_{CCl4\_vapor})$

$Wt_{CCl4\_total} = 3.529 \cdot 10^{-4} \cdot lb \qquad SQE_{CCl4} := 20 \cdot \frac{lb}{yr}$

For Chloroform (CHCl3), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{CHCl3} := 119.38 \cdot \frac{gm}{mol}$ $\quad H_{CHCl3} := 3.67 \cdot 10^{-3} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{CHCl3\_vapor} := 6.1 \cdot \frac{mg}{m^3}$

$$moles_{CHCl3\_vapor} := \frac{C_{CHCl3\_vapor} \cdot Volume_{vapor}}{MW_{CHCl3}}$$

$moles_{CHCl3\_vapor} = 4.836 \cdot 10^{-3} \cdot mol$

$$P_{CHCl3} := \frac{moles_{CHCl3\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{CHCl3} = 1.249 \cdot 10^{-6} \cdot atm$$

$$C_{CHCl3\_liquid} := \frac{P_{CHCl3}}{H_{CHCl3}} \qquad C_{CHCl3\_liquid} = 3.405 \cdot 10^{-4} \cdot \frac{mol}{m^3}$$

$$moles_{CHCl3\_liquid} := C_{CHCl3\_liquid} \cdot Volume_{liquid}$$

$$Wt_{CHCl3\_total} := MW_{CHCl3} \cdot \left(moles_{CHCl3\_liquid} + moles_{CHCl3\_vapor}\right)$$

$Wt_{CHCl3\_total} = 8.056 \cdot 10^{-3} \cdot lb$ $\qquad SQE_{CHCl3} := 10 \cdot \frac{lb}{yr}$

For Dichloromethane (CH2Cl2), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{CH2Cl2} := 84.93 \cdot \frac{gm}{mol}$ $\quad H_{CH2Cl2} := 3.25 \cdot 10^{-3} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{CH2Cl2\_vapor} := .056 \cdot \frac{mg}{m^3}$

$$moles_{CH2Cl2\_vapor} := \frac{C_{CH2Cl2\_vapor} \cdot Volume_{vapor}}{MW_{CH2Cl2}}$$

$moles_{CH2Cl2\_vapor} = 6.24 \cdot 10^{-5} \cdot mol$

$$P_{CH2Cl2} := \frac{moles_{CH2Cl2\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{CH2Cl2} = 1.612 \cdot 10^{-8} \cdot atm$$

$$C_{CH2Cl2\_liquid} := \frac{P_{CH2Cl2}}{H_{CH2Cl2}} \qquad C_{CH2Cl2\_liquid} = 4.961 \cdot 10^{-6} \cdot \frac{mol}{m^3}$$

$$moles_{CH2Cl2\_liquid} := C_{CH2Cl2\_liquid} \cdot Volume_{liquid}$$

$$Wt_{CH2Cl2\_total} := MW_{CH2Cl2} \cdot \left(moles_{CH2Cl2\_liquid} + moles_{CH2Cl2\_vapor}\right)$$

$Wt_{CH2Cl2\_total} = 8.201 \cdot 10^{-5} \cdot lb$ $\qquad SQE_{CH2Cl2} := 50 \cdot \frac{lb}{yr}$

For Tetrachloroethylene (C2Cl4), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C2Cl4} := 165.83 \cdot \frac{gm}{mol}$ $\quad H_{C2Cl4} := 1.77 \cdot 10^{-2} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{C2Cl4\_vapor} := 13 \cdot \frac{mg}{m^3}$

$$moles_{C2Cl4\_vapor} := \frac{C_{C2Cl4\_vapor} \cdot Volume_{vapor}}{MW_{C2Cl4}}$$

$moles_{C2Cl4\_vapor} = 7.419 \cdot 10^{-3} \cdot mol$

$$P_{C2Cl4} := \frac{moles_{C2Cl4\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}}$$ $P_{C2Cl4} = 1.917 \cdot 10^{-6} \cdot atm$

$$C_{C2Cl4\_liquid} := \frac{P_{C2Cl4}}{H_{C2Cl4}}$$ $C_{C2Cl4\_liquid} = 1.083 \cdot 10^{-4} \cdot \frac{mol}{m^3}$

$moles_{C2Cl4\_liquid} := C_{C2Cl4\_liquid} \cdot Volume_{liquid}$

$Wt_{C2Cl4\_total} := MW_{C2Cl4} \cdot (moles_{C2Cl4\_liquid} + moles_{C2Cl4\_vapor})$

$Wt_{C2Cl4\_total} = 5.71 \cdot 10^{-3} \cdot lb$ $\quad SQE_{C2Cl4} := 500 \cdot \frac{lb}{yr}$

For Trichloroethylene (C2HCl3), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C2HCl3} := 131.39 \cdot \frac{gm}{mol}$ $\quad H_{C2HCl3} := 9.85 \cdot 10^{-3} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{C2HCl3\_vapor} := 4.9 \cdot \frac{mg}{m^3}$

$$moles_{C2HCl3\_vapor} := \frac{C_{C2HCl3\_vapor} \cdot Volume_{vapor}}{MW_{C2HCl3}}$$

$moles_{C2HCl3\_vapor} = 3.529 \cdot 10^{-3} \cdot mol$

$$P_{C2HCl3} := \frac{moles_{C2HCl3\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{C2HCl3} = 9.119 \cdot 10^{-7} \cdot atm$$

$$C_{C2HCl3\_liquid} := \frac{P_{C2HCl3}}{H_{C2HCl3}} \qquad C_{C2HCl3\_liquid} = 9.258 \cdot 10^{-5} \cdot \frac{mol}{m^3}$$

$$moles_{C2HCl3\_liquid} := C_{C2HCl3\_liquid} \cdot Volume_{liquid}$$

$$Wt_{C2HCl3\_total} := MW_{C2HCl3} \cdot \left(moles_{C2HCl3\_liquid} + moles_{C2HCl3\_vapor}\right)$$

$Wt_{C2HCl3\_total} = 3.053 \cdot 10^{-3} \cdot lb$ $\qquad SQE_{C2HCl3} := 50 \cdot \frac{lb}{yr}$

For Acetic Acid (C2H4O2), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C2H4O2} := 60.05 \cdot \frac{gm}{mol}$ $\quad H_{C2H4O2} := 1.0 \cdot 10^{-7} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{C2H4O2\_vapor} := .13 \cdot \frac{mg}{m^3}$

$$moles_{C2H4O2\_vapor} := \frac{C_{C2H4O2\_vapor} \cdot Volume_{vapor}}{MW_{C2H4O2}}$$

$$moles_{C2H4O2\_vapor} = 2.049 \cdot 10^{-4} \cdot mol$$

$$P_{C2H4O2} := \frac{moles_{C2H4O2\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{C2H4O2} = 5.294 \cdot 10^{-8} \cdot atm$$

$$C_{C2H4O2\_liquid} := \frac{P_{C2H4O2}}{H_{C2H4O2}} \qquad C_{C2H4O2\_liquid} = 0.529 \cdot \frac{mol}{m^3}$$

$$C_{C2H4O2\_liquid} = 5.294 \cdot 10^{-4} \cdot \frac{mol}{liter}$$

$$moles_{C2H4O2\_liquid} := C_{C2H4O2\_liquid} \cdot Volume_{liquid}$$

$$Wt_{C2H4O2\_total} := MW_{C2H4O2} \cdot \left(moles_{C2H4O2\_liquid} + moles_{C2H4O2\_vapor}\right)$$

$$Wt_{C2H4O2\_total} = 5.306 \cdot lb \qquad SQE_{C2H4O2} := 10500 \cdot \frac{lb}{yr}$$

For Acetone (C3H6O), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C3H6O} := 58.08 \cdot \frac{gm}{mol}$ $\quad H_{C3H6O} := 3.97 \cdot 10^{-5} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{C3H6O\_vapor} := .047 \cdot \frac{mg}{m^3}$

$$moles_{C3H6O\_vapor} := \frac{C_{C3H6O\_vapor} \cdot Volume_{vapor}}{MW_{C3H6O}}$$

$moles_{C3H6O\_vapor} = 7.658 \cdot 10^{-5} \cdot mol$

$$P_{C3H6O} := \frac{moles_{C3H6O\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{C3H6O} = 1.979 \cdot 10^{-8} \cdot atm$$

$$C_{C3H6O\_liquid} := \frac{P_{C3H6O}}{H_{C3H6O}} \qquad C_{C3H6O\_liquid} = 4.984 \cdot 10^{-4} \cdot \frac{mol}{m^3}$$

$$moles_{C3H6O\_liquid} := C_{C3H6O\_liquid} \cdot Volume_{liquid}$$

$$Wt_{C3H6O\_total} := MW_{C3H6O} \cdot \left(moles_{C3H6O\_liquid} + moles_{C3H6O\_vapor}\right)$$

$Wt_{C3H6O\_total} = 4.842 \cdot 10^{-3} \cdot lb$ $\qquad SQE_{C3H6O} := 43748 \cdot \frac{lb}{yr}$

For Freon-11 (Trichlorofluoromethane, CClF3), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{CClF3} := 104.46 \cdot \frac{gm}{mol}$ $\quad H_{CClF3} := 1.38 \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{CClF3\_vapor} := 3.4 \cdot \frac{mg}{m^3}$

$$moles_{CClF3\_vapor} := \frac{C_{CClF3\_vapor} \cdot Volume_{vapor}}{MW_{CClF3}}$$

$moles_{CClF3\_vapor} = 3.08 \cdot 10^{-3} \cdot mol$

$$P_{CClF3} := \frac{moles_{CClF3\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{CClF3} = 7.959 \cdot 10^{-7} \cdot atm$$

$$C_{CClF3\_liquid} := \frac{P_{CClF3}}{H_{CClF3}} \qquad C_{CClF3\_liquid} = 5.767 \cdot 10^{-7} \cdot \frac{mol}{m^3}$$

$$moles_{CClF3\_liquid} := C_{CClF3\_liquid} \cdot Volume_{liquid}$$

$$Wt_{CClF3\_total} := MW_{CClF3} \cdot \left(moles_{CClF3\_liquid} + moles_{CClF3\_vapor}\right)$$

$Wt_{CClF3\_total} = 7.194 \cdot 10^{-4} \cdot lb$ $\qquad SQE_{CClF3} := 43748 \cdot \frac{lb}{yr}$

For N-Butane (C4H10), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C4H10} := 54.09 \cdot \frac{gm}{mol}$ $\quad H_{C4H10} := 9.50 \cdot 10^{-1} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{C4H10\_vapor} := .28 \cdot \frac{mg}{m^3}$

$$moles_{C4H10\_vapor} := \frac{C_{C4H10\_vapor} \cdot Volume_{vapor}}{MW_{C4H10}}$$

$moles_{C4H10\_vapor} = 4.899 \cdot 10^{-4} \cdot mol$

$$P_{C4H10} := \frac{moles_{C4H10\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{C4H10} = 1.266 \cdot 10^{-7} \cdot atm$$

$$C_{C4H10\_liquid} := \frac{P_{C4H10}}{H_{C4H10}} \qquad C_{C4H10\_liquid} = 1.332 \cdot 10^{-7} \cdot \frac{mol}{m^3}$$

$$moles_{C4H10\_liquid} := C_{C4H10\_liquid} \cdot Volume_{liquid}$$

$$Wt_{C4H10\_total} := MW_{C4H10} \cdot \left(moles_{C4H10\_liquid} + moles_{C4H10\_vapor}\right)$$

$Wt_{C4H10\_total} = 5.962 \cdot 10^{-5} \cdot lb$ $\qquad SQE_{C4H10} := 43748 \cdot \frac{lb}{yr}$

For N-Pentane (C5H12), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C5H12} := 72.15 \cdot \frac{gm}{mol}$ $\qquad H_{C5H12} := 1.25 \cdot \frac{atm \cdot m^3}{mol}$ $\qquad C_{C5H12\_vapor} := .016 \cdot \frac{mg}{m^3}$

$$moles_{C5H12\_vapor} := \frac{C_{C5H12\_vapor} \cdot Volume_{vapor}}{MW_{C5H12}}$$

$moles_{C5H12\_vapor} = 2.099 \cdot 10^{-5} \cdot mol$

$P_{C5H12} := \frac{moles_{C5H12\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}}$ $\qquad P_{C5H12} = 5.423 \cdot 10^{-9} \cdot atm$

$C_{C5H12\_liquid} := \frac{P_{C5H12}}{H_{C5H12}}$ $\qquad C_{C5H12\_liquid} = 4.338 \cdot 10^{-9} \cdot \frac{mol}{m^3}$

$$moles_{C5H12\_liquid} := C_{C5H12\_liquid} \cdot Volume_{liquid}$$

$$Wt_{C5H12\_total} := MW_{C5H12} \cdot \left(moles_{C5H12\_liquid} + moles_{C5H12\_vapor}\right)$$

$Wt_{C5H12\_total} = 3.39 \cdot 10^{-6} \cdot lb$ $\qquad SQE_{C5H12} := 43748 \cdot \frac{lb}{yr}$

For Toluene (C7H8), H = Henry's Law Constant:
(Reference: Handbook of Physical Properties of Organic Chemicals, CRC Press)

$MW_{C7H8} := 92.14 \cdot \frac{gm}{mol}$ $\quad H_{C7H8} := 6.64 \cdot 10^{-3} \cdot \frac{atm \cdot m^3}{mol}$ $\quad C_{C7H8\_vapor} := .027 \cdot \frac{mg}{m^3}$

$$moles_{C7H8\_vapor} := \frac{C_{C7H8\_vapor} \cdot Volume_{vapor}}{MW_{C7H8}}$$

$moles_{C7H8\_vapor} = 2.773 \cdot 10^{-5} \cdot mol$

$$P_{C7H8} := \frac{moles_{C7H8\_vapor} \cdot R_{gas} \cdot T}{Volume_{vapor}} \qquad P_{C7H8} = 7.166 \cdot 10^{-9} \cdot atm$$

$$C_{C7H8\_liquid} := \frac{P_{C7H8}}{H_{C7H8}} \qquad C_{C7H8\_liquid} = 1.079 \cdot 10^{-6} \cdot \frac{mol}{m^3}$$

$$moles_{C7H8\_liquid} := C_{C7H8\_liquid} \cdot Volume_{liquid}$$

$$Wt_{C7H8\_total} := MW_{C7H8} \cdot \left(moles_{C7H8\_liquid} + moles_{C7H8\_vapor}\right)$$

$Wt_{C7H8\_total} = 2.223 \cdot 10^{-5} \cdot lb$ $\qquad SQE_{C7H8} := 43748 \cdot \frac{lb}{yr}$

APPENDIX B

RADIOACTIVE AIR MONITORING PLAN FOR SAMPLING TANK 241-Z-361 SLUDGE

B1.0 INTRODUCTION

Between 1949 and 1973, Tank 241-Z-361 was used as a settling tank prior to discharging liquid effluent streams to the soil column. Tank 241-Z-361 received inorganic waste from the Plutonium Reclamation Facility (236-Z Building), organic, inorganic, and laboratory waste from the Plutonium Finishing Plant (PFP) (234-5Z Building), inorganic and organic waste from the Incinerator Building (232-Z) and from Building 242-Z from the americium recovery process. The low salt aqueous waste stream from PFP consisted of plutonium-contaminated aqueous solutions (88%), contaminated laboratory waste (7%), and uncontaminated cooling water (5%). Lines into and out of Tank 241-Z-361 were blanked off in 1975, the supernate pumped from the tank in the 1975 - 1977 timeframe, and the tank sealed in 1985. A detailed discussion of the historical information is presented in Section 1.3 of this Sampling and Analysis Plan (SAP).

Tank 241-Z-361 is a steel-lined rectangular concrete tank, with a nominal volume of 45,000 gallons (currently containing approximately 20,000 gallons of liquid/sludge). The dimensions of Tank 241-Z-361 are 7.92 m (26 ft) in length, 3.96 (13 ft) in width and a depth that slopes from 5.18 to 5.49 m (17 to 18 ft). Figure 1-2 of this SAP shows a cross section of the tank. The tank has an estimated residual liquid/sludge layer approximately 2.44 m (8 ft) deep (PHMC 1999). The proposed action entails sampling and characterizing the sludge that exists in Tank 241-Z-361.

In accordance with *Washington Administrative Code* (WAC) 246-247-030(16) and (25), the proposed sampling activity constitutes a minor modification. This activity has been identified as a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) program activity. Quantification of radioactive air emissions, implementing best available radionuclide control technology (BARCT), and air monitoring have been identified as substantive requirements (i.e., relevant and appropriate requirements) to be applied to this activity. These substantive requirements have been determined based on provisions contained in WAC 246-247-040. A BARCT compliance demonstration is determined by the regulatory agency on a case-by-case basis. This plan presents the compliance plan to meet the identified requirements.

B1.1 PLANNED ACTIVITIES

Risers will be opened to allow push core sampling of one, and a maximum of two, full depth samples. Each core sample will consist of approximately five (5) segments each with a length of 48.26 cm (19 in.). The total length for one full depth sample is estimated to be 241.30 cm (95 in.). A detailed description of sample collection is presented in Section 2.3 of this SAP. Because of the sloped floor of the tank and possible irregularities in the sludge surface, the depth of the sample, and thus the actual length of the core, will be adjusted to include the entire sludge depth at each riser sampled. The samples will be sealed in an Onsite Transfer Cask (OTC) immediately upon retrieval of each segment. The sampler is sealed by a piston with an o-ring and a ball valve as shown in Figure 2-6 of this SAP. If storage of the OTC is required, the

OTC's will be vented before shipment to prevent the accumulation of hydrogen gas from the hydrolysis of water and organic compounds that may be present in the sludge.

Push Mode Core Sampling (PMCS) will be used. In push mode there is no rotation of the drill string or purge gas flow. Health Physics Technician (HPT) coverage is provided during the entire time that the riser is open. A detailed discussion on performing PMCS, sampling, sample handling, and transportation are included in Section 2.3 of this SAP. The same process and equipment have been successfully used to sample double- and single-shell tanks (DST/SSTs) containing similar levels of plutonium as have been estimated in Tank 241-Z-361.

B2.0 AIRBORNE SOURCE INFORMATION

B2.1 SOURCE BASED ON PREFERRED SAMPLING APPROACH

The preferred sampling approach is presented in detail in this SAP, Section 2.3.1. Handling and loading the material described above has the potential to generate particulate radioactive air emissions if loose contamination is present. Estimates of potential emissions for this activity are based on the radiological inventory identified in HNF (1997).

The primary radionuclides of concern are plutonium-239 and americium-241; however, other isotopes could potentially be encountered during waste sampling activities. Based on historical data presented in Section 1.3 of this SAP, no mixed fission products are expected to be in the tank. It is expected that isotopic concentrations listed in Table B-1 represent the upper bounds of what will actually be encountered during work activities. Furthermore, the estimates presented here are believed to be conservative.

The annual possession quantities, as defined by WAC-246-247-030 (5), for each expected isotope and subsequent potential emission calculations are presented in Table B-1 to this radioactive air monitoring plan. The release fraction presented in Table B-1 is conservative and is based on the mass of material available for release under the sample collection scenario described in this SAP, including site conditions identified as basis for implementing optional contamination control measures. The possession quantity is based on the volume of sludge to be sampled. The fraction of radionuclides estimated to be released to the atmosphere is based on Title 40 *Code of Federal Regulations (CFR)* Part 61, Appendix D, applying a conservative release fraction of 1.0×10^{-3} for liquids and particulates. The CAP-88 model was used to determine the annual unabated offsite dose.

B2.2 SOURCE BASED ON OPTIONAL CONTAMINATION CONTROL TECHNIQUES

Section 2.3.2 of this SAP describes the optional contamination control and sampling techniques that may be used. These include:

- Constructing a wind break
- Operating a high efficiency particulate air- (HEPA) filtered air exhauster with a flexible intake near selected work areas (not connected to the tank)
- Alternate core sample removal method

The estimated emissions associated with the source in this section are based on total emissions. The source term associated with the optional items is a subset of the estimated source term in this section and the release fraction of 1.0×10^{-3} is consistent with 40 CFR 61, Appendix D, for the use of optional controls.

B3.0 EMISSION CONTROLS

Push mode sampling of the tank waste has the potential to release radioactive particulate emissions to the atmosphere. Implementing BARCT for these potential emissions has been identified as a substantive requirement for this CERCLA activity. The following approach will be taken to control emissions:

- Radiological technical smears will be taken of equipment, tools, and materials in areas where there is the potential for smearable contamination.
- Equipment, tools, and materials with smearable contamination above 100,000 dpm/100 cm^2 beta/gamma or 400 dpm/100 cm^2 alpha will be wrapped or the contamination otherwise fixed by an appropriate means prior to being moved from the current location.

The controls discussed in Section 2.3.2 of this SAP and briefly discussed in Section B2.2, are further discussed here. The HEPA filtered exhauster is the same exhauster presented in the Vapor SAP (Hill et al. 1998). The difference between the previous usage and this usage is that the exhauster will not be connected to a tent but to flexible tubing that will allow mobility, as described in Section 2.3.2 of this SAP. The exhauster will capture up to 1,000 cubic feet of air per minute. The exhauster was evaluated against substantive requirements and approved for use in the Phase I SAP (Hill et al. 1998).

If used, the alternate core sampling technique will use a glove box that is not attached to the tank. The glove bag will have a HEPA filter attached. Because the glove box will not be attached to the tank, it can be collapsed without need of a tent and exhauster, as were used during the tank venting process (Hill et al. 1998).

B4.0 MONITORING

The potential dose from these activities (see Section B2.0) is less than 0.1 mrem/yr; therefore, these air emission sources are not subject to the radionuclide National Emission Standards for Hazardous Air Pollutants for continuous monitoring systems. However, periodic confirmatory measurements will take place throughout the duration of the project.

To confirm low emissions are continuous, an air monitor (for alpha) with alarm will be placed near the riser, and one fixed head air sampler will be located at the exclusion zone boundary. The fixed head filter sample will be read with a field alpha-detection instrument every 15 min to detect the presence of airborne alpha emitters.

At a minimum, the air sample filters will be changed bi-weekly and counted for gross alpha and beta. In addition, the filters will be composited for further analysis by dissolving the filters in acid and performing an isotopic analysis either semi-annually (which is the frequency used for the near-facility monitoring stations) or at the completion of the sampling activities.

B5.0 REFERENCES

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," U.S. Environmental Protection Agency, Washington, D.C.

Hill, S., M. Hughey, C. Miller, M. Miller, C. Narquis, 1998, *Tank 241-Z-361 Vapor Sampling and Analysis Plan,* HNF-2867, Rev. 0, and errata sheets data January 5, 1999, Waste Management Hanford Corporation, Richland, Washington.

HNF, 1997, *Engineering Task Plan Cleanup of Miscellaneous Underground Storage Tank 241-Z-361*, Rev. 1, HNF-SD-WM-ETP-208, SG Eurysis Services Corporation, Richland, Washington.

PHMC, 1999, *Justification for Continued Operation for Tank 241-Z-361*, HNF-2024, Rev. 2, Prepared by the PHMC Companies and The Chiron Group LLC, Richland, Washington.

WAC 246-247, "Radiation Protection -- Air Emissions," State of Washington Department of Health, Olympia, Washington.

Table B-1. Estimates of Potential Radionuclide Emission

SLUDGE VOLUME	75.0	M^3
SLUDGE VOLUME	2648.6	FT^3
TOTAL NUMBER OF CORE SAMPLES	3.0	
SAMPLE HEIGHT	95.0	INCH
SAMPLE DIAMETER	1.0	INCH
TOTAL SAMPLE VOLUME	74.61	$INCH^3$
TOTAL SAMPLE VOLUME	4.32E-02	$FEET^3$
FRACTION OF SLUDGE VOLUME DISTURBED	1.63E-05	
NUMBER OF HEPA FILTERS	1	
HEPA FILTER EFFICIENCY	99.95%	
RELEASE FRACTION	1.00E-03	

(40 CFR 61 APPENDIX D)

Table B-2. Radionuclide Dose Estimation

ISOTOPE	QUANTITY, KG	KG/FT^3	TOTAL POSSESSION QUANTITY, CURIES	UNABATED RELEASE, CURIES	ABATED RELEASE, CURIES	DOSE CONVERSION FACTOR, MREM/CURIE WHC-EP-0498	UNABATED DOSE, MREM	ABATED DOSE, MREM	PERCENT OF ABATED OFFSITE DOSE
Pu-239	7.00E+01	2.64E-02	1.01E-03	1.01E-06	5.05E-10	5.15E+00	5.21E-06	2.60E-09	72.56%
Am-241	3.16E-01	1.19E-04	2.53E-04	2.53E-07	1.26E-10	7.79E+00	1.97E-06	9.84E-10	27.44%
TOTAL	**7.03E+01**		**1.26E-03**	**1.26E-06**	**6.32E-10**		**7.17E-06**	**3.59E-09**	**100.00%**

APPENDIX C

HEALTH AND SAFETY PLAN FOR SLUDGE SAMPLING TANK 241-Z-361

This document is INCOMPLETE unless attached to the complete Sampling and Analysis Plan

TABLE OF CONTENTS

ATTACHMENTS

TABLES

TERMS

ACES	Access Control Entry System
ACM	asbestos-containing material
APR	air-purifying respirator
BWHC	Babcock and Wilcox Hanford Corporation
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CGM	combustible gas meter
DOE	U.S. Department of Energy
HASP	health and safety plan
HAZMAT	hazardous materials
HEPA	high-efficiency particulate air (filter)
HPT	Health Physics Technician
HSRCM	*Hanford Site Radiological Control Manual*
JCS	Job Control System
JCO	Justification for Continued Operations
JHA	Job Hazard Analysis
LFL	lower flammability limit
LMHC	Lockheed Martin Hanford Corporation
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
OHE	Occupational Health Examiner
OSHA	Occupational Safety and Health Administration
OVM	organic vapor meter
PEL	permissible exposure limit
PFP	Plutonium Finishing Plant
PHMC	Project Hanford Management Contract
PIC	person-in-charge
PPE	personal protective equipment
RCRA	*Resource Conservation and Recovery Act of 1976*
RPP	River Protection Project
RWP	Radiation Work Permit
SAP	Safety and Analysis Plan
SCBA	self-contained breathing apparatus
S/RID	Standards/Requirements Identification Document
TLV	threshold limit value
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UFL	upper flammability limit
WAC	*Washington Administrative Code*

C1.0 INTRODUCTION

This site-specific health and safety plan (HASP) has been developed to address health and safety requirements for conduct of Phase II characterization of Tank 241-Z-361. The Phase II activities include opening the tank and collection of full-thickness core samples of the sludge in the tank.

The core samples will be analyzed for the contaminants of concern identified in the sampling and analysis plan. This HASP is provided in order to minimize health and safety risks to workers and other onsite personnel. This HASP establishes requirements, provides general guidelines, and conveys facility-specific hazard communication information. This HASP is provided also as a reference for use during the planning of work activities at Tank 241-Z-361. This HASP is intended to provide information consistent with HNF-SD-WM-HSP-002, *Tank Farm Health and Safety Plan* (LMHC 1998a).

The main body of this appendix is organized according to subject matter and presents first, the site-specific information relating to Tank 241-Z-361, followed by general information relevant for the planning and conduct of work. This information establishes baseline health and safety requirements and provides general guidelines. Supplemental information is provided in attachments to this HASP. A summary of site-specific health and safety requirements relevant to Tank 241-Z-361 is presented in Attachment C-1.

C1.1 FACILITY BACKGROUND

Tank 241-Z-361 is an inactive underground tank within the protected area of the Plutonium Finishing Plant (PFP) at the Hanford Nuclear Reservation near Richland, Washington. It is located approximately 240 ft south of Building 236-Z.

Tank 241-Z-361 served as a primary solids settling tank for low-salt liquid (primarily aqueous) waste. Historic flows during the operating history of the tank were approximately 2,000,000 gal/yr of process and laboratory wastewater. The supernate from Tank 241-Z-361 was routed to 216-Z-1, 216-Z-2, 216-Z-3, and 216-Z-12 Cribs for disposal to ground. The tank was in service from 1949 until 1973, supernatant was removed in 1975, and the tank sealed in 1985. All tank inlet and outlet pipes and risers have remained sealed since that time, leaving a layer of sludge sediments approximately 94 in. deep in the bottom of the tank.

The tank is considered to contain a substantial quantity of plutonium. The estimated inventory of plutonium ranges from 30 to 70 kg, based on the results of limited sampling and analysis conducted in the 1970s and evaluation of the limited available historic waste stream information. In addition to plutonium, the tank contents are expected to include constituents from nearly all PFP processes used during the tank's 24-yr operational period, but will be dominated by the nonsoluble components of effluents from Buildings 232-Z, 234-5Z, and 236-Z. The exact nature of the solids remaining in the tank is not well described currently. The largest expected contributors of settleable solids and insoluble liquids are expected to have been ash from incinerator scrubber operations, excess acid and caustic salts from waste neutralization activities, and solvents (e.g., carbon tetrachloride) from plutonium recovery and refining operations and laboratory disposal. Additional background information on Tank 241-Z-361 is presented in Section 1.0 of this Sampling and Analysis Plan (SAP).

At the time of this writing, verbal reports of the ambient condition and headspace monitoring of the tank during Phase I activities indicate the following conditions:

1. No indication of combustible gases in the tank headspace, and no pressurization of the tank;

2. No indication of smearable or airborne radioactive contamination at the closed tank risers;

3. No indication of ammonia volatile organic compounds or acid gases; and

4. Preliminary analysis indicates nitrous oxide (N_2O) at about 60 ppmV in headspace.

The results of Phase I vapor analysis from Tank 241-Z-361 are discussed in Section C2.5.

C1.2 SCOPE

The characterization activities at Tank 241-Z-361 are being conducted as part of the Hanford Site remedial activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). The requirements for health and safety planning, training, and safe field operations are specified by Occupational Safety and Health Administration (OSHA) *Code of Federal Regulations* (CFR), 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." This characterization has been separated into two distinct phases. Phase I (planned for implementation in December 1998) addresses evaluation of immediate hazards related to the tank (i.e., assessment of tank head space vapors for flammable gases, airborne radioactivity, and toxic vapors; and photographic documentation of the internal condition of the tank). Phase II characterization includes collection and analysis of full-thickness core samples of the sludge in the tank bottom. The completed characterization of Tank 241-Z-361 will be used to support the assessment of alternatives for safe removal and disposal of the contents of the tank.

This HASP applies to Lockheed Martin Hanford Corporation (LMHC), Babcock and Wilcox Hanford Corporation (BWHC), other prime contractors to the U.S. Department of Energy (DOE), and subcontractors to LMHC or Project Hanford Management Contractors (PHMC) who will conduct characterization activities at Tank 241-Z-361. It has been prepared in recognition of, and is consistent with, National Institute of Occupational Safety and Health (NIOSH), OSHA, United States Coast Guard, and U.S. Environmental Protection Agency's, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH 1985); Project Hanford Occupational Health and Safety Procedures; 29 CFR 1910.120; and Project Hanford Management Policies and Procedures. When differences in governing regulations or policies exist, the more stringent requirements shall apply until the discrepancy can be resolved.

The characterization of Tank 241-Z-361 involves cleanup under the CERCLA past-practice sites listed in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994) and is outside the normal tank farm operations. Over and above the requirements of 29 CFR 1910.120(p), LMHC has directed that in certain areas/circumstances additional precautions will be taken and respiratory protection zones established. The areas and circumstances are identified in the body of this document.

C1.3 DESCRIPTION OF PLANNED ACTIVITIES AT TANK 241-Z-361

The objectives of the current activity at Tank 241-Z-361 are as follows:

1. Collect a series of representative samples of the tank sludge from the existing tank risers.

2. Provide quantitative analysis of the chemical composition of the sludge samples and define the distribution of contaminants of concern within the identifiable sludge layers.

To meet these project objectives, the following activities will be implemented. Field activities are described in detail in Section 2.0 of this SAP. The results of Phase I characterization activities (i.e., tank dome loading test, tank head space vapor samples, and ambient condition monitoring), will be reviewed before implementation of Phase II activities. Any changes to this HASP will be incorporated as a safety plan amendment before initiating the Phase II actions. The site will be prepared before beginning the sampling activity. At the time of preparation of this HASP, a tank dome load test had been conducted. The results of this test indicate the need for construction of a truck bridge to support the core sampling vehicle during the Phase II activities. This bridge is currently under design by BWHC and will be fabricated and installed under a separate work package prior to collection of core samples. The tasks to be performed during site preparation and the sampling activities are described below.

Task 1: Review the results of the Phase I characterization activities and identify and incorporate any appropriate changes to this HASP. This review will include, but not necessarily be limited to, the following issues:

1. Effectiveness of the support infrastructure established during the Phase I action (e.g., exclusion zone, decontamination facilities, support area, communication, coordination between PFP and River Protection Project [RPP] staff).

2. The results of real-time ambient monitoring during the Phase I actions (e.g., combustible gas concentrations, toxic vapor concentrations, radiological monitoring results).

3. The results of laboratory analysis of vapor samples collected from the tank.

4. The video record of conditions inside the tank.

Task 2: Review site preparation conditions including the following and confirm that site is ready for sampling activities

1. Verify bridge and ramp construction and placement.
2. Confirm utility line clearance.
3. Confirm riser preparation.
4. Confirm support area setup.

Task 3: Collect the sludge samples for analysis (this task will be conducted in accordance with established RPP operating procedures for collection of tank waste samples).

1. Place the sampling vehicle on the vehicle bridge at the selected riser location and establish required containment structures.

2. Collect core samples from the tank sludge and vapor samples from tank headspace, place the samples in appropriate shipping containers as required by the procedure, document the samples and receive shipping approval from PFP staff, and deliver the samples to the laboratory.

3. Repeat the process at the remaining selected tank riser locations.

Task 4: Decommission the work area.

1. Containerize all radiologically or chemically contaminated investigation-derived waste and arrange for transportation and final disposition.

2. Dismantle and remove all structures (e.g., weather shelter), temporary barriers, and support facilities.

All work will be performed by employees of the PHMC companies. BWHC staff will manage the characterization project and provide oversight to all field activities, including site preparation activities. BWHC operations staff will provide plant-specific training to RPP staff and will manage emergency response requirements. The sludge sampling activities will be conducted by RPP staff using RPP equipment and existing procedures.

Field work is planned and performed using a team composed of Operations, Maintenance, Health Physics, Engineering, Quality, and Safety personnel. This team is responsible for work package planning and preparation; completion of corrective maintenance, surveillance, and calibration field activities; as well as support to project and characterization activities.

The planned activities at Tank 241-Z-361 will be managed, operated, and maintained in a safe, healthful, and efficient manner. All activities will be conducted within the bounds of this appendix and in compliance with all applicable federal, state, and local regulations as mandated through the approved *Plutonium Finishing Plant (PFP) Standards/Requirements Identification Document (S/RID)* (WHC 1996).

C1.4 METHODS OF CONTROLLING WORK

To facilitate the timely performance of the characterization effort at Tank 241-Z-361, the Phase II effort will be conducted according to the SAP and this site-specific HASP prepared by BWHC. Based on these planning documents, RPP tank farm staff will implement the sampling effort in a manner similar to routine tank sampling activities work at the 200 Areas Tank Farms using the RPP Job Control System (JCS). For detailed information on JCS implementation, refer to HNF-IP-0842, TWRS *Administration* (WHC 1992).

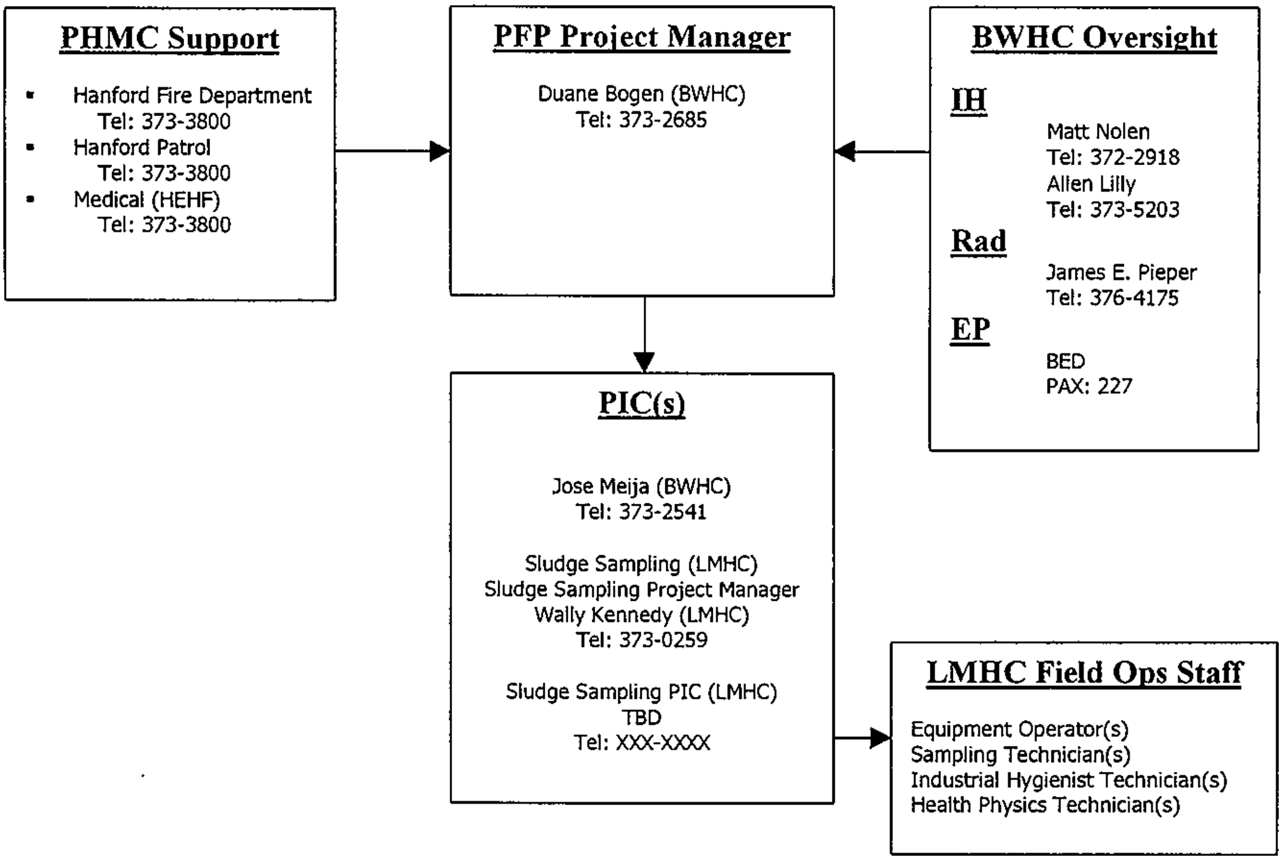
Work control for the Tank 241-Z-361 activities will follow RPP'S most formal method of performing maintenance work, HNF-IP-0842 (WHC 1992), with a detailed resolution, which is approved before performance of the work. The hazards evaluation necessary to protect the worker is covered by the use of the Job Hazard Analysis (JHA) process described in Section C2.0 of this appendix.

Jobs for which performance of work is hazardous, very complex, or has a higher potential of adversely affecting the environment or equipment operability may require more details in planning. Jobs in these categories may also require additional approvals, stricter control of release to work and more control/overview during work. These complex or high-risk jobs are sent to the work package preparers for detailed planning. The requirements associated with work package approvals are described in WHC (1992).

C1.5 ROLES AND RESPONSIBILITIES

Organizational roles, responsibilities, and interfaces are described in charters and program plans. A more detailed description of the roles and responsibilities of organizations is presented in the Memorandum of Agreement for Roles and Responsibilities for Characterizing Tank Z-241-361 (20 November 1998). Specific individual responsibilities are described in position descriptions. The organizational responsibilities for this activity are shared between RPP and PFP staff. Key management personnel are identified in Section 3.0 of this SAP. An overview of responsibilities for both organizations and personnel key to worker safety and health is described below. An organizational chart for health and safety responsibilities is presented in Figure C1-1.

Figure C1-1. Project Organization.



C1.5.1 Management

BWHP staff at PFP are assigned overall project management responsibility for this project. Project management staff are responsible for ensuring all work is properly prioritized and planned, and then executed in a safe manner. In addition, management shall ensure that the project staff possesses skills and resources necessary to safely conduct their assigned tasks. RPP management staff will be responsible for ensuring that the appropriate staff and equipment are supplied for the actual tank sludge sampling activity.

C1.5.2 Employees

All PFP and RPP employees associated with this project are responsible for ensuring all work is conducted in a safe and healthy manner and that safety and health concerns are reported and understood. Employees shall report unsafe conditions or practices to their direct supervisor or the job supervisor/person-in-charge (PIC) during work performance. Employees have the authority and should stop work if an immediate threat to life or health exists. When appropriate, employees should take personal action to correct or mitigate the unsafe condition at the time it is discovered. Employees are responsible for following all written procedures, controls specified in permits (e.g., Confined Space Entry Permit and Radiation Work Permit [RWP]), and additional safety instructions contained in work control documents or conveyed by the job supervisor/PIC.

C1.5.3 Plutonium Finishing Plant and Tank Waste Remediation System Safety Management

The Safety Managers are responsible for ensuring close coordination between project staff and the organization for the purpose of maintaining a safe and healthful workplace. This activity includes coordination of all aspects of project safety (i.e., industrial safety, industrial hygiene, radiation protection/health physics, and safeguards and security). Other responsibilities include developing and implementing this HASP and auditing field activities, as appropriate, to verify compliance; ensuring the effective integration and involvement of safety and health professionals in daily activities to ensure hazards are identified and controlled; supporting the line organization in dealing with hazards and establishing safety and health requirements through the PFP S/RID (WHC 1996). PFP safety management will provide daily inspections and weekly field safety oversight during field operations at Tank 241-Z-361.

C1.5.4 Plutonium Finishing Plant Safety and Tank Waste Remediation System Safety Personnel

Personnel in the RPP and PFP Safety organization (including industrial safety specialists, industrial hygiene technicians, and health physics technicians [HPTs]) are responsible for assisting management in defining and resolving safety and health issues; aiding in the communication of hazards to employees; providing evaluations of hazards; verifying compliance with this HASP; and assisting project personnel to ensure all designated health and safety procedures and requirements are properly implemented in the field.

C1.5.5 Plutonium Finishing Plant and Tank Waste Remediation System Radiological Control

The Characterization Project Radiological Control organization is responsible for monitoring for radiological hazards, providing radiological survey maps to support work planning and performance, verifying compliance with established radiological procedures, and invoking stop-work authority for radiological hazards that could potentially jeopardize worker health and safety. HPTs from the RPP staff will perform site monitoring during the sludge sampling effort. PFP health physics and radiological control staff will advise with regard to any special requirements for PFP-specific radiological control evaluation and management of alpha-emitting radionuclides.

C2.0 HAZARD EVALUATION

Activities at Tank 241-Z-361 pose potential physical, chemical, environmental, and radiological hazards. The radiological hazard associated with Tank 241-Z-361 is better characterized than the chemical hazards at the time of this writing. Project safety staff must review the results of the Phase I characterization effort before implementing this Phase II activity.

Personnel may be exposed to a variety of chemical, physical, biological, and ergonomic agents while working at Tank 241-Z-361. Worker exposure to hazards may result from contact with materials, use of equipment, or working conditions. These hazards must be identified, and personnel must be properly protected. The ongoing efforts identified above are aimed at reducing the risks of injury, property damage, or exposure to chemicals or ionizing radiation. Multiple hazards must be considered, such as vapor exposures, waste contact exposures, flammability, heat and cold stress, electrical hazards, excessive noise levels, encounters with snakes, spiders, and insects, poor lifting techniques, and slips, trips, and falls.

Project personnel from BWHC and LMHC work together to identify hazards at the work location. As hazards are identified and evaluated, controls are employed to eliminate or mitigate the potential risks. The measures employed are documented, and the documentation is then disseminated. This information on hazards is used for work location posting and for discussion at prejob safety briefings and safety meetings.

This section of the HASP provides information on safety and health hazards that may be present at Tank 241-Z-361.

C2.1 TASK RELATED HAZARDS ASSOCIATED WITH TANK 241-Z-361

Most physical hazards (e.g., flammable vapors, trip and fall hazards, vehicle hazards, lifting and moving material hazards, heat and cold stress) and chemical hazards (e.g., potential toxic vapors, corrosive materials) associated with the planned sludge sampling of Tank 241-Z-361 are similar to hazards related to the tank farm operations routinely conducted by RPP personnel. Field personnel should review the protocols in the following sections for additional information. Some unique hazards, or potential degree of hazard, have been identified at the Tank 241-Z-361 Site. Detailed discussion of the Preliminary Hazard Analysis for Tank 241-Z-361 is presented in the *Justification for Continued Operation for Tank 241-Z-361* (PHMC 1999). These hazards are as follows:

1. potential structural instability of the tank (to be addressed through engineered controls),
2. potential combustible gas hazards (more detected during preliminary site activities),
3. potential toxic vapor hazards (to be addressed by personal protective equipment [PPE] and engineered controls),

4. mechanical hazards associated with a potentially-pressurized tank (tank was determined to be not pressurized and is currently passively vented),

5. potential for release of alpha-emitting radionuclides and potential exposure to other ionizing radiation (the tank is known to contain plutonium), and

6. criticality hazards: A recent review of the tank conditions, based on current knowledge of tank contents and conservative assumptions, has confirmed the existing criticality safety evaluation report's assessment that a criticality event in Tank 241-Z-361, while not entirely incredible, is highly unlikely during the planned characterization activities. The planned activities include collection of core samples using the tools and equipment specified in this SAP. Following completion of characterization activities, criticality hazards will be re-evaluated using the results of sludge analysis to support selection and evaluation of remedial alternatives.

C2.2 SLUDGE SAMPLING PROCEDURES AND SITE-SPECIFIC PROCEDURE MODIFICATIONS

The highest likelihood of accident is linked to procedural errors. Specific procedures have been developed by RPP for the collection of samples from the contents of radioactive waste tanks and these procedures are expected to be effective when followed during activities at Tank 241-Z-361. However, major problems can occur if operational errors are made (e.g., turning wrong valves, mixing incompatible materials, etc.). Tank-related operations, including the characterization of Tank 241-Z-361, cannot be made fail-safe. Safety must continue to rely on a rigorous conduct of operations. This requires a heavy commitment to training and administrative enforcement of proper conduct.

The following existing RPP procedures will be implemented at Tank 241-Z-361, depending upon the specific sampling hardware selected and available for use at the tank:

1. Procedure TO-020-454, "Setup and Takedown of Core Sample Systems" (LMHC 1998b)

2. Procedure TO-020-456, "Core Sampling Truck Tank Riser Access Platform and Ramp Setup" (LMHC 1998c)

3. Procedure TO-080-505, "Push Mode Sampling With Truck #1" (LMHC 1998g)

4. Procedure TO-060-003, "Perform Field Inspection and Loading of On-Site Casks During Core Sampling Operations" (LMHC 1998d)

5. Procedure TO-080-075, "Sample Transfer Truck Operation" (LMHC 1998e)

6. Procedure TO-080-090, "Transport the On-Site Transfer Cask" (LMHC 1998f)

These procedures have been reviewed by for appropriateness and applicability by BWHC health physics staff. The general philosophy to the procedure review is to make minimum changes to existing procedures consistent with the hazard associated with alpha-emitting radionuclides, personnel safety, and contamination control associated with Tank 241-Z-361.

C2.3 POTENTIAL STRUCTURAL INSTABILITY OF TANK 241-Z-361

Tank 241-Z-361 is a steel-reinforced concrete structure located completely underground. The nature of the waste solutions historically sent to the tank (i.e., acidic solutions) and the limited observations conducted in the 1970s (i.e., photographs indicating disappearance of the steel tank liner) indicate a concern for the continued structural integrity of the tank due to possible corrosion of the concrete and the steel reinforcing. Failure of the tank structure under a load could result in serious personnel injury, equipment damage or loss, and potential release of toxic and flammable vapors and alpha-emitting radionuclides to the atmosphere. In addition to the main tank structure, the riser pipes on the tank top, which are flanged pipes set in the concrete tank roof, are subject to corrosion and subsequent loss of integrity. The interim operating controls currently in place prohibit placing any personnel or equipment loads on the tank top.

BWHC has conducted a load test of the tank structure and determined that a bridge structure is required to support the sampling vehicle during the sludge sampling activities. The results of the load test have not been published at this time. At the time of preparation of this plan, a preliminary bridge design has been developed. The bridge will be constructed by an off-site subcontractor and will be erected over tank under the supervision of Fluor Daniel Northwest engineering staff under a separate work scope for site preparation.

C2.4 FIRE AND EXPLOSION HAZARD AT TANK 241-Z-361

The results of the flammable vapor assessment conducted during the Phase I Vapor Sampling activities conducted at Tank 241-Z-361 must be reviewed before initiating the Phase II (sludge sampling) activities. Appropriate flammable vapor mitigation practices will be implemented during sludge sampling in accordance with existing RPP tank sampling procedures. The tank should have been vented and have a passive vent in place before the sludge sampling activities. The following information regarding the potential flammable vapor hazard at Tank 241-Z-361 is based on information developed for the Phase I vapor sampling safety plan.

Based on the assumption that the tank is effectively sealed, the Justification for Continued Operation (JCO) (PHMC 1999) indicates that Tank 241-Z-361 has the potential to contain flammable vapors. The flammable vapors, if present, are most likely to be hydrogen (H_2) and/or methane (CH_4) from chemical or radiological degradation of organic materials in the remaining sludge. There is also a possibility for ammonia (NH_3) to be present in the tank vapor. All of these compounds are lighter than air and, if present, will tend to accumulate in the upper portion of the tank and the tank risers. The potential flammable gas hazard will be managed by implementing the flammable gas mitigation procedures specified in the JCO (PHMC 1999). The upper and lower flammability limits (UFL, LFL) for the most likely flammable compounds are shown in Table C2-1.

Table C2-1. Flammability Limits for Vapors of Concern, Tank 241-Z-361.

Compound	LFL (% in air)	UFL (% in air)	Autoignition temperature (° F)	Vapor density (air = 1.0)
Hydrogen (H_2)	4	75	1,075° F	0.07
Methane (CH_4)	5	15	1,000° F	0.55
Ammonia (NH_3)	15	28	1,204° F	0.60

LFL = lower flammability limit.
UFL = upper flammability limit.

Preliminary field observations and measurements during Phase I activities at Tank 241-Z-361 indicated no flammable gas mixture in the tank headspace. During work involving breaking containment on this tank and sludge sampling, monitoring will be performed to verify headspace levels are less than 25% of the LFL. If flammable vapor concentrations in the work area exceed 25% of the LFL, work will be suspended until the vapor concentrations have been reduced by supplemental ventilation, displacement of the vapors with an inert gas, or allowing the vapors to disperse. Personnel will observe and implement all bonding, grounding, and spark control protocols defined in the sludge sampling procedure(s) selected for use in Phase II.

Flammable liquids will be stored and dispensed from U.S. Department of Transportation-approved shipping containers or approved safety containers. The vapors given off from these liquids are above their flash point and, therefore, are susceptible to any ignition source. HNF-PRO-358, *Flammable/Combustible Liquids* (PHMC 1997j), provides the requirements for the use, storage, and handling of these liquids. Flammable liquids for the project are expected to be limited to motor fuel in vehicles and a portable generator. All refueling will be performed at the PFP fueling station.

C2.5 CHEMICAL AGENTS POTENTIALLY PRESENT IN TANK 241-Z-361

Before conducting the Phase II sludge characterization at Tank 241-Z-361, project safety staff must review the results of the Phase I characterization effort an evaluate the potential for continuing hazard of toxic vapors and other chemical agents in the tank. At the time of this writing, preliminary Phase I observations and field measurements have been summarized and incorporated into this document where appropriate. This hazard should be assessed on the presence or absence and concentration of toxic vapors observed during the Phase I activities and on the apparent effectiveness of the tank venting system installed during Phase I. Potentially toxic materials are expected to remain present in the sludge at the tank bottom even in the presence of effective tank headspace ventilation that may be established during Phase I. The following information regarding chemical agents in the tank is based on information developed during planning for Phase I activities.

The possibility exists for accumulation of toxic vapors in Tank 241-Z-361 based on historic operations and the nature of the processes which contributed wastes to the tank. These compounds included strong mineral acids (e.g., nitric acid, sulfuric acid, hydrochloric acid, hydrofluoric acid), strong caustics (e.g., sodium hydroxide), a number of organic compounds (e.g., carbon tetrachloride; tri-, di-, and monobutyl phosphate, dibutylbutyl phosphonate, butanol, urea, lard oil, oxalic acid, acetic acid, benzene, and p-phthalic acid), some metals, and a limited number of radionuclides.

Most of the acids and caustics are expected to have reacted with each other or with other tank contents and are not expected to be present in un-ionized states. A sample of the sludge from the early 1970s indicated a slightly acid pH of 4.0, so the possibility exists for some pH extremes to be encountered during sludge sampling. The metallic contents of the tank are most likely present as solids in the tank, with the largest quantity in the sludge at the tank bottom. Field monitoring detected no acid gases in the tank headspace during preliminary Phase I activities.

The organic compounds with substantial vapor pressure are most likely to present a toxic vapor hazard during the planned activities at Tank 241-Z-361. A list of the characteristics of the suspected waste constituents with vapor pressure greater than 1.0 mm mercury (including ammonia) is shown in Table C2-2. These compounds also comprise the organic constituents that are most likely to be present in the tank sludge in any substantial amount as either phase-separated liquids or in aqueous solutions in tank liquids. No volatile organic compounds or ammonia were detected in the tank headspace with field instruments during Phase I activities. Nitrous oxide (N_2O) was detected at approximately 60 ppmV in an air grab sample collected from the headspace. Additional analysis of tank headspace vapors collected from a level near the sludge surface detected a number of additional compounds shown in Table C2-3.

Table C2-2. Characteristics of Selected Potential Volatile Waste Constituents, Tank 241-Z-361.

Chemical	Vapor pressure (mm Hg)	Exposure limit[1] (ppm in air)	Ionization potential (eV)	Vapor density (air = 1.0)
Ammonia	10,340	25	10.18	0.6
Acetic Acid	11	10	10.66	2.07
Benzene	75	1	9.24	2.77
Butanol	6	50 (ceiling)	10.04	2.55
Carbon Tetrachloride	91	2	11.47	5.5
Dibutyl Phosphate	1	1	not determined	<1 (estimated)
Monobutyl Phosphate	<1 (estimated)	none established	not determined	<1 (estimated)
Dibutylbutylphosphonate	1 (approximately)	none established	not determined	<1 (estimated)
Nitrous Oxide	528,000	25	12.89	1.53

[1]Exposure limit is most conservative of OSHA PEL or NIOSH recommended exposure limit.

NIOSH = National Institute of Occupation Safety and Health.
OSHA = Occupational Safety and Health Administration.
PEL = permissible exposure limit.

Table C2-3. Exposure Limits for Compounds Detected in Tank 241-Z-361 Headspace.

Compound	Concentration Reported (ppmv)	OSHA PEL (ppmv)	NIOSH REL (ppmv)	ACGIH TLV (ppmv)	Comment
Freon 11	0.61	1000	1000	1000	IP = 11.77 eV. Monitoring is addressed through the existing H&S protocols.
Dichloromethane (Methylene chloride)	0.016	500	Lowest feasible	50	IP = 11.32 eV. Potential Carcinogen. Monitoring is addressed through the existing H&S protocols.
Chloroform	1.30	50	2 (ST) Lowest feasible	10	IP = 11.42 eV. Potential Carcinogen. Add compound-specific monitoring to field monitoring. APRs not recommended for this compound.
Carbon tetrachloride	0.16	10	2 (ST) Lowest feasible	5	IP = 11.47 eV. Potential Carcinogen. Monitoring is addressed through the existing H&S protocols.
Tetrachloroethylene, PCE	2.00	100	Lowest feasible	50	IP = 9.32 eV. Potential Carcinogen. Monitoring is addressed through the existing H&S protocols.
Trichloroethylene, TCE (TIC)	0.9 (TIC)	100	25	50	IP = 9.45 eV. Potential Carcinogen. Monitoring is addressed through the existing H&S protocols.
Acetone	0.02	1000	250	750	IP = 9.69 eV. Monitoring is addressed through the existing H&S protocols.
Toluene	0.007	200	100	100	IP = 8.82 eV. Monitoring is addressed through the existing H&S protocols.
n-Butane	0.12	NE	800	800	IP = 10.63 eV. Monitoring is addressed through the existing H&S protocols.
n-Pentane	0.06	1000	120	600	IP = 10.34 eV. Monitoring is addressed through the existing H&S protocols.
Acetic Acid	0.054	10	10	10	IP = 10.66 eV. Monitoring is addressed through the existing H&S protocols.
Carbon dioxide	13,000	5,000	5,000	5,000	IP = 13.77 eV. Asphyxiant . Add compound-specific monitoring to field activities. APRs not effective against compound.

APR = air-purifying respirator
IP = ionization potential
NE = none established
ND = not determined
ST = short-term exposure limit (60 minutes)
TIC = tentatively identified compound

With the exception of ammonia, the volatile organic compounds potentially contained in the tank have vapor densities of greater than 1.0 (i.e., they are more dense than air). The long quiescent period with the tank sealed (e.g., about 13 yr) creates the potential for stratification of vapors within the tank headspace with the lightest compounds closest to the tank top. The proposed vapor sampling activities are expected to cause minimal disturbance of the tank headspace. The proposed Phase II sludge sampling activities may disturb stratified vapors within the tank and result in a different mixture of vapors at the tank risers, including the presence of compounds that were not detected during the Phase I sampling and analysis. Personnel must continue a rigorous real-time air monitoring protocol during all activities at Tank 241-Z-361. This monitoring must include continuous monitoring for organic vapors and ammonia with regular periodic sampling for carbon tetrachloride.

In addition to the organic compounds suspected to be present in the tank, the sludge consists largely of poorly described inorganic solids. Major contributors to the inorganic solids may include sodium hydroxide used in neutralization processes, incinerator ash, silica from undetermined sources, and neutralization reaction products (e.g., sodium fluoride). The primary acidic constituent is reported to be nitric acid with a smaller contribution of and hydrofluoric acid. Both of these acids are extremely toxic and corrosive. Personnel must avoid all direct skin contact with sludge from Tank 241-Z-361. In addition to its corrosive nature, hydrofluoric acid is extremely toxic via direct contact and absorption through the skin. Most of the acidic materials in the tank are expected to have been neutralized by treatment of the waste streams discharged to the tank. Historical testing of one sludge segment displayed a slightly acidic pH of 4.0. This indicates that acids in the sludge, if un-neutralized, are very dilute.

The following routes of exposure are applicable to the Phase II sludge sampling activities. Chemical exposure may occur through inhalation, absorption, ingestion, or injection.

- Inhalation of hazardous materials may occur from lack of, or improper use of, respiratory equipment, malfunctioning monitoring equipment, or the presence of either undetected chemicals or chemicals in quantities greater than respiratory equipment protection limits.

- Absorption through the skin or eyes of solid, liquid, or gaseous hazardous substances can occur by direct contact or through cuts and/or abrasions. Skin or eye absorption can occur when a worker does not wear the proper protective clothing or proper eye protection, when a break or a tear occurs in the protective clothing, or when unwashed hands come in contact with the eyes.

- Exposure by ingestion might occur and affect the digestive system if hazardous substances are ingested by workers who do not practice good personal hygiene habits (e.g., washing hands thoroughly after completion of work or before smoking, eating, drinking, or chewing gum or tobacco).

- Hazardous substances may be injected into the body through puncture wounds while using contaminated equipment with sharp edges, from protrusions, pressurized hoses, or air lines.

C2.6 PHYSICAL AGENTS

The planned characterization of Tank 241-Z-361 is subject to all of the physical hazards associated with similar work at other tanks at the Hanford Site. The following discussion was developed directly for use at the Hanford tank farms and could apply to Tank 241-Z-361.

C2.6.1 Heat Stress

The Heat Stress Program for Tank 241-Z-361 characterization will follow the requirements of HNF-PRO-121, *Heat Stress Control* (PHMC 1997h), which appears in the Project Hanford Policy and Procedures System. Assistance in applying heat stress controls is available through cognizant industrial hygienists.

C2.6.2 Cold Exposure

If schedule delays extend the project field work into cold weather, cold exposure management procedures will be implemented per the tank farms HASP.

C2.6.3 Noise Hazards

The identification and control of noise hazards, and the criteria for employee enrollment into the Hearing Conservation Program, will follow the requirements of HNF-PRO-115, *Hearing Conservation* (PHMC 1997g). The noise sources of potential concern for this project are a portable generator and the engine of the sampling truck. If the activities at the site exceed noise standards, then appropriate hearing protection will be used.

C2.6.4 Illumination

Although field activities are expected to be performed during the day shift, personnel may encounter areas with inadequate lighting levels when working around Tank 241-Z-361. When there is concern of inadequate lighting, an illumination evaluation will be performed and improvements made to allow safe conduct of work activities. Improvements could include the location and use of portable lighting, dependent on the job-specific needs.

Requirements for minimum illumination intensities (measured in foot-candles) have been established by 29 CFR 1910.120. Areas accessible to employees shall be lighted to not less than the specified minimum intensities.

C2.6.5 Pressurized Tank Hazards

Pressurized tank hazards, if present, should be mitigated by the tank venting actions undertaken during the Phase I tank head space sampling effort. Before conducting the Phase II sludge characterization at Tank 241-Z-361, project safety staff must review the results of the Phase I characterization effort and evaluate the potential for continuing tank pressurization hazards.

C2.7 RADIOLOGICAL HAZARDS

Tank 241-Z-361 is expected to contain a substantial quantity of plutonium (estimated at 30 to 70 kg) and is expected to contain a much smaller quantity of americium from radioactive decay of the plutonium (PHMC 1999). The presence of other radionuclides is possible, but none have been identified to date. The gross activity of previous sludge samples was not reported. Plutonium is an alpha-particle emitter and the plutonium in the tank may be present as either particulate plutonium metal, or as inorganic plutonium salts (e.g., plutonium fluoride or plutonium nitrate) as a result of reaction with the acidic waste constituents in the tank. Plutonium salts are acutely toxic if ingested and inhalation or ingestion of alpha-emitting radionuclides can cause serious exposure-related health effects.

The existing criticality safety analysis for this tank has recently been revalidated. This analysis confirmed that a criticality event is extremely unlikely during the collection of core samples from Tank 241-Z-361. The current criticality analysis does not address the potential criticality hazards associated with bulk removal of the sludge from Tank 241-Z-361. Following the characterization activities and using the information generated during the characterization, the criticality hazard associated with this tank will be re-evaluated to support selection and evaluation of remedial alternatives. Although most of the radionuclides in the tank are expected to be contained in the sludge at the tank bottom, some radioactive particles may be found in any portion of the tank, including on the tank sides, roof, and within the risers. It is possible for some dry, fine-textured particulate material containing the nuclides of concern to be disturbed during tank opening and sludge sampling actions. These particulates may be suspended in the tank headspace and, therefore, may be discharged from the tank during tank opening and insertion and removal of sampling equipment and tools.

The potential release of, and exposure to, these radionuclides will be controlled through the use of sleeves and other containment systems in association with the sampling equipment itself, and through the use of PPE, including appropriate respiratory protection. Due to the potential for exposure to particulate plutonium, the sludge sampling effort will be conducted in Level B respiratory protection.

AN RWP and an as low as reasonably achievable (ALARA) Management Worksheet (AMW) will be prepared for the activities at Tank 241-Z-361 to specify radiological safety measures and HPT support during field operations. The field activities will require continuous field monitoring for alpha radiation during sampling activities. Action levels for ionizing radiation will be defined in the RWP. Project safety staff will ensure that all aspects of the safety plan are integrated to control exposure to toxic materials as well as radiological contaminants. Alpha particle monitoring will be conducted using an alpha continuous air monitor with alarm in the work area near the riser being used for sample collection. In addition, one fixed-head air sampler will be placed at the exclusion zone boundary. The filter samples will be read with a field alpha-detection instrument every 15 min to detect the presence of airborne alpha emitters. Preliminary action levels for airborne alpha emitters have been determined based on the limitations and protection factor of the respiratory protection devices expected to be in use at the site. For supplied air systems, the airborne plutonium action level for evacuation of the work area is 2×10^{-9} µCi/mL Pu. For air purifying respirators, the airborne action level for evacuation of the work area and/or upgrading to supplied air is 2×10^{-11} µCi/mL Pu.

The primary means of contamination control is containment. Areas where contamination has already spread will be posted to warn personnel.

The RWP is used to govern all entries to radiation areas, all radiological work, and all storage of radioactive materials (see site forms A-6000-272 and A-6000-272.1).

C2.8 ERGONOMIC HAZARDS

The most common ergonomic hazard identified at the tank farms is use of backpack mounted self-contained breathing apparatus (SCBAs) and manual lifting of tools, equipment, or materials necessary to perform operations. This hazard could and has resulted in back injuries (the predominantly reportable injury in the tank farms).

The medical service provider provides a back injury prevention program emphasizing back strengthening and flexibility. The job hazard evaluation for Tank 241-Z-361 should consider the ergonomic risks. NIOSH guidelines suggest a maximum object weight of 23 kg (51 lb) for a single lift. The maximum object weight is lowered proportionally based on the following factors:

- How high the object is lifted;
- How far in front of the body the object must be placed;
- How much twisting from the center line of the body occurs;
- How many lifts occur in a given period of time; and
- How well the object may be gripped with both hands.

The following is a guide for manual lifting activities.

1. If available, use a material handling system when possible.

2. If the lifting activity occurs regularly, a material handling system or tool should be purchased (e.g., dolly, hoist, or spring-loaded cart).

3. Employees who perform manual lifts should be instructed in proper lifting techniques (materials on manual lifting are available from the Shared Resource Center, listed in the Hanford Site phone directory).

4. Physical capabilities or limitations of potential employees should be considered. Any concerns about a potential employee's lifting ability should be discussed with the physicians at the medical service provider.

Ergonomics must also be a consideration in the design, development, and installation of new equipment, processes, and facilities. The most effective means for ensuring incorporation of ergonomic considerations is the involvement of both specialists and users in all phases of planning and installation/construction.

Project staff will follow established procedures for operating the sampling equipment, samples, and sample containers to reduce lifting and awkward operating positions.

C2.9 BIOLOGICAL HAZARDS

Venomous snakes, scorpions, bees, and spiders may hide under or inside of equipment or in protective clothing storage areas. Workers disturbing them may be bitten or stung. The consequences of a bite or sting can be a severe reaction and, possibly, death. If an injury from a biological hazard occurs, prompt medical aid must be requested and provided. Workers with known extreme reactions to bee stings should consider carrying an anaphylaxis emergency treatment kit and inform co-workers of the condition. Workers are advised to shake out all protective clothing before donning.

C2.10 WORK ENVIRONMENT

Hazards discussed in this section may be encountered in routine job activities performed at Tank 241-Z-361. Sections C2.10.1 through C2.10.14 reflect items for consideration during the JHA phase required for use in planning of nonroutine work activities.

C2.10.1 Asbestos

The flange gasket(s) on Tank 241-Z-361 risers are expected to contain asbestos and will be treated as asbestos-containing material (ACM). When working on or disturbing ACM, controls as stated in HNF-PRO-408, *Asbestos - Facility Management/General Industry* (PHMC 1997k) or HNF-PRO-338, *Asbestos Control - Construction Industry* (PHMC 1997i), must be used and followed. An asbestos work permit, site form 54-6700-149, shall be completed before performing asbestos work.

ACM might present an inhalation hazard if the gasket becomes damaged and non-intact. Chronic (long-term) exposure can cause lung cancer, mesothelioma, digestive system cancer, and asbestosis. These risks are minimal when material is not disturbed.

Facilities with ACM have postings at each entrance, and known ACM is identified using ACM labels or pink coating. Only Washington State-certified asbestos workers may handle asbestos.

C2.10.2 Walking/Working Surfaces

The walking/working surfaces in the site present slip, trip, and fall hazards. Next to heat stress, this hazard has the highest potential (based on injury statistics) for causing harm to employees. Hazards that may exist include uneven terrain, guy wires, stairs, ramps, wind-blown soil, rocks, risers, conduit, ducts, well caps, electrical cords, and hoses. Additional risks from walking/ working surface hazards are present during inclement weather or during the evening when illumination (lighting) in the site is minimal. Workers must be informed of these potential hazards during training and prejob briefings, in accordance with HNF-PRO-091, *Walking/ Working Surfaces* (PHMC 1997c).

BWHC and RPP safety personnel will inspect the sampling truck bridge after installation and before use to evaluate the potential need for additional fall protection requirements during sludge sampling activities. Because the sampling truck will be placed on the bridge during sampling, the on-bridge work area around the truck must be evaluated and appropriate measures taken to prevent fall-related injuries to personnel.

C2.10.3 Working in Proximity to Moving Equipment/Vehicles

A variety of equipment may be present and operating near Tank 241-Z-361 including cranes, backhoes, personnel lifts, sample trucks, pickup trucks, and other vehicles. Spotters and/or signal persons must be used whenever there is a potential hazard from the movement or operation of machine or vehicle, in accordance with DOE-RL (1993) and HNF-PRO-100, *Transportation Safety* (PHMC 1997e).

Workers must pay close attention when working in areas where vehicles are operated. The drivers of vehicles must also be aware of people and obstacles around them. Where a driver has a limited view to the rear of the vehicle, a spotter must be used for backing. When cranes are operated, workers around the cranes must wear hard hats and never work or pass under lifted loads. Carbon monoxide is a potential hazard when working around internal combustion engines. If it is necessary to operate engines, sufficient ventilation must be allowed to prevent exhaust gas accumulation.

Operators must pay particular attention when operating the core sampling equipment. The nature of the sampling activity precludes complete guarding of all moving parts of the sampling truck apparatus and personnel must exercise caution to prevent entanglement in mechanisms and to avoid pinch points (e.g., contact between sampling strings and riser pipes). Support personnel (e.g., health physics and industrial hygiene technicians) who are required to approach the tank risers and samples regularly to perform monitoring, but who may not be familiar with the mechanical hazards of the sampling system, must be briefed on mechanical hazards before beginning work at the site.

C2.10.4 Machine Guarding

Those authorized to remove guarding for any purpose must follow HNF-IP-0842 (WHC 1992) and then immediately replace the guards when their work is complete, in accordance with HNF-PRO-086, *Machine Guarding* (PHMC 1997b). Workers must be aware of these potential hazards and report them when observed so they may be properly guarded.

C2.10.5 Electrical Hazards

Overhead power lines, downed electrical wires, and buried cables all pose the danger of shock or electrocution. Electrical equipment may also pose a hazard to workers. Careful observation for overhead electrical hazards shall be performed by operating personnel before raising masts on drill rigs, booms on cranes, or when operating any equipment capable of coming into contact with electrical wires. Workers must also look for frayed cables, uncovered openings in boxes and switch centers, and any other defects in electrical equipment. These hazards must be reported to the line manager as soon as they are observed.

C2.10.6 Natural Hazards

Because most work performed at Tank 241-Z-361 is done out-of-doors, many environmental factors need to be considered. As identified in Sections C2.5.1 and C2.5.2, heat and cold stress can be a problem for workers. Inclement weather can make walking/working surfaces slippery. In addition, rain or melting snow can fill in low areas in normal walkways, causing workers to take new routes, where they may encounter other hazards.

Thunderstorms and their resultant lightning are of particular concern at the tank farms. If lightning strikes more than 8 km (5 mi) away from the site, people can continue to work. If lightning strikes within 8 km (5 mi), they should leave the site; workers may return if no lightning strikes are observed within 30 minutes. If lightning is identified within a 50-mi radius of Tank 241-Z-361, intrusive activities will be stopped until the storm passes and no lightning strikes are observed for 30 minutes.

The impact of wind (dust storms/high winds with potential to resuspend contamination and reduce visibility) on work in outdoor areas containing nonfixed contamination will be controlled by the applicable RWP. Operations will determine additional precautions to be taken at Tank 241-Z-361 in high wind and predicted high-wind conditions.

C2.10.7 Stored Energy Sources/Lock and Tag

Stored energy sources pose a potential hazard to workers. These hazards include, but are not limited to, electrical, mechanical, hydraulic, pneumatic, chemical, radiation and thermal energies, and various forms of potential energy (e.g., springs, compressed gases, or suspended objects). Lockouts/tagouts shall be used to protect workers from these energy sources. The lockout/tagout procedures are described in HNF-IP-0842 (WHC 1992) and are controlled by the PFP shift supervisor.

C2.10.8 Ladders

Ladders purchased and used at the Tank 241-Z-361 Site shall be appropriate for industrial applications and comply with the specifications of HNF-PRO-094, *Portable Ladders* (PHMC 1997d). Employees working with portable ladders shall know and follow established rules and safe practices for ladder use. Ladders shall be maintained in good condition at all times, inspected before each use, and stored properly.

C2.10.9 Vehicle Traffic

All vehicle drivers at Tank 241-Z-361 shall obey all posted signs and Washington State vehicle laws. Guidelines for transportation are provided in HNF-PRO-100 (PHMC 1997e). Vehicles are not allowed on the site unless the job requires the use of a vehicle. Vehicle movement near Tank 241-Z-361 is not allowed without approval of the shift manager and spotters to assist.

Pedestrians at the site shall be aware of all vehicle traffic and obey all safety rules.

C2.10.10 Rigging Operation

For operation, inspection, maintenance, and repair requirements for cranes, hoists, fork trucks, and rigging equipment, refer to DOE-RL (1993).

C2.10.11 Hand and Portable Power Tools

Employees who operate hand and/or power tools shall be properly trained in the use of the equipment. Power tools should be operated in strict accordance with the manufacturers' instructions. Required PPE shall be worn as needed when operating power tools. The requirements and responsibilities for the use of power tools are located in HNF-PRO-085, *Hand and Portable Hand Power Tools* (PHMC 1997a) and HNF-PRO-086 (PHMC 1997b).

C2.10.12 Pinch Points

During certain work activities at the Tank 241-Z-361 Site, a situation may arise exposing workers to moving machinery injury hazards. This situation may present a "pinch-point hazard." Pinch-point injury hazards can exist between unguarded rotating and fixed parts that create a shearing, crushing, or abrading action. For guidance to preventing pinch-point injuries refer to HNF-PRO-086 (PHMC 1997b).

C2.10.13 Sharp Objects

Certain work activities in Tank 241-Z-361 investigations may expose workers to hazards involving sharp object injuries. Sharp objects can be encountered as a result of mechanical failure, in the course of using tools and machinery, and in handling discarded waste materials. For guidance in preventing injuries due to sharp objects, refer to site procedures and any applicable JHA.

C2.10.14 Sanitation

All work places shall be kept clean and housekeeping shall be monitored regularly. At the end of each task/job, the work area will be clean with all work materials, tools, and equipment returned to appropriate storage locations. Adequate potable water and toilet facilities shall be provided.

C3.0 TRAINING

The training requirements for personnel conducting the activities at Tank 241-Z-361 are the same as for the tank farm operations typically conducted by these personnel, with the exception of plant-specific training for operations at PFP. The training requirements are described in the following sections.

C3.1 GENERAL OVERVIEW

Safety training is designed to provide workers with the necessary skills and knowledge to perform assigned duties and functions in a safe and healthful manner.

Training for personnel is dependent on the level and type of work each individual will be responsible for performing. At a minimum, each worker requires a general level of training to meet the OSHA requirements of both 29 CFR 1910.120 and 29 CFR 1910.1200, "Hazard Communication." Additional training that meets other regulatory requirements provides further safety and health training for tank farm operations may be required (such as "Dangerous Waste Regulations" [*Washington Administrative Code* 173-303)], *Radiation Protection for Occupational Workers* [DOE 1988]).

C3.2 REQUIREMENTS

All employees working onsite who may be exposed to hazardous substances or health or safety hazards shall receive appropriate training. All managers are responsible for ensuring that a training program is in place and that employees are properly trained. Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility. Worker qualification records are maintained by Fluor Daniel Hanford, Inc. Training Records. Qualifications for entry into radiological control areas are verified through the Access Control Entry System (ACES), which includes the employee hazardous waste worker training information. Entry to radiological control areas will be denied if entry requirements are not met. For specific entry requirements, refer to HNF-IP-0842 (WHC 1992).

Tank Farm Facility Orientation and initial hazardous waste operations field experience received under escort will include discussion of applicable safe work practices. Site-specific hazard communication information (i.e., signs, postings, maps, and safe work practices) will be maintained for employee review at tank farm facilities and primary access points such as change trailers. As part of the entry process through the ACES stations, employees are required to acknowledge when they sign in that they have read and understand the applicable RWP.

All field personnel working on the Tank 241-Z-361 project will participate in plant-specific training sessions provided by PFP staff before commencing work at the site. This plant-specific training includes, but is not limited to, the following topics:

- facility layout and location;
- emergency signals, notification, and communication;
- routes of egress and staging areas;
- plant-specific safety requirements; and
- plant emergency response procedures.

Participation in the plant-specific training will be documented and documentation retained in personnel training records. RPP staff will make arrangements with PFP training personnel to obtain the necessary training in a timely manner which facilitates the field operations. Task-specific hazards are covered during formal prejob briefings which are required when the specific hazards require a "Job Hazard Analysis" (HNF-PRO-079, PHMC 1998).

C3.3 TANK WORKERS

Workers who have the potential for direct contact with tank wastes (hazardous waste workers) shall receive 40 hr of hazardous waste operations training, supplemented with a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. The program shall include annual 8-hr refresher training.

Personnel requiring this level of training and will be supporting these sampling activities perform work that:

- directly contacts the tank headspace (breaking of tank containment),
- contacts tank waste or waste-contaminated materials, and
- directly involves operation or maintenance of installed tank farm equipment.

Typical tank farm activities include maintenance and operations of the existing facilities to ensure their continued integrity and safety. Specific activities include daily surveillance, equipment maintenance, waste transfers, in-tank sampling and single-shell tank pumping.

Workers involved in activities for the tank farms that do not potentially expose them to direct contact with the waste shall receive 24 hr of hazardous waste operations training. The work being performed must meet <u>all</u> of the following criteria for the 24-hr training requirement to apply.

- workers will not directly contact tank headspace (no breaking of tank containment),

- workers will not contact tank waste or waste-contaminated materials,

- workers will not be directly involved in the operation or maintenance of installed tank farm equipment.

This training must be supplemented with a minimum of one day of actual field experience under the direct supervision of a trained, experienced supervisor. The program shall include annual 8-hr refresher training.

C3.3.1 Upgrading of Worker Status

Workers with 24 hr of hazardous waste worker training (tank farm workers) who become hazardous waste workers can upgrade their training by obtaining an additional 16 hr of training and two days of actual field experience under the direct supervision of a trained, qualified supervisor.

C3.3.2 Equivalent Training

Employees who can document or certify that their work experience and/or training has resulted in training equivalent to a 24- or 40-hr course written to 29 CFR 1910.120 requirements shall not be required to retake initial training. Responsibility for determination of equivalent training is with the Environmental Training organization. However, certified employees who are new to the Hanford Site shall receive appropriate site-specific training before site entry and shall have appropriate supervised field experience at the site to qualify for unescorted access.

C3.3.3 Refresher Training

All employees requiring 24- or 40-hr hazardous waste worker training shall receive 8 hr of refresher/retraining annually. Workers who do not complete the refresher training (such as those not assigned to hazardous waste operations for an extended period) must retake initial training if (1) they are reassigned to hazardous waste operations and (2) more than 3 yr have passed since they completed the initial or refresher training. Refresher training is due by the anniversary date of the initial training. There are no exceptions.

C3.4 ONSITE MANAGEMENT AND SUPERVISORS

Onsite management and/or supervisors who supervise or are directly responsible for employees engaged in activities at Tank 241-Z-361 must be trained to the same level as the employees they supervise.

C3.5 HEALTH AND SAFETY STAFF

Industrial safety, industrial hygiene, and fire protection personnel assigned to support this project shall meet the most stringent of health and safety training requirements for the site and PFP facility. This requirement allows field support to be provided under all conditions.

C3.6 VISITORS

Visitors are defined as persons who are only occasionally at the Tank 241-Z-361 site for the purpose of visual inspection, surveillance, or observation. A visitor may also perform work activities not involving critical systems and installed equipment, operations, or maintenance as long as there will not be contact with tank headspace (no breaking of tank containment), tank waste, or waste-contaminated materials. Examples of such work include an engineer measuring a pipe, a tow-truck driver pulling an inoperable vehicle off-site, a subcontractor excavating for placement of forms, etc. Visitors will be escorted per PFP policy and will not be directly engaged in any Tank 241-Z-361 site activities that require entry into a controlled zone or activities that could result in exposure to hazardous substances or other health and safety hazards identified for this work activity. Visitors shall never be permitted to enter a controlled (i.e., exclusion) zone or decontamination zone (i.e., contamination reduction zone and corridor) unless they meet all of the training requirements specified for the area they are to enter. Access is controlled by the ACES as described in Section C8.0. Any exceptions to the entry requirements must be approved by the Shift Operations Manager, the PIC and PFP safety personnel.

C3.7 REGULATORS

Personnel from regulatory agencies not falling under BWHC oversight responsibilities shall be responsible for compliance with applicable federal, state, and local requirements for entry into the Tank 241-Z-361 site. When checking in with the ACES station, they will be requested to verify that they have met appropriate training and hazardous waste physical requirements for tank farms entry. Unless regulators have completed Tank Farm Orientation and PFP training and met applicable tank farm supervised field experience requirements, they will require an escort. Any exceptions to the entry requirements must be approved by the Shift Operations Manager.

C3.8 RECORD OF TRAINING

A record of training shall be kept and entered into the ACES database. If completed training for an individual has not been entered into the ACES, evidence of training (roster, card, etc.) may be presented for review and acceptance by the ACES station operator.

Training conducted as part of the Quality Training and Resource Center program is recorded upon receipt of course completion rosters. Fluor Daniel Hanford, Inc. Training Records staff enters the data, which includes employee payroll number, course number, course title, date taken, name of instructor, and recertification date (if required). This data is then entered into the Soft Reporting System where the Training Records Information System (employee training) can be accessed. Training information required by the ACES is forwarded electronically for incorporation into the ACES database.

Personnel completing the 24- or 40-hr worker hazardous waste operations training or 8-hr annual refresher course are issued a card by the International Environmental Institute to reflect completion of OSHA 29 CFR 1910.120 hazardous waste operations training.

C4.0 PERSONAL PROTECTIVE EQUIPMENT

The purpose of PPE is to shield or isolate individuals from the chemical, physical, biological, and radiological hazards that may be encountered during field operations. The use of PPE to mitigate a hazard should be chosen only after a determination that engineered safeguards and/or administrative controls do not provide adequate protection. The specific PPE requirements will vary depending on the nature of the work being performed and the area where the task is taking place. Requirements for PPE are itemized or noted in work control documentation, JHA, and/or RWPs, as applicable, and requirements shall be discussed with workers during prejob briefings. The planned activities at Tank 241-Z-361 will follow the PPE procedures established by RPP. These procedures are described in the following sections. The level of protection and specific garment ensembles may be modified based on actual conditions encountered in the field.

C4.1 PERSONAL PROTECTIVE EQUIPMENT SELECTION GUIDELINES

The preliminary evaluation of protective equipment needs for the Tank 241-Z-361 Phase II activities indicates that Level C protection is appropriate (i.e., air purifying respirator and anti-contamination clothing). Project safety staff must review the complete results of the Phase I characterization activities to identify any changes to protective equipment requirements based on that information. Industrial hygiene personnel and Health Physics must evaluate the hazards identified during work location characterization and analysis. If engineered safeguards and/or administrative controls cannot be used, the Industrial Hygienist and Health Physicist, in concert with the PIC, will select PPE to protect employees from the known and potential hazards likely to be encountered at the Tank 241-Z-361 Site. Health Physics will identify PPE requirements for radiological hazards via the RWP. The JHA will specify PPE for chemical hazards. Where PPE is necessary to address both chemical and radiological concerns, the Industrial Hygienist, PIC, and Health Physics will jointly determine requirements through the work planning and/or as low as reasonably achievable review process.

Employees who are engaged in activities at the site which require the use of PPE must meet all applicable training requirements specified in Project Hanford Occupational Safety and Health Policies and Procedures, and the medical surveillance requirements identified in Section C5.0 of this appendix.

Once a work activity has begun, if the level of PPE for the actual site conditions is found to be inadequate, the job supervisor/PIC will be notified immediately and work will stop until an evaluation is performed and approval to resume work activities is granted.

C4.2 LEVEL D PERSONAL PROTECTIVE EQUIPMENT

Level D PPE is the minimum basic level of PPE used at the Tank 241-Z-361 Site for areas or operations where no air contaminants are present which would require respiratory protection. However, while enroute from one work location to another, modesty clothing is acceptable as the minimum dress. This also allows workers exiting a radiological surface contamination area to remove protective clothing at the step-off pad and proceed to the change trailer in modesty clothes. No work may be performed in modesty clothing. Specific PPE requirements will be determined by hazards associated with the work activity and may include the following:

- coveralls and/or street clothes (covering the legs and shoulders),
- anti-contamination clothing (as required by Health Physics if radiological hazards exist),
- substantial footwear, and
- gloves.

C4.3 LEVEL C PERSONAL PROTECTIVE EQUIPMENT

Level C PPE is required where conditions are known or characterized, and a potentially hazardous atmosphere exists. Use of Level C PPE is not permitted in oxygen-deficient atmospheres (less than 19.5% oxygen), for contaminants with poor warning properties (odor detection level is greater than the threshold limit value [TLV]), or when contaminant concentrations exceed the respirator canister limits. Personnel working inside the Tank 241-Z-361 Site wearing Level C PPE shall wear the following as a minimum:

- anti-contamination clothing,
- substantial footwear,
- double gloves, and
- full-face air-purifying respirators (APR) (with appropriate filters and prescription eye wear).

C4.4 LEVEL B PERSONAL PROTECTIVE EQUIPMENT

Level B PPE is required where conditions are unknown, and a potentially hazardous atmosphere exists. Level B PPE may be used only when it is unlikely that workers will be exposed to high concentrations of contaminants or chemical splashes that will affect the skin or be absorbed by it. Level B is generally the same as Level C, except the respiratory protection is upgraded to air-supplied respirator or SCBA. Personnel working at the Tank 241-Z-361 Site with designated Level B PPE shall wear the following as a minimum:

- Pressure demand air-supplied respirator or SCBA,
- Anti-contamination,
- Substantial footwear, and
- Double gloves.

C5.0 MEDICAL SURVEILLANCE

Medical surveillance requirements for the Tank 241-Z-361 activities are identical to those established for other tank farm operations. These requirements are described in the following sections.

C5.1 MEDICAL EXAMINATIONS

All employees who require access to the Tank 241-Z-361 Site and may potentially be exposed to hazardous materials at or above the TLV and/or permissible exposure limit (PEL) for 30 or more days per year, or are required to wear a respirator, will participate in the medical surveillance program as required by 29 CFR 1910.120. The medical surveillance program, which is designed to assess, monitor, and maintain records for worker health and fitness for employment, consists of a pre-employment screening, periodic medical examination, follow-up exposure physicals (as required by the Occupational Health Examiner [OHE]), and a termination examination.

The medical contractor for the Hanford Site provides medical services for BWHC and LMHC. The medical contractor will be provided with information relative to the type of work being performed, potential and actual exposures, and expected contaminants. The provision on information is accomplished through the Employee Job Task Analysis process. This process involves workers, management, and industrial hygiene personnel jointly developing an exposure profile, medical surveillance needs, and training required for each individual.

C5.2 PERIODIC MEDICAL EXAMINATION

The periodic medical examination will determine biologic trends that may mark early signs of adverse health effects, and thereby facilitate appropriate protective measures. The frequency of the periodic medical examination will depend on the extent of potential or actual exposures as determined by the OHE and the Employee Job Task Analyses.

The annual examination may consist of the following:

- updated medical history,
- physical examination,
- chemical panel,
- urinalysis,
- complete blood count,
- pulmonary function test (as determined by the Employee Job Task Analyses),
- respirator fit test (as determined by the Employee Job Task Analyses),
- electrocardiogram (as determined by the OHE),
- chest x-ray within 54 months (as determined by the OHE),

- visual acuity, and
- hearing conservation audiogram (for individuals exposed to an 8-hr time-weighted average of 85 dBA or greater).

C5.3 FOLLOW-UP EXPOSURE PHYSICAL

Potential job-related symptoms or illnesses must be reported as soon as possible to the employee's supervisor and the medical contractor. The OHE will perform a follow-up physical to evaluate the symptoms or illness in the context of the employee's exposure to hazardous substances.

Based on the results of the pre-employment or periodic medical examinations, the OHE may determine that follow-up examinations or consultations are medically necessary. It is the responsibility of the employee to participate in the follow-up examinations as directed by the OHE.

Any person who feels he/she has been exposed to noxious vapors or suspects that he/she was exposed to a hazardous material or chemical that exceeded the established PEL and/or TLV, shall report the information to their direct supervisor and medical staff at the nearest Health Service Center. The concerned worker will be evaluated by a designated doctor. An entry will be made into the medical surveillance tracking log for continued follow-up, as deemed appropriate by medical and industrial hygiene staff.

C5.4 EMERGENCY MEDICAL SURVEILLANCE

Employees must notify their supervisor and report to the medical contractor's nearest Health Service Center for an evaluation. The contents of the evaluation will be determined by the OHE based on the circumstances of the incident.

Employees who feel they may have been exposed to noxious vapors, or suspect that they received an over exposure to a hazardous material or chemical (which exceeded the established PEL and/or TLV), shall promptly notify their supervisor and report to first aid. An OHE will evaluate the employee and, based on the evaluation, enter the individual into the medical surveillance tracking log for continued follow-up, as appropriate.

C5.5 RECORD KEEPING

Employee medical records are maintained by the medical contractor for the duration of employment plus 30 yr.

Copies of the medical examinations can be made available to the employee as requested. Employees or their designated representative may request a copy of their medical records by completing the Request for Information form from the medical contractor. For records older than 2 yr, the Privacy Act Information Request (DOE form F1800.1) must be completed. This form can be obtained from the DOE, Richland Operations Office. The medical contractor provides the physician's written opinion to the employee and a copy to industrial hygiene. The physician's written opinion contains information regarding the employee's fitness for work, including the ability to wear PPE, and the results of the examinations and tests. The physician's written opinion is maintained in the employee's medical file.

The medical clearance form is forwarded to the employee and to the employee's manager by the medical contractor. A medical clearance indicates restrictions or provides full clearance for performing the work duties. If an employee is injured or exposed to a toxic material, a medical clearance must be evaluated by the medical contractor and signed before the employee is authorized to return to work.

C5.6 BLOODBORNE PATHOGEN EXPOSURE CONTROL

It is unlikely that bloodborne pathogens will present a problem for this project. Any potential pathogens will be controlled in accordance with RPP Administrative Manual, HNF-IP-0842, Vol. IX, Section 1.2, "Bloodborne Pathogen Exposure Control Plan" (WHC 1992).

C6.0 MONITORING

The procedures established by RPP for collection of core samples from radioactive waste tanks include detailed requirements for performing both radiological and chemical monitoring during sample collection. These procedures will be implemented during Phase II activities at Tank 241-Z-361. The following information is provided to support monitoring efforts during Phase II.

C6.1 OVERVIEW

The purpose of industrial hygiene monitoring during Tank 241-Z-361 activities is to assess employee exposure to chemical and physical agents in the work place. This monitoring effort is essential before instituting control measures, as the degree of control must be based on level of hazard present. Monitoring at Tank 241-Z-361 can be divided into monitoring for assessment purposes and monitoring for entry into the work area. Although both types of monitoring are necessary, they serve somewhat different purposes. The primary purpose of assessment monitoring is to identify and quantify specific chemical and physical agents present in the work place as part of an industrial hygiene strategy. Entry monitoring is performed to evaluate agents at the time specific work is being performed. Entry monitoring is thus targeted more toward verifying that existing control measures are adequate, rather than identifying or quantifying contaminant levels.

Monitoring can be broken down into three basic subgroups: biological, chemical and physical agents. Chemical agents include gases and vapors, asbestos, and any chemical agents used in operations or maintenance activities at the farms. Physical agents include ionizing radiation, noise, heat, illumination, explosivity, ergonomic and biologic factors, and others. Monitoring for occupational stressors is necessary to fully characterize the associated hazard. Monitoring will be prioritized based on perceived need, given the amount of available baseline monitoring data and a JHA.

C6.2 WORK ACTIVITY MONITORING

A JHA of planned work activities shall be performed and reviewed by the industrial hygienist, health physicist, and the industrial safety professional. This review is to ensure that all hazards that might affect employee health have been considered before worker entry into the work area. This includes existing hazards present before entry, chemicals introduced during work activities, and any expected reaction products.

The JHA consists of an evaluation for any potential exposure to physical hazards and chemical contaminants based on where the work is to be performed and what operations are to be conducted. This monitoring plan was developed to ensure that employee exposures to chemical and physical hazards are evaluated, and that appropriate controls are instituted to protect worker health and safety. There are three types of monitoring being used to assess exposure levels. Each of these is discussed in Sections C6.2.1 through C6.2.3.

C6.2.1 Personal Monitoring

Personal monitoring consists of attaching various sampling devices to an employee during their work tasks and evaluating any determinant exposures. Personal exposure monitoring is considered to be the closest measure of employee exposure.

C6.2.2 Area Monitoring

Area monitoring involves the collection and analysis of samples in the general area where work is taking place. Area monitoring provides a general overview of the potential for employee exposure and is considered more representative than source monitoring (Section C6.2.3). Area monitoring can include both entry and assessment monitoring, if entry monitoring has been defined as a control measure for the specific agent.

C6.2.3 Source Monitoring

Source monitoring consists of the collection of samples at the supposed source. This type of monitoring is used to determine the highest potential for which employees could be exposed. Source monitoring is also useful in providing an estimate of the frequency and magnitude of any release. During sludge core sampling, source monitoring will be performed on the tank headspace during intrusive activities.

C6.3 SAMPLING AND MONITORING EQUIPMENT

The DynCorp Industrial Hygiene Instrument Laboratory currently maintains monitoring equipment. Tables C6-1 and C6-2 describe the types of monitoring equipment available to assist in the characterization of employee exposures at Tank 241-Z-361 for both chemical and physical agents. Radiological monitoring equipment will be provided by PFP.

C6.4 SAMPLE COLLECTION AND ANALYSIS

Industrial hygienists are responsible for sample collection and analysis. Sampling and analytical methods will adhere to standard operating procedures for industrial hygiene monitoring and evaluation.

C6.5 MONITORING DATA REVIEW AND ACTION

Monitoring data will be reviewed by an industrial hygienist and compared to established safe levels. Safe levels for gas or vapor exposure have been established in the form of an administrative action level by RPP Safety. This action level is known as an occupational exposure limit which has been defined as one-half of the lower of the PEL, the TLV, or the NIOSH recommended exposure limit. Engineering controls will be implemented or PPE issued if monitoring data suggests that workers could be exposed at a level exceeding the occupational exposure limit. Data review/action for dermal exposure to chemical agents and exposure to physical agents in the tank farms will be completed using OSHA standards and American Conference of Government Industrial Hygienists guidelines.

Table C6-1. Chemical Agents—Monitoring Tool.

Tool	Need	Main feature(s)
Combustible gas indicator	Flammable gases	Nonspecific detector for combustible gases measures gas concentrations as a percentage of lower explosive limit; visual and audible alarms.
Oxygen meter	Oxygen deficiency	Direct readout in percent oxygen; visual and audible alarms.
OVMs/analyzers	Toxic gas/vapor	Nonspecific gas and vapor detection for organics and some inorganics; sensitivity related to ionization potential.
Indicator tubes	Toxic gas/vapor	Quantitative accuracies are variable; real time/semireal time results.
Multi-gas meter	Toxic gas/vapor	Generally compound specific; audible alarm upon exceeding preset action level.
Sampling media, containers, and pumps	Specific contaminants	Collects personal sample in the "breathing zone" to evaluate the exposure level of the person sampled; requires laboratory analysis; most accurate method for measuring exposure.

Table C6-2. Physical Agents—Monitoring Tool. (2 Sheets)

Tool	Need	Main feature(s)
Sound level meter	Sound levels from noise source	Provides real time measurements of sound levels; has mechanism that duplicates the sensitivity of the human ear.
Noise dosimeter	Exposure to noise	Worn by the person being sampled to record the noise energy to which the worker was exposed throughout the work shift.
Octave band analyzer	Quieting a noise source	Identifies sound intensities at various frequencies to establish engineering controls.
Wet bulb globe thermometer	Heat stress	Provides an environmental measurement of heat stress to workers by measuring air temperature and movement, water vapor pressure, and radiant heat.
Light meter	Illumination levels for specific tasks	Measures visible radiation falling on a surface, or the brightness of reflective light.
Observation	Evaluate work practices and conditions	Practical, effective method of appraising work practices, determining work station layout, verifying structural and wiring configurations, identifying signs of physiological and psychological stress in workers, and ensuring compliance with procedures.

Table C6-2. Physical Agents—Monitoring Tool. (2 Sheets)

Tool	Need	Main feature(s)
Radiation Dosimeter	Exposure to Ionizing Radiation	Worn by individual personnel to record ionizing radiation to which the worker(s) were exposed.
Radiation Detector	Ionizing Radiation	Non-nuclide specific detection of alpha, beta, and gamma radiation for evaluation of radiation sources, fields, and surface contamination.
Continuous Air Sampler	Airborne Radioactive Materials	Non-nuclide specific detection of airborne radioactive particles, commonly used for alpha particle detection.

C6.6 DETERMINING FACTORS FOR MONITORING AND RESPIRATORY PROTECTION REQUIREMENTS

Monitoring strategies and respiratory protection prescriptions are based on the expected or measured hazard that is affected by both the work location and the type of work being performed. A job may require respiratory protection because the location has the potential to contain a respiratory hazard. Similarly, a job may require monitoring because of the kind of work being performed, even though no monitoring is required for the specific location. Only by considering both the location of the work and the type of work being performed can the proper levels of respiratory protection and monitoring be determined.

In order to reduce potential for exposures at Tank 241-Z-361, the minimum contingent of employees necessary to perform the work scope should be used. Employees not needed to support the immediate work activity should stand well clear of the exclusion zone in the upwind direction, if possible. Any necessary monitoring shall be performed by an Industrial Hygienist or an Industrial Hygienist Safety Technician under the direction of an industrial hygienist before starting work activities. Radiological monitoring will be conducted by an HPT under the direction of a health physicist.

C6.6.1 Monitoring Methods and Respiratory Protection

Monitoring for toxic and flammable gases and ionizing radiation shall be conducted throughout the activity at Tank 241-Z-361. Flammable gases shall be monitored as detailed in the JCO (PHMC 1999). Toxic gases shall be monitored in accordance with this section. Respiratory protection, when required, generally involves the use of full-face APRs with GME-H or GME-P100 cartridges, depending on location or activity and ambient conditions.

During core sampling, APRs shall be worn and monitoring for toxic gases shall be performed at the designated source port. If this measurement indicates concentrations greater than the allowable source concentrations identified in Table C6-3, breathing zone monitoring is required for personnel working directly outside the riser. If breathing zone concentrations are greater than Table C6-3 limits, appropriate actions shall be taken in accordance with Table C6-3. The monitoring requirements and action levels for radiological exposure are summarized in Table C6-4. If the breathing zone concentrations exceed the Table C6-3 or C6-4 limits in the exclusion zone, then the air at the exclusion zone boundary will be monitored to ensure that the exclusion zone is sufficiently large to preclude the need for respiratory protection outside the established exclusion zone.

C6.6.2 Monitoring Methods and Compounds of Concern

Air monitoring shall be performed for the compounds of concern as discussed in Sections C2.3, C2.4, and Attachment C-1 of this appendix, as follows: (1) flammable gas, (2) organic vapors, (3) ammonia, (4) carbon tetrachloride and chloroform, (5) alpha radiation, (6) nitrous oxide (N_2O), and (7) other monitoring as identified by the Industrial Hygienist or Health Physicist. Continuous headspace monitoring will be conducted. Additional monitoring will be required at the times and interval specified in the RPP sludge sampling procedure(s). Air filter samples for airborne alpha emitters will be read every 15 minutes during sample collection. In addition, an alpha continuous air monitor will be used at the sampling riser.

Table C6-3. Action Levels for Industrial Hygiene Monitoring Readings.[1]

Contaminant	Action		
	Monitor breathing zone if source indicates levels are exceeded	**Full-face mask APR with GME-H/GME-P100 cartridge required if the following organic vapor or ammonia breathing zone levels are exceeded; supplied air required if the following carbon tetrachloride breathing zone levels are exceeded. Implement engineered controls as appropriate.**	**Stop work and evacuate area if any of the following breathing zone levels are exceeded and implement engineered controls.**
Organic vapors (3-minute reading)	2 ppm	2 ppm	25 ppm
Ammonia	12 ppm	12 ppm	250 ppm
Carbon tetrachloride	1 ppm	2 ppm (use supplied air)	25 ppm
Nitrous Oxide	25 ppm	50 ppm (use supplied air)	500 ppm
Chloroform	1 ppm	2 ppm (use supplied air)	50 ppm
Carbon dioxide	2,500 ppm	5,000 ppm (use supplied air or ventilation)	5,000 ppm

[1]Radiological conditions may warrant additional controls. Consult with the Radiological Control Analyst.

APR - air-purifying respirator.

Table C6-4. Action Levels for Airborne Alpha Particle Emitter Readings on Air Sampler Filters.

Contaminant (Monitoring Point)	Action			
	Check all air filter samples	Identify Source, and Increase Radius of Exclusion Area (for readings at the exclusion area boundary	Implement Contamination Control Measures To stop/reduce release, use APRs	Upgrade to Level B (Supplied Air)
Airborne Alpha (breathing zone in exclusion area)	Readings above background	Readings above background	2×10^{-13} µCi/mL Pu	2×10^{-11} µCi/mL Pu
Airborne Alpha (exclusion area boundary)	Readings above background	Readings above background	Readings above background	

Table C6-5. Summary of Toxic Vapor Monitoring Requirements.

Activity/Condition	Tank 241-Z-361
Initial Containment Breech	• Personnel wear APRs, • Toxic monitoring and radiological monitoring at designated source port, and take actions described in Tables C6-3 and C6-4.
Tank Intrusive Activities	• Personnel wear APRs, • Toxic gas and radiological monitoring at designated source port and per standard operating procedures and take actions described in Tables C6-3 and C6-4.

Flammable gases are measured to determine their percent of LFL and oxygen content using a Combustible Gas Meter. The JCO (PHMC 1999) contains current flammable gas monitoring requirements. If flammable gas concentration exceeds 25% LFL, operations will be discontinued and flammable gas mitigation actions will be taken.

Organic vapor concentrations in the work area are measured qualitatively using an organic vapor meter (OVM) with an 11.7 eV lamp or the equivalent. Ammonia and carbon tetrachloride levels are determined using colorimetric indicator tubes or equivalent. Action levels for OVM, ammonia, and carbon tetrachloride readings are described in Table C6-3. This type of monitoring is to be performed only by an Industrial Hygienist or Industrial Hygienist Safety Technician under the direction of an Industrial Hygienist.

Ammonia, nitrous oxide (N_2O), and organic levels are measured inside the respiratory protection zones for the tank, as indicated in Table C6-5. Initial readings taken at the riser or in the vapor space that exceed exposure standards shall require an Industrial Hygienist or Industrial Hygiene Technician to monitor the breathing zone for the respiratory protection setting. If the values exceed the limits specified in Table C6-3, either respiratory protection will be worn or the work will be discontinued as shown in the table.

In the event that exceeded breathing zone concentrations of ammonia or carbon tetrachloride result in stopping work and evacuating the farm, operations will not resume until approval is received from the Operations Manager and a RPP Safety industrial hygienist.

C6.6.3 Personal Sampling

Personal sampling shall be conducted on representative employees, if appropriate, throughout the Tank 241-Z-361 work activities. Sampling shall be conducted for the compounds of concern in accordance with established industrial hygiene protocols and under the direct supervision of an industrial hygienist.

C6.7 INCIDENT RECOVERY

In the event of a tank incident and resulting evacuation, re-entry to work area shall be coordinated by operations management and conducted by Industrial Hygiene and Health Physics personnel. Tank incidents include, but are not limited to, gas release events, tank pressurization, high-LFL, and immediately dangerous to life and health breathing zone concentrations. SCBAs should be used for recovery when the immediately dangerous to life and health levels may be exceeded.

C7.0 DECONTAMINATION PROCEDURES

All personnel that may have been contaminated with chemical or radiological contaminants will be decontaminated before leaving the site. Tools and equipment or PPE that cannot be decontaminated will be disposed of. The field operations manager will supervise the establishment of a contamination reduction zone of sufficient size and equipped with sufficient supplies to support decontamination of personnel and equipment before leaving the exclusion zone. The general decontamination requirements established for work at Tank 241-Z-361 are described in the following sections.

Normal tank farm operations deal mainly with radiological decontamination. When unusual work is performed at the tank farms and a step-by-step decontamination protocol for site personnel and equipment is required, this protocol can be found in the specific work plan, procedure, or package.

Decontamination, the process of removing or neutralizing contaminants that have accumulated on personnel and equipment, is critical to worker health and safety. Decontamination protects workers from contact with hazardous substances that may contaminate and eventually permeate protective clothing, respiratory equipment, tools, vehicles, and other equipment used on site. Decontamination (1) protects all site personnel by minimizing the transfer of harmful materials into clean areas and (2) protects the community by preventing uncontrolled transportation of contaminants from the site.

Decontamination takes on additional significance in that most chemical contamination will be combined with radiological contamination, thus making the decontamination problem one of dealing with mixed wastes. If equipment or personnel are radiologically contaminated, decontamination procedures shall comply with guidelines established in the *Hanford Site Radiological Control Manual* (HSRCM-1) (DOE-RL 1996). If radiological contamination is detected on skin or clothing by any means, a HPT must be contacted. Contaminated personnel shall be decontaminated following site procedures. Easily detected radiological contamination serves as an indicator of potential chemical contamination when working with mixed wastes, similar to the use of radioactive tracers.

C7.1 PREVENTING CONTAMINATION

C7.1.1 Minimizing Contamination

The amount of decontamination required can be minimized substantially by adhering to the following operating guidelines and requirements as appropriate:

1. Observe work practices that minimize contact with hazardous substances (e.g., do not walk through areas of known contamination; do not directly touch potentially hazardous substances).

2. Protect monitoring and sampling instruments in highly-contaminated areas by bagging the instrument bodies and probes and wrapping cords in appropriate material (such as cellophane or plastic). Make openings in the bags for sample ports and sensors that must contact site materials.

3. Wear disposable outer garments and use disposable equipment where appropriate.

4. Cover equipment and tools with a strippable coating that can be removed during decontamination.

5. Encase the source of contaminants (e.g., with plastic sheeting or overpacks).

C7.1.2 Proper Dressing Procedures

Adherence to proper procedures for dressing before entering a radiation area minimizes the potential for contaminants to bypass the protective clothing and escape decontamination. In general, all fasteners should be used (i.e., velcro fully closed, all buttons used, all snaps closed). Gloves and boots should be tucked under the sleeves and legs of outer clothing, and hoods (if not attached) should be worn outside the collar. An extra pair of tough outer gloves is often worn over the sleeves. All open joints should be taped to prevent contaminants from running inside the gloves, boots, and jackets (or suits, if one-piece construction). Specific requirements shall be addressed by the applicable RWP and/or JHA.

C7.1.3 Personal Protective Equipment Checks

PPE shall be checked before each use to ensure that it contains no cuts or punctures that could expose workers to contaminants. Injuries to the skin (such as cuts and scratches) may enhance the potential for chemicals, radioactive contaminants, or infectious agents that directly contact the worker's skin to penetrate into the body. Workers with open cuts or damaged skin should be kept from working until the skin heals or the area is protected with an approved covering.

C7.1.4 Surveying of Instruments

All instruments and equipment must be surveyed by an HPT for radiological contamination control purposes before being removed from a contamination area. Items with detectable levels of contamination must be controlled as radioactive material (controlled or regulated equipment).

C7.2 TYPES OF CONTAMINATION

Personnel and equipment contamination at hazardous waste sites, such as Tank 241-Z-361, can take numerous forms (e.g., solids, liquids, and gases). These contamination forms can require unique approaches to decontamination. These approaches are discussed in the following sections.

C7.2.1 Physical States of Contaminants

Contaminants may be present in the form of solids, liquids, gases, or vapors. Dust and dirt contaminated with radionuclides, toxic organic compounds, or metals may collect on the surface of PPE, or in cracks, crevices, folds, and seams. Specific contaminants (when known) will be addressed as part of the site-specific characterization and analysis. Specific task-related concerns should be addressed in the RWP and/or JHA.

C7.2.2 Liquids and Gases

Liquid and gaseous contaminants may be limited to the surface of PPE or may permeate the PPE material. Surface contaminants may be easy to detect and remove; however, contaminants that have permeated a material are difficult or impossible to detect and remove. If contaminants that have permeated a material are not removed by decontamination, they may continue through the material until they reach the inner surface, where they can cause an unexpected exposure (breakthrough). This is one advantage of the use of disposable protective clothing (provided that the clothing is changed at intervals that are less than the chemical breakthrough time).

C7.2.3 Breakthrough Time

Five major factors affect the breakthrough time.

1. **Contact Time**—The longer a contaminant is in contact with an object, the greater the probability and extent of permeation. For this reason, minimizing contact time is one of the most important objectives of a decontamination program.

2. **Concentration**—Molecules tend to flow from areas of high concentration to areas of low concentration. As concentrations of wastes increase, the potential for permeation of personal protective clothing also increases.

3. **Temperature**—An increase in temperature generally increases the permeation rate of contaminants.

4. **Size of Contaminant Molecules and Pore Space**—Permeation increases as the contaminant molecules becomes smaller and as the pore space of the material to be permeated increases.

5. **Physical State of Wastes**—As a rule, gases, vapors, and low-viscosity liquids tend to permeate more readily than high-viscosity liquids or solids.

C7.3 POLICIES FOR DECONTAMINATION PROCEDURES

General Guidance:

1. Decontamination procedures shall be developed, communicated to employees, and implemented before any employees or equipment may enter onsite areas where potential for exposure to hazardous substances exists as appropriate.

2. A step-off pad shall be established between the radiation area and the radiation buffer area for each task. Disposable clothing is to be removed (outer layers are removed first) and placed in containers. Nondisposable clothing (such as anti-contamination clothing) that can be cleaned will be removed, bagged, and sent to the laundry. After removing outer protective clothing, each team member must be surveyed before being permitted to go into an uncontrolled area.

3. If radioactive skin or clothing contamination is detected, decontamination must be performed under the direction of the HPT.

4. The RWP should be revised whenever the type of personal protective clothing or equipment changes, the site conditions change, or the site hazards are reassessed based on new information.

C7.4 POLICIES FOR SPECIFIC DECONTAMINATION PROCEDURES

C7.4.1 Objectives

The primary objective of decontamination procedures is to minimize the risk of personnel exposure to hazardous substances. Historically, decontamination of personnel has involved a successive removal sequence, from outermost to innermost layers of protective clothing. However, in many instances, the objectives of decontamination can be accomplished most effectively by the use of disposable protective clothing, combined with the systematic removal and disposal of multiple layers of protective coveralls, gloves, and boot covers.

C7.4.2 Decontamination Required

All personal, nondisposable clothing, equipment, and samples leaving the contaminated area must be decontaminated or properly packaged to prevent the spread of any harmful chemicals or radioactive contamination that may have adhered to them.

Due to the uncertainty in the actual nature of the sludge remaining in Tank 241-Z-361, and the likelihood that the sludge contains variable concentrations of hazardous materials (e.g., plutonium, carbon tetrachloride, and hydrofluoric acid), a rigorous decontamination protocol and contamination control will be employed for all personnel and equipment that may come into contact with the tank contents.

The primary decontamination for personnel during the sludge sampling activities at Tank 241-Z-361 will be achieved by following a rigorous protocol for doffing contaminated and potentially-contaminated protective clothing. The protective clothing is then either packaged for laundering (e.g., reusable cloth anti-contamination clothing), or for disposal (e.g., disposable garments, gloves and boot covers. This protocol has proved effective during previous tank sampling activities at Hanford tank farms and will be applied during this activity. By following this protocol, a minimal amount of water will be used and the quantity of contaminated investigation-derived waste will be minimized. The doffing protocol should be effective in this situation because the containment of tank waste materials provided by the sampling device(s) and the bags and sleeves used seal the tank riser(s) will present minimal opportunity for gross contamination of personnel during sample collection and handling.

The recommended decontamination solution for Tank 241-Z-361 sludge sampling activities is water with liquid detergent added (either common dishwashing detergent or a laboratory detergent such as "Clean and Bright"). A supply of potable water will be available on site for personnel and small equipment decontamination.

Disposable clothing and expendable tools will be packaged for proper disposal to prevent the spread of contaminants. The sampling vehicle and non-disposable equipment that contact the tank contents will be decontaminated per RPP tank sampling procedures.

C7.4.3 Health and Safety of Decontamination

The decontamination procedures described in Section C7.4.2 should provide safe and effective decontamination of both radioactive and non-radioactive contaminants.

C7.4.4 Change Rooms

Protective clothing will be provided at the Tank 241-Z-361 work site by PFP. At special access points (step-off pads), change areas are frequently set up for special tasks. Personnel who have reason to don protective clothing in areas other than the change rooms shall contact Health Physics before obtaining or transporting the anti-contamination clothing. Most of the authorized change rooms are trailers that are used as exit and entry points to controlled areas. Change facilities for work at Tank 241-Z-361 will be located in a RPP job trailer placed in the 241-Z-361 support area.

C7.4.5 Showers

Although there are various showers that could be used in an emergency for decontamination, the only authorized fixed shower is located at the PFP. The shower at Building 2704 HV will be used by project personnel for non-emergency showering.

C7.5 TESTING FOR DECONTAMINATION EFFECTIVENESS

C7.5.1 Visual Observation

In some cases, the effectiveness of decontamination can be estimated by visual observation. Discolorations, stains, corrosive effects, visible dirt, or alterations in clothing fabric may indicate that contaminants have not been removed. It is important to remember that not all contaminants leave visible traces. Many contaminants can permeate clothing and are not easily observed.

C7.5.2 Wipe-Testing/Direct Reading Sampling

Wipe-testing/direct reading sampling can provide after-the-fact information on the effectiveness of decontamination. For this procedure a swab is wiped over the surface of the potentially contaminated object and then analyzed in a laboratory or on-site. For direct reading, an alpha scintillation counter may be used for a whole-body survey. Outer surfaces and underlying layers of protective clothing should be checked for radioactivity.

C7.6 HEALTH AND SAFETY HAZARDS

Although decontamination is performed to protect health and safety, it can pose hazards under certain circumstances. Decontamination methods may

- be incompatible with the hazardous substances being removed,
- be incompatible with the clothing or equipment being decontaminated, and
- pose a direct health hazard to workers.

The chemical and physical compatibility of the decontamination solutions or other decontamination materials must be determined before they are used. A qualified health professional should assess the benefits and risks associated with the use of decontamination methods at a waste site.

C7.7 DECONTAMINATION EQUIPMENT SELECTION

In selecting decontamination equipment, it is important to consider whether the equipment itself can be decontaminated for reuse or disposed of easily.

C7.8 DISPOSAL METHODS

All decontamination equipment must be properly decontaminated and/or disposed of (as necessary). All spent solutions and wash water should be collected and disposed of properly. Incompletely decontaminated clothing should be placed in plastic bags or radiation boxes, pending further decontamination and/or disposal. The Generator Services Group provides technical support for designating and disposing of hazardous wastes.

C7.9 PERSONAL PROTECTION

C7.9.1 General Safe Work Practices

1. Eating, drinking, smoking, taking medications, and chewing gum are normally prohibited within the radiation area. Under potential heat stress conditions drinking water will be allowed under high-heat conditions.

2. Do not handle soil, waste samples, or any other potentially contaminated items unless wearing protective gloves as specified in the JHA and RWP.

3. Be alert to potentially changing exposure conditions evidenced by perceptible odors, unusual appearance of excavated soils, or oily sheen on water. Whenever possible, approach from or stand upwind (as indicated by the required onsite windsock) of excavations, boreholes, well casings, and drilling spoils.

4. At the end of the work day, or each job, disposable clothing shall be removed and placed in drums (chemical contamination) or plastic lined radioactive waste containers, as appropriate. Clothing that can be cleaned shall be sent to the Hanford Site laundry contractor.

5. Thoroughly wash hands and face before eating (or putting anything in the mouth) to avoid hand-to-mouth contamination.

C7.10 EMERGENCY DECONTAMINATION

In an emergency, the primary concern is to prevent the loss of life or severe injury to personnel. Personnel must contact the onsite emergency response organizations by calling 911 (by site telephone), Station 1 (by radio), 811 (by government cellular telephone), or 373-3800 (on any other telephone). If immediate medical treatment is required to save a life, decontamination should be delayed until the victim's condition is stabilized. Kadlec Medical Center in Richland has an emergency room and procedures for handling contaminated personnel. If decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could itself cause severe injury or loss of life, decontamination must be performed immediately.

If an emergency due to a heart-related illness develops, protective clothing should be removed from the victim as soon as possible to reduce the heat stress. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing and equipment.

If possible, first responders should (1) move the person into the radiological buffer area (area of less contamination) and remove the person's outermost layer of protective clothing, (2) place the person on a clean blanket or plastic sheet, and (3) remove their own outermost layer of protective clothing. Ideally, the person's next layer of protective clothing should be removed by rescue personnel who enter the radiological buffer area (area of less contamination) for appropriate life saving/emergency procedures.

C8.0 SITE CONTROL

The purpose of site control is to minimize the potential contamination of workers, protect the public from hazards and prevent unauthorized entry. Appropriate site control protocols will be implemented at Tank 241-Z-361. Work area boundary controls are established to limit access to areas of hazard concerns. Based on the expected levels of contamination and work activity, appropriate areas must be established and entry controlled. Unnecessary personnel shall be excluded. Applicable maps reflecting boundary controls shall be posted at the entry points (change trailers) to the work site. The protocols described in this section were developed for use at Hanford tank farms. The requirements for site control at Tank 241-Z-361 are similar to the general tank farm requirements and application of the tank farm protocols is appropriate.

In addition to general training concerning PPE, all employees entering the designated area around Tank 241-Z-361 shall receive training on the establishment of respiratory protection zones.

Because many tasks at the Tank 241-Z-361 involve radiological work, Contamination/Airborne Radioactivity Control Areas and/or Radiation Areas are established in accordance with HSRCM-1 (DOE-RL 1996).

C8.1 RADIOLOGICAL CONTROL AREAS

The results of the Phase I Tank 241-Z-361 vapor sampling activities will be evaluated to determine the appropriate level of radiological control to be established for Phase II. Radiation areas are classified as follows.

Radiological Buffer Area—An intermediate area established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure.

Radiation Area—Any area, accessible to individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hr at 30 cm from the radiation source or from any surface that the radiation penetrates. (Not anticipated.)

High Radiation Area—Any area, accessible to individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem (0.001 Sv) in 1 hr at 30 cm from the radiation source or from any surface that the radiation penetrates. (Not anticipated.)

C8.2 CONTAMINATION/AIRBORNE RADIOACTIVITY CONTROL AREAS

Very High Radiation Area—Any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads

(5 grays) in 1 hr at 1 m from the radiation source or from any surface that the radiation penetrates. (Not expected.)

Contamination Area—Any area where contamination levels are greater than the values specified in HSRCM-1, Chapter 2, Table 2-2 (DOE-RL 1996), but less than or equal to 100 times those values.

High Contamination Area—Any area where contamination levels are greater than 100 times the values specified in the HSRCM-1, Chapter 2, Table 2-2 (DOE-RL 1996). (Not likely.)

Fixed Contamination Area—An area with no detectable removable contamination but contains fixed contamination levels exceeding specified limits.

Soil Contamination Area—An area where surface or subsurface contamination levels exceed specified limits. A Soil Contamination Area may be located outside a Radiological Controlled Area.

Airborne Radioactivity Area—Any area where the concentration of airborne radioactivity above natural background exceeds or is likely to exceed 10% of the derived air concentration values. Derived air concentration values are contained in 10 CFR 835, "Department of Energy Occupational Radiation Protection" and Appendix A of this SAP.

C8.3 HAZARDOUS WASTE OPERATIONS/ CLEANUP WORK ZONES

The procedures addressed in this section are only required for those tasks which fall under nonroutine work requiring a JHA. The planned activities at Tank 241-Z-361 fit under this category of activities. To reduce the accidental spread of hazardous substances from contaminated areas to clean areas, various zones shall be established. By defining work zones, work activities and contamination can be confined to the appropriate areas and personnel can be located and evacuated in an emergency. Hazardous waste operations and waste cleanup projects can be divided into as many different work zones as needed to meet operational and safety objectives. These zones will be specified in the work package. The three primary zones that will be established are the exclusion zone, contamination reduction zone, and support zone. These functional work zones will be fully coordinated with the establishment and posting of radiological control zones (i.e., the radiation or contamination delineation will coincide with the exclusion zone and the radiological buffer area will coincide with the contamination reduction zone.)

C8.3.1 Exclusion Zone

The preliminary exclusion zone around Tank 241-Z-361 will be established at a radius of 20 ft from the tank riser to be opened. The exclusion zone is the area where contamination does exist or could occur.

The outer boundary of the exclusion zone shall be clearly marked by rope, barrier tape, fences, or other physical barriers which include placards or signs. An access control point should be established at the periphery of the exclusion zone to regulate the flow of personnel and equipment into and out of the area. Personnel working in the exclusion zone may include the supervisor/PIC, operators, other workers, and specialized personnel such as equipment operators. All personnel working in the exclusion zone must wear the level of personal protection clothing specified.

C8.3.2 Contamination Reduction Zone

The contamination reduction zone is a transition area between a contaminated area and the clean area. This zone is designed to reduce the probability that the clean support zone will become contaminated or be affected by hazardous substances from the exclusion zone. Decontamination should take place within a designated area of the contamination reduction zone with the access point located in close proximity to the access point for the exclusion zone. The degree of contamination should decrease as one moves away from the exclusion zone towards the support zone. Personnel protective clothing, equal to but not greater than, that required in the exclusion zone, should be worn by everyone in the contamination reduction zone. Besides decontamination, the contamination reduction zone should be used to facilitate emergency equipment, equipment resupply, sample packaging, worker temporary rest areas, and drainage or containment of water or other liquids used for decontamination.

C8.3.3 Support Zone

The support zone is the location of the administration support functions needed to keep the other two zones operational and running smoothly. This can be used as a staging area for equipment, containers, and supplies. No special protective clothing is required in this area. Personnel exiting the contamination reduction zone should be monitored before entering the support zone to ensure they are free of all contaminants from the exclusion zone.

C8.4 ACCESS CONTROL

Access control to areas containing radiological hazards is performed through the ACES. The ACES is used to verify entry requirements are met for individuals requiring access to radiologically controlled areas. HNF-IP-0842 (WHC 1992), contains access control requirements.

C8.5 BUDDY SYSTEM

The purpose of the buddy system is to:

- provide personnel with assistance, if needed;
- observe co-workers for signs of chemical or heat exposure;
- periodically check the integrity of a co-worker's PPE; and
- notify the supervisor if help is needed.

Under the buddy system, an attendant (provided with the required PPE) must be capable of observing the worker performing the task. For Tank 241-Z-361, the buddy system is used in the following cases:

- activities requiring the use of supplied air or SCBA and
- work performed under a JHA.

Enforcement of the buddy system is the responsibility of the supervisor/PIC.

C8.6 COMMUNICATIONS

Communications are essential to all smoothly run operations. Personnel should be provided with the appropriate equipment to facilitate the transmission of information necessary to support work activities, report emergencies, and receive emergency information. This does not require that each person be in possession of a transmitting or receiving device, but that such instruments be accessible to workers within the assigned work area. Information can be received by one person and given to other individuals by any recognized direct means. The primary means for communicating to and from the field is by use of radios and cellular phones.

C9.0 EMERGENCY RESPONSE PLAN

The activities at Tank 241-Z-361 will utilize HNF-IP-0263-PFP, *Building Emergency Plan for Plutonium Finishing Plant Complex* (WHC 1998). All RPP field staff working on the Tank 241-Z-361 project will attend a PFP emergency response briefing. The Tank 241-Z-361 sludge sampling contingency plan is included in Attachment C-2.

C10.0 CONFINED SPACE ENTRY POLICIES, GUIDELINES, AND REQUIREMENTS

No confined space entry is planned for the Phase II activities at Tank 241-Z-361. If confined space work is determined to be necessary during the course of the work, it will be conducted in accordance with the requirements and procedures prescribed in HNF-PRO-110, "Confined Space" (PHMC 1997f).

C11.0 ENVIRONMENTAL PROTECTION AND RESPONSE

Because of the hazardous nature of many materials used and found in the Hanford Site tanks, only trained personnel shall respond to a hazardous material or hazardous waste spill. Appropriate Material Safety Data Sheets (MSDS) shall be referenced before performing cleanup. All spill responses will be conducted in accordance with the PFP Building Emergency Response Plan (see Section C9.0 of this appendix and Attachment C-2).

It is the responsibility of the employee identifying the spill to notify the BWHC PFP Building Emergency Director (BED) immediately in the event of a release to the environment, or if unexpected contaminated spills are encountered. The PFP BED, after consulting with the appropriate BWHC environmental group, will determine whether the spill is a reportable occurrence under DOE Order 5000.3B, *Occurrence Reporting and Processing of Operations Information* (DOE 1990). The requirements for notifying state or other regulatory agencies are included in the BWHC reporting procedures. Substantial spills of hazardous materials may require response by the Hanford Fire Department Hazardous Materials (HAZMAT) Response Team.

C11.1 SMALL CONTROLLED SPILLS

When the spill is a small, controlled amount and the identity of the spilled substance is known, the spill can be cleaned up by personnel who have received appropriate training. To clean-up a spill, the following actions and MSDS guidelines for the substance should be followed.

- stop the spill,
- warn other people of the spill,
- isolate the area around the spill, and
- minimize personal exposure.

C11.2 LARGE CONTROLLED/UNCONTROLLED SPILLS

When the spill is large, the Hanford Fire Department HAZMAT Response Team should be notified to clean-up the spill. The HAZMAT Response Team will develop a plan of action on each response (based on training), because every response to a spill is different.

C12.0 HAZARD COMMUNICATION

Hazard communication related to the Tank 241-Z-361 sampling and analysis activities will be implemented in a manner consistent and in accordance with PFP hazard communication requirements. The purpose of this program is to communicate to workers the potential for illnesses and injuries related to the work environment. This program requires managers to inform their workers of the hazards in the work area and how they can protect themselves. The written program will be kept in various locations and will be available to all employees.

C12.1 HAZARDOUS CHEMICAL INVENTORY

A complete, current, hazardous chemical inventory will be maintained for the work conducted at Tank 241-Z-361. The location of "Right-to-know" stations will be identified to project staff during PFP orientation. The chemical inventory must include the MSDS number, may be cross-referenced by synonyms, and may include the Hanford HAZMAT Rating.

C12.2 PHYSICAL AND BIOLOGICAL HAZARD INVENTORY

A physical and biological hazard inventory will be included consistent with PFP hazard communication requirements. The physical agents considered include fire, lighting, noise, temperature-extremes, and ergonomic hazards. Biological hazards include venomous animals and pathogenic materials. Locations of the physical and biological hazard inventory will be in the "right-to-know" stations as indicated in Section C12.1.

C12.3 CHEMICAL LABELING

All hazardous materials will be labeled with manufacturer's warning labels or with internally generated hazardous materials information system labels.

C12.4 MATERIAL SAFETY DATA SHEETS

MSDS will be readily available to all employees. They will be retained at the "right-to-know" stations along with the chemical inventories.

C12.5 HAZARDS TRAINING

All employees will be trained to recognize and protect themselves from all hazards identified upon job assignment. All affected employees will be trained whenever a new hazard is introduced into their work areas.

C13.0 REFERENCES

10 CFR 835, "Department of Energy Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910.120, 1991, "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*, as amended.

29 CFR 1910.1200, 1991, "Hazard Communication," *Code of Federal Regulations*, as amended.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C 9601, et seq.

DOE, 1988, *Radiation Protection for Occupational Workers*, DOE Order 5480.11, U.S. Department of Energy, Washington, D.C.

DOE, 1990, *Occurrence Reporting and Processing of Operations Information*, DOE Order 5000.3B, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1993, *Hanford Site Hoisting and Rigging Manual*, DOE/RL-92-36, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996, *Hanford Site Radiological Control Manual*, HSRCM-1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

LMHC, 1998a, *Tank Farm Health and Safety Plan*, HNF-SD-WM-HSP-002, Rev. 3, Lockheed Martin Hanford Company, Richland, Washington.

LMHC, 1998b, *Setup and Takedown of Core Sample Systems*, TO-020-454, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1998c, *Core Sampling Truck Tank Riser Access Platform and Ramp Setup*, TO-020-456, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1998d, *Perform Field Inspection and Loading of On-site Casks During Core Sampling Operations*, TO-060-003, Rev. A-7, March 16, 1998, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1998e, *Sample Transfer Truck Operation*, TO-080-075, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1998f, *Transport the Onsite Transfer Cask*, TO-080-090, Rev. G-A, August 11, 1998, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1998g, *Tank Farm Plant Operating Procedure*, TO-080-505, "Push Mode Sampling With Truck #1," Rev. G-3, Lockheed Martin Hanford Company, Richland, Washington.

NIOSH, 1985, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, National Institute for Occupational Safety and Health, Washington, D.C.

PHMC, 1999, *Justification for Continued Operation for Tank 241-Z-361*, HNF-2024, Rev. 0A, Prepared by the Project Hanford Management Contractor and The Ciron Group LLC, Richland, Washington.

PHMC, 1998, *Job Hazard Analysis*, HNF-PRO-079, Rev. 2, Project Hanford Management Contractor, Richland, Washington.

PHMC, 1997a, *Hand and Portable Hand Power Tools*, HNF-PRO-085, Rev. 1, Project Hanford Management Contractor, Richland, Washington.

PHMC, 1997b, *Machine Guarding*, HNF-PRO-086, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997c, *Walking/Working Surfaces*, HNF-PRO-091, Rev. 1, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997d, *Portable Ladders*, HNF-PRO-094, Rev. 1, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997e, *Transportation Safety*, HNF-PRO-100, Rev. 1, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997f, *Confined Space*, HNF-PRO-110, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997g, *Hearing Conservation*, HNF-PRO-115, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997h, *Heat Stress Control*, HNF-PRO-121, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997i, *Asbestos Control – Construction Industry*, HNF-PRO-338, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997j, *Flammable/Combustible Liquids*, HNF-PRO-358, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

PHMC, 1997k, *Asbestos – Facility Management/General Industry*, HNF-PRO-408, Rev. 0, Project Hanford Management Contractors, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 U.S.C 6901, et seq.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 296-62, Part P, "Hazardous Waste Operations and Emergency Response," *Washington Administrative Code*, as amended.

WHC, 1992, *TWRS Administration*, HNF-IP-0842, Westinghouse Hanford Company, Richland, Washington.

WHC, 1996, *Plutonium Finishing Plant (PFP) Standards/Requirements Identification Document (S/RID)*, WHC-SD-MP-SRID-003, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1998, *Building Emergency Plan for Plutonium Finishing Plant Complex*, HNF-IP-0263-PFP, Rev. 5, Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT C-1

TANK 241-Z-361 SITE-SPECIFIC SUMMARY INFORMATION

I. SITE IDENTIFICATION

Project Name:	241-Z-361 Tank Sludge Characterization
Site Name:	Tank 241-Z-361
Site Address:	Plutonium Finishing Plant
	200 West Area
	Department of Energy Hanford Site
Safety Contact Person:	Matthew (Matt) Nolen
Phone Number:	372-2918
Proposed Work Dates:	Start: 1999
	Stop: 1999

Type of Site

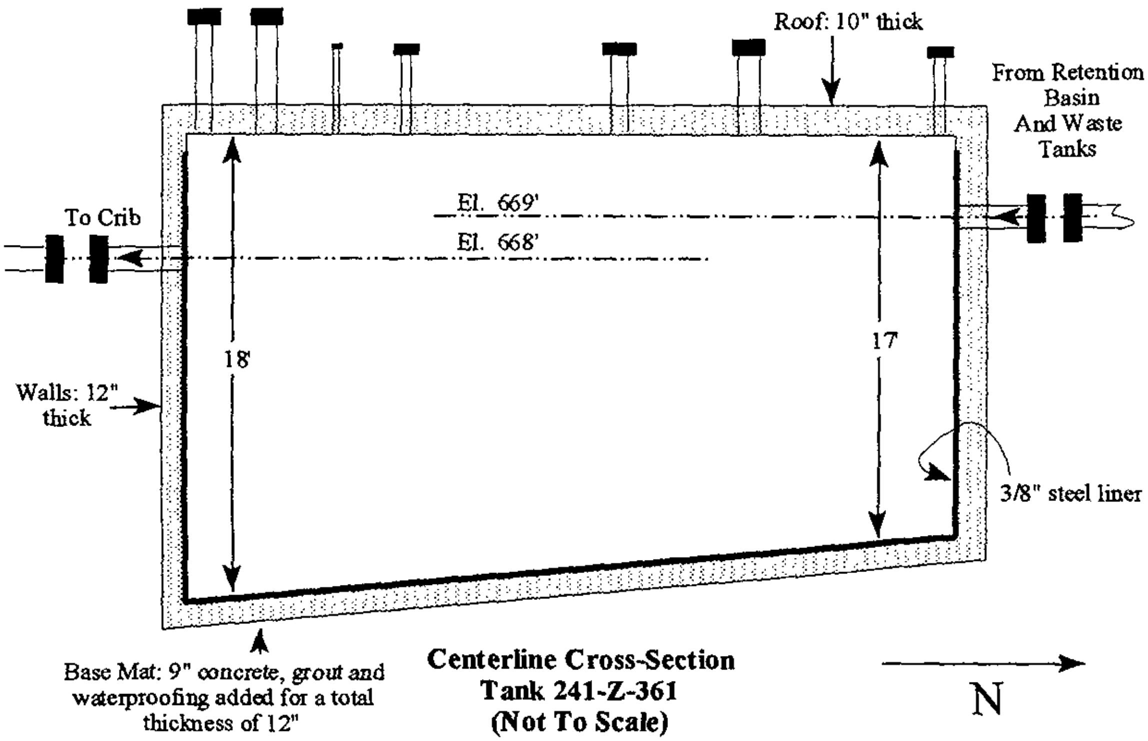
X Inactive   X Industrial Facility

Tank 241-Z-361 is an inactive underground tank within the protected area of the Plutonium Finishing Plant (PFP) at the Hanford Nuclear Reservation near Richland, Washington. It is located approximately 240 ft south of Building 236-Z. A cross section is shown in Figure Att-C2-1.

Tank 241-Z-361 served as a primary solids settling tank for low-salt waste water. Historic flows during the operating history of the tank were approximately 2,000,000 gal of waste water per year. The supernatant from Tank 241-Z-361 was routed to the 216-Z-1, 216-Z-2, 216-Z-3, and 216-Z-12 Cribs for disposal to ground. The tank was in service from 1949 until 1973, supernatant was removed in 1975 and the tank was isolated in 1985. All tank inlet and outlet pipes and risers have remained sealed since that time, leaving a layer of sludge sediments approximately 94 in. deep in the bottom of the tank.

The tank is expected to contain a substantial quantity of plutonium. The tank is expected to contain an estimated inventory of plutonium ranging from 30 to 70 kg, based on the results of limited sludge sampling and analysis conducted in the 1970s and evaluation of the limited available historic waste stream information. In addition to plutonium, the tank sludge may include constituents from nearly all PFP processes used during the tank's 24-yr operational period, but will be dominated by the nonsoluble components of effluents from Buildings 232-Z, 234-5Z, and 236-Z. The exact nature of the solids remaining in the tank is not well described currently. The largest expected contributors of settleable solids and insoluble liquids are expected to have been ash from incinerator scrubber operations, excess acid and

Figure Att-C1-1. Section and Plan View of Tank 241-Z-361. (not to scale)



caustic salts from waste neutralization activities, and solvents (e.g., carbon tetrachloride) from plutonium recovery and refining operations and laboratory disposal. Sludge residues analyzed in 1977 exhibited a slightly acidic pH of approximately 4.0. Elemental analysis of the sludge indicated substantial concentrations of aluminum, calcium, and iron. Carbon content (not specified as organic or inorganic) ranged from less than 1 percent to a maximum in one sample of 6 percent.

Hazards And Safety Concerns

Most physical hazards (e.g., mechanical hazards, trip and fall hazards, vehicle hazards, lifting, and moving material hazards, heat and cold stress) and chemical hazards (e.g., potential toxic vapors) associated with the planned vapor sampling of Tank 241-Z-361 are similar to hazards related to the tank farm operations routinely conducted by RPP personnel. Some unique hazards, or potential degree of hazard, have been identified at the Tank 241-Z-361 site. Detailed discussion of the Preliminary Hazard Analysis for Tank 241-Z-361 is presented in the Justification for Continued Operation (JCO) for Tank 241-Z-361 (PHMC 1999). These hazards are as follows:

1. potential structural instability of the tank (major concern),

2. potential for release of alpha- and beta-emitting radionuclides (known to be present),

3. potential combustible gas hazards (not detected during Phase I),

4. potential toxic vapor hazards,

5. mechanical hazards associated with a potentially-pressurized tank (determined to be not pressurized during Phase I), and

6. potential criticality hazards (current information indicates noncritical density).

II. SCOPE OF WORK

The characterization activities at Tank 241-Z-361 are being conducted as part of the Hanford Site remedial activities under CERCLA. The requirements for health and safety planning, training, and safe field operations are specified by OSHA and codified in 29 CFR 1910.120.

The objectives of the current activity at Tank 241-Z-361 are as follows:

Task 1: Review the results of the Phase I characterization activities and identify and incorporate any appropriate changes to this health and safety plan. This review will include, but not necessarily be limited to, the following issues:

1. Effectiveness of the support infrastructure established during the Phase I action (e.g., exclusion zone, decontamination facilities, support area, communication, coordination between PFP and RPP staff).

2. The results of real-time ambient monitoring during the Phase I actions (e.g., combustible gas concentrations, toxic vapor concentrations, radiological monitoring results).

3. The results of laboratory analysis of vapor samples collected from the tank.

4. The video record of conditions inside the tank.

Task 2: Review site preparation conditions including the following and confirm that site is ready for sampling activities

1. Verify bridge and ramp construction and placement.
2. Confirm utility line clearance.
3. Confirm riser preparation.

4. Confirm support area setup.

Task 3: Collect the Sludge Samples for Analysis (this task will be conducted in accordance with established RPP operating procedures for collection of tank waste samples)

1. Place the sampling vehicle on the vehicle bridge at the selected riser location and establish required containment equipment.

2. Collect core samples from the tank sludge, place the samples in appropriate shipping containers as required by the procedure, document the samples and receive shipping approval from PFP staff, and deliver the samples to the laboratory.

3. Repeat the process at the remaining selected tank riser locations.

Task 4: Decommission the Work Area after Completion of Sampling.

1. Containerize all radiologically- or chemically-contaminated investigation-derived waste.

2. Dismantle and remove all structures (e.g., truck ramp), temporary barriers, and support facilities.

All work will be performed by employees of the Project Hanford Management Contract companies. PFP operations staff will provide plant-specific training to RPP staff and will manage emergency response requirements.

III. SITE CONTROL (Specify site control requirements and identify on a map the location of work areas and exclusion zones)

The field operations manager will visit the site and identify the most appropriate layout for the exclusion zone, decontamination area, and support area.

An exclusion zone will be established around the selected riser and Tank 241-Z-361 of sufficient size to contain the job equipment and allow a sufficient buffer zone to ensure that respiratory protection and protective clothing are not required at the exclusion zone boundary. Preliminary estimate is for an exclusion zone with at 20-ft radius from the selected riser. The exclusion zone will be identified for the following requirements based on site monitoring:

1. Respiratory Protection Required,
2. Air Toxics and Flammable Gas Monitoring Required,
3. Radiation Protection Zone, and
4. Tank structural concerns.

The exclusion zone may include a windbreak around the selected tank riser to protect workers from wind, rain, and sun exposure. The size and boundary marking for the exclusion zone will be modified as required based on site monitoring results and tank structural calculations.

A decontamination area will be established and equipped with sufficient supplies to perform decontamination of personnel and equipment before leaving the controlled area. The decontamination area will also be equipped with containers for used personal protective equipment.

The support area will include a RPP field support trailer for use as a change room. A shaded rest area will be established and supplied with drinking water.

A diagram of the site with preliminary location of the exclusion zone, decontamination area, and support area is shown in Figure Att-C2-2. A similar arrangement, but larger to accommodate the core sampling equipment, will be used to sample the risers in the center and south-end of the tank.

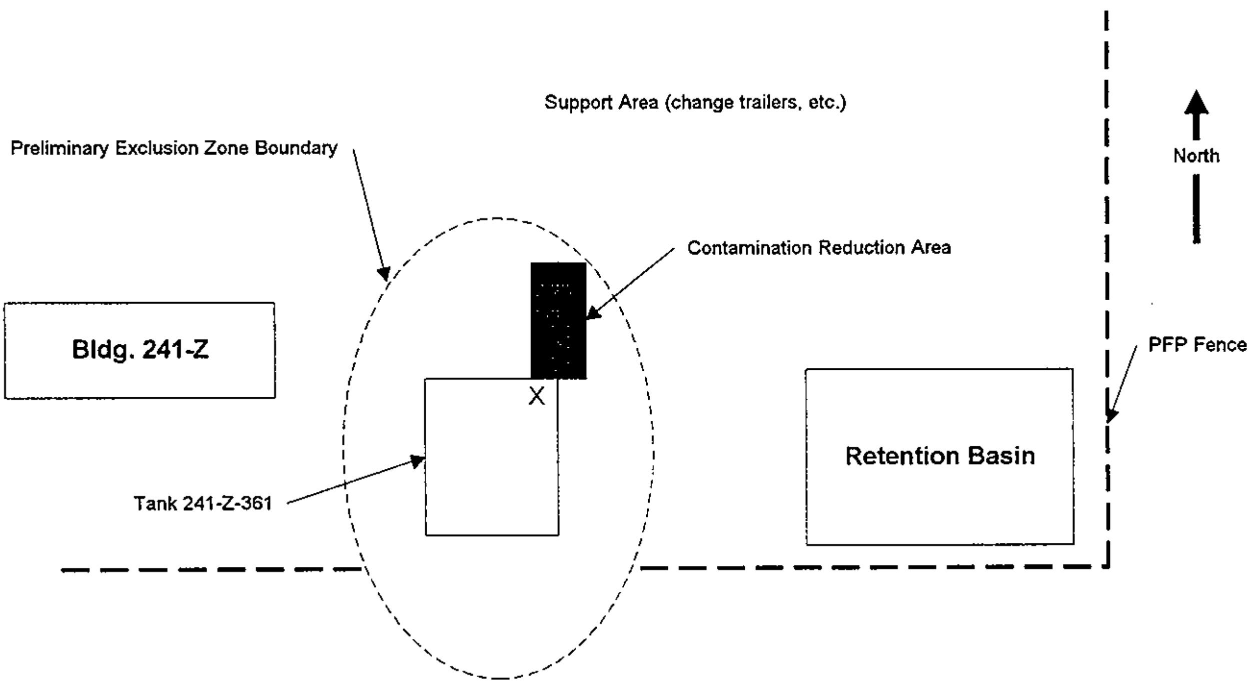
IV. EMERGENCY INFORMATION (NOTE: All personnel performing field work at PFP must attend a PFP Emergency Response Training Session)

Emergency Contacts:

Fire/Rescue	911 or 373-3800
Ambulance:	911 or 373-3800
Police/Sheriff:	911 or 373-3800
Onsite Medical Facility (clinic):	Yes (day shift, Monday – Friday)
	Health Service Center, 200 West 20th Street, Bldg. 2719 WB (near the 200 West area east gate) 373-2714
PFP Health and Safety Officer:	Matthew (Matt) Nolen
Phone Number:	372-2918

PFP Health Physicist:	James E. Pieper
Phone Number:	376-4175
PFP Industrial Hygienist:	Allen Lilly
Phone Number:	373-5203
Hospital Name and Address:	Kadlec Medical Center
	888 Swift Blvd.
	Richland, WA 99352
	(509) 946-4611
PFP Building Emergency Director:	Shift BED
Phone Number:	373-2337
PAX:	277

Figure Att-C1-2. Preliminary Site Layout and Exclusion Zone Location, Tank 241-Z-361.



There are some overhead lines paralleling the roadway. These could present hazards to workers when traversing. Utility lines will be relocated during site preparation activities. The road way is not immediately adjacent to the work site but vehicular traffic could present a hazard to workers when they are accessing the work area. There are currently signs posted which must be removed and replaced with signs restricting entry to sampling personnel and PFP support only.

V. SOURCE/RELEASE CHARACTERIZATION

Estimated Volume: Approx. 2,000,000 gal of waste water per year for 22 yr

Product:	No	Waste:	Yes	Lead Hazard:	No
Liquid:	minimal free liquid remains	Flammable:	Unlikely	Asbestos:	? maybe flange gaskets
Sludge:	94 in. deep in tank	Corrosive:	pH range 4-7		
Solid:	Yes	Reactive:	No		
Empty:	No	Toxic:	? Uncertain		
Other:	Radioactive (alpha emitter), Plutonium and Americium (from Plutonium decay)				

Between 1949 and 1973, Tank 241-Z-361 was used as a settling tank prior to discharging liquid effluent streams to the cribs. Tank 241-Z-361 received a high volume of waste water, which included inorganic waste from PRF, organic, inorganic and laboratory mixed waste from PFP, inorganic and organic waste from the Incinerator Building and from Building 242-Z from the americium recovery process. The low salt aqueous waste stream from the PFP consisted of plutonium contaminated aqueous solutions (88%), contaminated laboratory waste (7%) and uncontaminated cooling water (5%). Organic materials remaining in the tank sludge likely came from laboratory waste streams. Most supernate was pumped out in 1975.

VI. CHEMICAL HAZARDS

PRIMARY CHEMICALS OF CONCERN

Chemical Name	Highest Reported Concentration (media)	PEL/[1] TLV	IDLH	Symptoms/ Effects of Acute Exposure
Plutonium salts (unspecified)	0.52 g/L in sludge (Range of 5 samples = 0.21 to 0.52 g/L)	None established		Plutonium is an alpha-particle-emitting radionuclide. Inhalation and/or ingestion of plutonium particulate can cause cancer. Acute exposure to high concentration of plutonium via ingestion or inhalation can cause effects similar to other heavy metals (i.e., lung injury, central nervous system damage, acute gastro-intestinal upset).
Carbon tetrachloride	0.16 ppm	2 ppm	200 ppm	Skin and eye irritation. Inhalation and ingestion causes damage to nervous system, pulmonary system, and gastrointestinal system. Acute inhalation causes narcosis, coma, and death. A suspected carcinogen.

PRIMARY CHEMICALS OF CONCERN

Chemical Name	Highest Reported Concentration (media)	PEL/[1] TLV	IDLH	Symptoms/ Effects of Acute Exposure
Nitric acid	Sludge pH approximately 4.0. No acid gases detected.	2 ppm	25 ppm	Skin and eye irritation from dilute vapors and solutions. Severe damage to eyes and skin on contact. Inhalation may cause respiratory failure and death.
Hydrofluoric acid	Sludge pH approximately 4.0. No acid gases detected.	3 ppm	30 ppm	Skin and eye irritation from dilute vapors and solutions. Severe damage to eyes and skin on contact. Inhalation may cause respiratory failure and death. Skin absorption may cause delayed death due to fluoride imbalance effects.
Tetrachloro-ethylene	2.0 ppm in headspace	25 ppm	150 ppm	Skin and eye irritation. Inhalation and ingestion causes damage to nervous system, pulmonary system, and gastrointestinal system. Acute inhalation causes narcosis, coma, and death. A suspected carcinogen.
Tributyl phosphate	Not measured	0.2 ppm	30 ppm	Moderately toxic by ingestion (low volatility minimizes inhalation hazard). Causes headache nausea, narcosis, paralysis, edema, irritation of skin, eyes, and mucous membranes.
Hydrogen	3 ppm	Fire hazard		Flammable Gas. LFL = 4%, UFL = 75%.
Methane	3 ppm	Fire hazard		Flammable Gas. LFL = 5%, UFL = 15%.
Nitrous oxide	60 ppmV in headspace	25 ppm (REL) 50 ppm (TLV)	Not specified	An anaesthetic gas causing euphoria, drowsiness, narcosis. Medical anesthesia uses approximately 8 vol.%
Chloroform	1.30 ppm in headspace	10 ppm	500 ppm	An anesthetic gas causing drowsiness, narcosis. A potential carcinogen.
Carbon dioxide	13,000 ppm	5,000 ppm	40,000 ppm	Asphyxiant gas; exposure causes rapid breathing and disorientation. High concentrations cause death by asphyxiation.
Trichloroethylene	0.9 ppm in headspace	50 ppm	1000 ppm	Skin and eye irritation. Inhalation and ingestion causes damage to nervous system, pulmonary system, and gastrointestinal system. Acute inhalation causes narcosis, coma, and death. A suspected carcinogen.

[1]The most conservative of either the OSHA PEL or ACGIH TLV is selected for the exposure limit.

VII. AIR MONITORING

MONITORING INSTRUMENTATION: (NOTE: Monitoring instruments must be used for all operations unless appropriate rationale or restrictions are provided).

X	Photoionization Detector (organic vapor meter [OVM]) Lamp Energy 11.7 eV
X	Combustible Gas Indicator
X	Oxygen Meter
X	Detector Tubes (specify): Carbon Tetrachloride and chloroform (if volatiles are detected with the OVM)
X	Other (specify: toxic gas, air sampling pumps, etc.): Radiological Monitoring for alpha (continuous alpha monitors and fixed head filter samplers), beta, and gamma emissions, passive monitor for carbon dioxide.

The frequency of real time air monitoring may be adjusted to meet conditions observed in the field. The sludge sampling procedure requires monitoring on specified intervals and at specified points during the activities. Personnel will review the standard operating procedure(s) used for this activity to ensure the collection of timely monitoring data. In addition to the source monitoring specified by the sampling procedures, monitoring for airborne radioactivity will be conducted using a continuous air monitor for detection of airborne alpha emitters in the exclusion zone near the riser and one fixed-head air sampler at the exclusion zone boundary. The fixed-head sampler will be monitored for alpha emissions about every 15 minutes during sampling activities, or any time that the riser(s) is open.

Real time monitoring for combustible gases and toxic materials will be performed when the riser is opened and during sludge sampling.

ACTION LEVELS:

Combustible Gas Indicator (at area of possible accumulation)

0 - 10%	of LFL	No Explosion Hazard
10 - 25%	of LFL	Potential Explosion Hazard; Notify PIC; Implement Control Measures, Monitor continuously
> 25%	of LFL	Explosion Hazard; Interrupt Task/Evacuate

Oxygen Meter (in workers' breathing zone)

19.5% - 23.5%	O2	Oxygen Normal

<19.5%	O2	Oxygen Deficient; Interrupt Task/Evacuate
>23.5%	O2	Oxygen Enriched; Interrupt Task/Evacuate

Organic Vapors (nonspecific, indicated by photoionization detector or flame ionization detector readings in workers breathing zone for 3-minute duration) NOTE: All activities in the exclusion zone when risers are open will be conducted in Level C respiratory protection (i.e., APRs).

< 2 ppm	No respiratory protection required unless needed for radiation protection, potential for release, or carbon tetrachloride. Use colorimetric indicator tubes to confirm presence or absence and concentration of ammonia and carbon tetrachloride (see specific action levels for carbon tetrachloride and ammonia).
2 to 25 ppm	Level C using full-face APR equipped with GME-H or GME-P100 cartridge if APRs are confirmed effective against contaminants. Initiate monitoring at the exclusion zone boundary and extend the boundary as required to ensure that action levels are not exceeded at the exclusion zone boundary.
> 25 ppm	Stop work and evacuate the exclusion zone. Continue boundary monitoring. Determine the need for enhanced respiratory protection or engineered controls before continuing work.

Ammonia (indicated by colorimetric indicator tubes, readings in the workers' breathing zone)

< 12 ppm	No respiratory protection required unless required by other action levels or for enhanced worker comfort. Continue monitoring for ammonia.
12 to 250 ppm	Level C using full-face APR equipped with GME-H or GME-P100 cartridge. Initiate monitoring at the exclusion zone boundary and extend the boundary as required to ensure that action levels are not exceeded at the exclusion zone boundary.
> 250 ppm	Stop work and evacuate the exclusion zone. Continue boundary monitoring. Determine the need for enhanced respiratory protection or engineered controls before continuing work.

Carbon Tetrachloride and/or chloroform (indicated by colorimetric indicator tubes, readings in workers' breathing zone)

< 2 ppm	No respiratory protection required unless required by other action levels. Continue monitoring for carbon tetrachloride.

2 to 25 ppm	Level B using pressure demand supplied air respirator. Initiate monitoring at the exclusion zone boundary and extend the boundary as required to ensure that action levels are not exceeded at the exclusion zone boundary.
> 25 ppm	Stop work and evacuate the exclusion zone. Continue boundary monitoring. Determine the need for enhanced respiratory protection or engineered controls before continuing work.

Carbon Dioxide (indicated by CO_2 monitor in workers' breathing zone)

< 2,000 ppm	No respiratory protector required.
2,000 – 5,000 ppm	Implement engineered controls (e.g., power ventilation)
> 5,000 ppm	Level B using pressure demand supplied air respirator. Initiate monitoring at the exclusion zone boundary and extend the boundary as required to ensure that action levels are not exceeded at the exclusion zone boundary.

Radiological Monitoring action levels will be described in the Radiological Work Permit.

VIII. PHYSICAL HAZARDS

CONFINED SPACE ENTRY

No **Requires Specific H&S Procedures**

MATERIALS HANDLING

Flammable Liquid:	No	
Spoil:	No	
Manual Lifting	Yes	Field equipment, sampling devices

HOT WORK

No Presence of flammable gases potentially trapped in sludge may require ignition control measures.

TRAFFIC HAZARDS

Yes Routine plant traffic.

THERMAL STRESS

Heat: _Yes_ Cold: _Yes_ Depending on weather at time of implementation.

NOISE EXPOSURE

_No_ Not expected to be a problem with this task.

IX. PERSONAL PROTECTIVE EQUIPMENT

MINIMUM: *Substantial footwear and Work Clothing*

NOTE: Respiratory protection equipment will be supplied and maintained by RPP. Protective clothing will be provided by PFP. PFP will collect used clothing for laundering or disposal.

ADDITIONAL: (Specify by Task, Complete Additional Sheets As Needed)

TASK 1: Review Phase I Characterization Results

RESPIRATORY PROTECTION:

None required.

PROTECTIVE CLOTHING

None required.

TASK 2 Review status of Site Preparation

RESPIRATORY PROTECTION:

None required unless indicated by results of Phase I action. If installation of pilings for the truck bridge unearths subsurface soil, this soil will be monitored for radiological and non-radiological contamination and protective measures implemented per the action levels.

PROTECTIVE CLOTHING

Level D work clothing (unless indicated by site monitoring).

TASK 3 Collect the Sludge Samples for Analysis (this task will be conducted in accordance with established RPP operating procedures for collection of tank waste samples)

RESPIRATORY PROTECTION:

Pressure demand supplied air respirator, as indicated by monitoring results, or full-face air purifying respirator with GME-H/GME-P100 cartridges until

a. Riser(s) are closed;

b. Equipment and personnel decontamination are complete; and/or

c. Radiological and IH monitoring confirm that action levels are not exceeded, or work is complete within restricted area.

PROTECTIVE CLOTHING

Standard anti-contamination clothing ("whites") with hood, gloves, and boot covers until

a. Riser(s) are closed;

b. Personnel and equipment decontamination are complete; and/or

c.. Radiological and IH monitoring confirm that action levels are not exceeded, or work is complete within restricted area.

TASK 4: Decommission the Work Area

RESPIRATORY PROTECTION:

Pressure demand supplied air respirator or full-face air-purifying respirator with GME-H/ GME-P100 cartridges until

a. Riser(s) are closed;

b. Equipment and personnel decontamination are complete; and/or

c. Radiological and IH monitoring confirm that action levels are not exceeded, or work is complete within restricted area.

PROTECTIVE CLOTHING

Standard anti-contamination clothing ("whites") with hood, gloves, and boot covers until

a. Riser(s) are closed;

b. Personnel and equipment decontamination are complete; and/or

c. Radiological and IH monitoring confirm that action levels are not exceeded, or work is complete within restricted area.

X. DECONTAMINATION

DESCRIBE METHODS USED:

Personnel: All personnel, nondisposable clothing, equipment, and samples leaving the contaminated area must be decontaminated or properly packaged to prevent the spread of any harmful chemicals, or radioactive contamination that may have adhered to them.

Due to the uncertainty in the actual nature of the sludge remaining in Tank 241-Z-361, and the likelihood that the sludge contains variable concentrations of hazardous materials (e.g., plutonium, carbon tetrachloride, and hydrofluoric acid), a rigorous decontamination protocol and contamination control will be employed for all personnel and equipment that may come into contact with the tank contents.

The primary decontamination for personnel during the sludge sampling activities at Tank 241-Z-361 will be achieved by following a rigorous protocol for doffing contaminated and potentially-contaminated protective clothing. The protective clothing is then either packaged for laundering (e.g., reusable cloth anti-contamination clothing), or for disposal (e.g., disposable garments, gloves and boot covers. This protocol has proved effective during previous tank sampling activities at Hanford tank farms and will be applied during this activity. By following this protocol, a minimal amount of water will be used and the quantity of contaminated investigation-derived waste will be minimized. The doffing protocol should be effective in this situation because the containment of tank waste materials provided by the sampling device(s) and the bags and sleeves used to seal the tank riser(s) will present minimal opportunity for gross contamination of personnel during sample collection and handling.

The recommended decontamination solution for Tank 241-Z-361 sludge sampling activities is water with liquid detergent added. A supply of potable water will be available on site for personnel and small equipment decontamination. Decontamination with large volumes of water is typically not required by tank sampling activities.

Disposable clothing and expendable tools will be packaged for proper disposal to prevent the spread of contaminants. The sampling vehicle and non-disposable equipment that contact the tank contents will be decontaminated as specified in the RWP.

Supplies will be available for dry decontamination (i.e., rags and brushes) and wet decontamination (i.e., water, detergent, brushes, and containers) as specified in the RWP. A personnel face and hand wash station will be established at the perimeter of the decontamination area. Personnel will change in the onsite job trailer and shower in RPP facilities at Building 2704 HV.

Equipment: Contaminated equipment will be sealed in containers and decontaminated or disposed according to PFP procedures or the Environmental Restoration Disposal Facility waste acceptance criteria as discussed in Section 2.10 of this SAP.

XI. DISPOSAL

DESCRIBE METHODS:

See WCP, Section 2.10 of this SAP.

ATTACHMENT C-2

EMERGENCY RESPONSE PLAN AND TANK 241-Z-361 SLUDGE SAMPLING CHARACTERIZATION FIELD OPERATIONS

Hanford Patrol who will dispatch Fire Department: **373-3800 (Cell Phone or Land Line); PAX # 222 or 210 or 211**

PFP Building Emergency Director (BED) Dial: **373-2337; PAX 227**

All personnel must review and understand the job-site communications specifications on Page 4 and understand the appropriate response.

The PIC/Supervisor is responsible for emergency notifications. The PIC/Supervisor will designate an alternate individual to make emergency notifications if the PIC/Supervisor is unable.

Always maintain a charged cellular telephone at the job site for use in emergency communications.

Always maintain one portable radio in the exclusion zone and one in the support zone.

Always maintain a flag or flutter strip in the project support area to determine wind direction.

Always maintain first aid supplies, decontamination supplies, and fire extinguishers in the support area and in the exclusion zone as appropriate.

A. **IN THE EVENT OF A PLANT EMERGENCY (NOT DIRECTLY RELATED TO JOB-SITE ACTIVITIES)**, see Page 4 for alarm meaning and take appropriate response.

B. **IN THE EVENT OF A JOB-SITE EMERGENCY, DO THE FOLLOWING**:

1. **Communicate nature of emergency between supervisor/PIC outside the exclusion zone from BWHC and the PIC from LMHC in the exclusion zone**
2. **Refer to the "AFFECTED PERSONNEL" sections of the PFP established procedures in the tabbed sections of this binder and respond as directed:**

ZCR-001	**CONTINUOUS AIR MONITOR ALARM**
ZCR-002	**UNPLANNED MATERIAL RELEASE**
ZCR-003	**PERSONNEL CONTAMINATION**
ZCR-004	**MEDICAL EMERGENCY**
ZCR-005	**FIRE ALARM/FIRE**
ZCR-008	**CRITICALITY ALARM**
ZCR-009	**EVACUATION**
ZCR-010	**TAKE COVER**

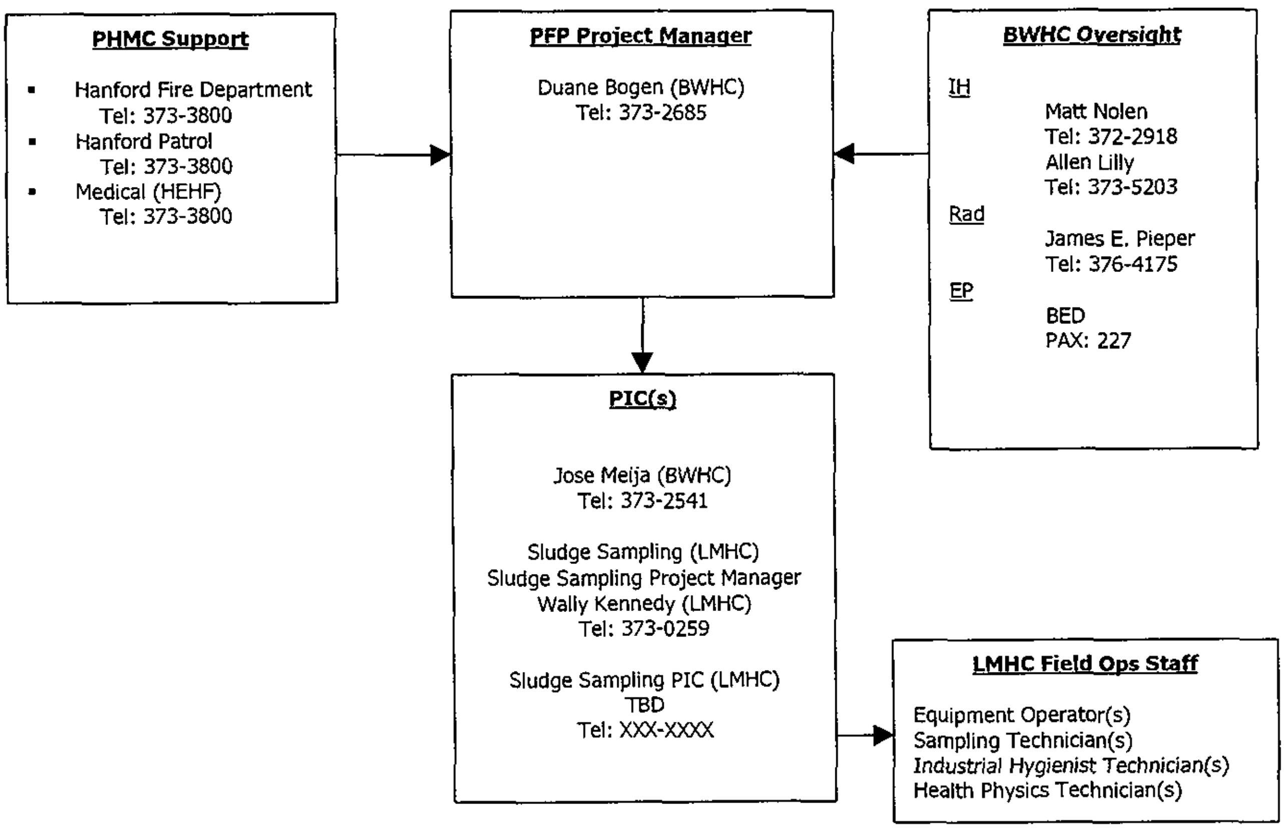
WS-98-00266

Field Operations Contingency Plan
Tank 241-Z-361 Sludge Sampling Characterization Activities

Emergency contingency operations required during field operations at 241-Z-361 Tank characterization will be implemented in accordance with existing plans and procedures developed for use at the Plutonium Finishing Plant.

1.0 Personnel Organization, Command and Responsibilities

For field activities conducted during characterization of 241-Z-361 Tank, the personnel organization is shown in the following two figures. PHMC support provides emergency services when requested by either a) LMHC PIC, b) BWHC PIC, or c) PFP Building Emergency Director [BED], after being contacted by either of the PICs. The project manager "owns" the work in its totality and reports to the BWHC site Senior Director. BWHC oversight reviews documents, work plans, procedures, etc., and provides comment and guidance to the project manager, and if requested, to LMHC. The BWHC PIC represents the project manager at the worksite and provides oversight of the LMHC PIC. The LMHC PIC provides direction to the LMHC field operations staff, under the oversight of the BWHC PIC. Actual staff assigned to field operations will be identified in the contingency plan prior to starting field operations.



WS-98-00266

FIELD PERSONNEL - AUTHORITY

PFP PIC
Jose Meija

LMHC PIC and Site Supervisor
TBD

CPO OPERATIONS & MAINTENANCE STAFF

NAME	PAYROLL
Campbell, Bobby C.	6A134
Ekstrom Brad C.	85421
Green, Dan J.	64196
Headley, Douglas R. (Doug)	82308
Kelly, Lorin K.	82596
Kennedy, Wallace J. (Wally)	56592
Matthews, Vernon P. (Vern)	55297
Parks, Robert J. (Bob)	84656
Perez, Jesus (Jesse)	82449
Rudick, John M. (Stubby)	83915
Ruelas, Rodolfo J. (Rudy)	64939
Sickels, James F. (Jim)	81542
Tatro, Tammy F.	81893
Tasci, Kenan	85680
Worley, Larry M.	81301

SAS STAFF

NAME	PAYROLL
Lockard, Larry D.	84929
McClellan, Charles S. (Chuck)	6C354
Pingle, Len A. Jr.	82536

CPO RadCon Staff

NAME	PAYROLL
Copeland, Michael A. (Mike)	6A589
Ellingson, David P. (Dave)	67122
French, Raymond P. (Ray)	6B678
Parmentier, Chris P.	89874
Reeder, Ricky J. (Rick)	83071
Wyant, Vivian M.	58266

CPO IH SUPPORT STAFF

NAME	PAYROLL
Arbogast, Steven L. (Steve)	57813
Horner, Randell L. (Randy)	8A734
Jones, Kenneth L. (Ken)	72045
Marquardt, Lauri J.	8A642
Melbihess, Rick D.	6B101
Payne, Joseph A. (Joe)	6A114
Spaulding, Dell F.	88404
Woods, Tom T.	69807
Zak, Fred A.	89339

CPO ENGINEERING STAFF

NAME	PAYROLL
Brown, Roland G.	84900
Esvelt, Chad A.	98165
Wanner, Dale D.	57858

2.0 Roles and Responsibilities

In the event of an emergency, the PIC/Supervisor for the field operations has primary responsibility for initiating an emergency response. The BWHC PIC initiates communication of emergencies originating outside the exclusion zone. The LMHC initiates communication of emergencies originating inside the exclusion zone. Prior to starting each shift, both the BWHC and LMHC PIC/Supervisors will designate an alternate individual for initiating emergency response in the event that either of the PIC/Supervisors is unable to initiate the emergency response.

3.0 Communications

Prior to initiating operations for each shift, the BWHC PIC/Supervisor will identify the type and location of off-site communications available for field team use. These communications will include the following.

Table C3-1. Off-Site Communications Capability

Type of Communication	Location (specify and verify function daily)
Cellular Telephone	In support area
Plant Radio	In support area
Land-Line Telephone	Nearest building w/phone

When making notification of an emergency at the job site, two communications are required to initiate the emergency response:

1. Contact BWHC PIC and BWHC PIC calls 911 and or BED or,
2. Call 373-3800 from any phone for the Hanford Patrol dispatch center (fire, ambulance, and rescue response).
2. Call 373-2337 for the PFP Building Emergency Director (all emergencies).
3. Stay at your communication post, unless conditions are IDLH. Do not tie up communications reporting to other managers, etc., until the emergency is under control.

IMPORTANT NOTE: Dialing 911 from a cellular phone will not connect you with the Hanford Patrol's central dispatch! Dialing 911 will connect directly to the Hanford dispatch only from a plant land line phone. When dialing 911 from a cellular phone, you may get a dispatch center in Yakima, Moses Lake, or even Spokane, which will only delay the response.

Include the following information when making all emergency notification calls:

1. Your Location (the job site location is 241-Z-361 Tank located inside the southeast corner of the PFP security fence in the 200 West Area, immediately east of Building 241-Z).
2. The Nature of the Emergency (e.g., medical emergency, fire, explosion, contaminant release).

3. The Number of Affected Personnel.
4. Your Name and the Telephone Number or Radio Unit From Which You are Calling.
5. Identify Any Special Hazards (e.g., chemical and radiological hazards, equipment hazards, PPE in use).
6. Assistance and/or response requested.

Because the field activities will be conducted in Level B respiratory protection (i.e., supplied air respirators), additional communications protocols will be required for use at the job site (i.e., local communications). Portable radios, hand-held and/or head-set, will be used for job site communication between the support area and the exclusion zone. Common hand signals that may be applicable for use in the exclusion zone are described in Table 3-2.

Table C3-2. Job-Site Communications.

Signal	Meaning	Response
a. Hand Clutching Throat	a. Out of Air / Can't Breath	a. Open escape/reserve air supply. Assist the affected person to the decon pad.
b. Thumbs Up	b. OK / I'm alright / Understood	b. No response necessary
c. Thumbs Down	c. No / Negative	c. No response necessary
d. Hand(s) on Top of Head	d. I need assistance	d. Respond as required
e. Grip partner's wrist	e. Leave area immediately.	e. Assemble at decon pad.

In addition to the job-site communications, specific emergency signals are used at Hanford. These standard warning signals are described below.

Table C3-3. Hanford Plant Emergency Signals (Emergency Not Related to Job Site Activities). (2 Sheets)

Warning Signal	Event	Response at Job Site
Gong	Fire	1. Notify job site personnel. 2. BWHC PIC/Supervisor account for all personnel. 3. Follow plant procedure **ZCR-005**.
Steady Siren	Plant Evacuation	1. Notify job site personnel. 2. BWHC PIC/Supervisor account for all personnel. 3. Follow plant procedure **ZCR-009**.
Wavering Siren	Take Cover	1. Notify job site personnel. 2. BWHC PIC/Supervisor account for all personnel. 3. Follow plant procedure **ZCR-010**.

Table C3-3. Hanford Plant Emergency Signals (Emergency Not Related to Job Site Activities). (2 Sheets)

Warning Signal	Event	Response at Job Site
Howler (Ah-OO-Gah)	Criticality	Not applicable. Job site is outside PFP criticality areas.
Flashing Red Light / Ringing Bell	Radiological Air Contamination	1. Notify job site personnel. 2. BWHC PIC/Supervisor account for all personnel. 3. Follow plant procedure **ZCR-001**.

NOTE: Procedures will be attached to the copies of the HSP for field personnel.

4.0 Site and Task-Specific Health and Safety Requirements

For quick reference at the job site, Attachment C-1 of the Site Specific Health and Safety Plan "Tank 241-Z-361 Site-Specific Summary Information" is attached in this binder under the tab marked SUMMARY INFORMATION.

APPENDIX D

HOLDING TIMES AND ANALYSIS OF TANK 241-Z-361

D1.0 INTRODUCTION

This Appendix is not a stand-alone document. The reader is referred to Section 1.5 of the Safety and Analysis Plan for detailed discussions of the decisions for which the data will be used, and potential action levels associated with the decisions. The focus of this appendix is the issue of holding times, preservation, and storage conditions with respect to the analyses that are required by Resource Conservation and Recovery Act of 1976 (RCRA) regulations. RCRA is an ARAR under this Compressive environmental Response, Compensation, and Liability Act of 1980 (CERCLA) remediation.

The data generated through sludge analysis will be used to make the decisions listed in Table 1-4. These decisions include selection of remedial alternatives; alternatives have not been preselected at this time. Disposal of the final waste form may occur at the Waste Isolation Pilot Plant (WIPP) or Environmental Restoration Disposal Facility. Unless a treatment process can remove a large portion of the plutonium, however, the more likely disposal location is the WIPP. The following must be clearly understood in assessing the issue of holding times, preservation, and storage:

- Additional analyses will be needed during the remediation process beyond what is specified in this document.
- The waste has been stored underground in a tank that is not air-tight. This means that oxidation and radiolytic reactions have been and are on-going whether the waste is inside or outside the tank.
- Regulatory guidance allows the appropriate alteration of methods when radioactive mixed waste is being analyzed. (*Federal Register*, November 20, 1997 [Volume 62, Number 224]).
- This waste has a high salt content; cooling causes precipitates to form in high salt content waste.
- The WIPP is working to assure mixed waste can be accepted in the future. If WIPP can accept mixed waste, the land disposal restriction (LDR) issue for concentrations of organics and metals will not be a concern.

The Joint U.S. Nuclear Regulatory Commission/ U.S. Environmental Protection Agency (NRC/EPA) Guidance published on Testing Requirements for Mixed Radioactive waste stresses the use of process knowledge for assessing whether waste is characteristic (e.g, ignitable, reactive, corrosive, toxic) or meets LDR requirements (*Federal Register*, November 20, 1997 [Volume 62, Number 224]). The use of process knowledge was key in the assessment of the Contaminants of Potential Concern as discussed in Section 1.6. As such, the guidance stresses the use of headspace analysis as opposed to use of direct volatile analysis for waste disposal. It also stresses the use of smaller sample sizes to minimize exposure to individuals. This SAP uses the smaller sample sizes and headspace analyses recommended by the Joint Guidance. Total metals and volatile organics are specified on the waste as opposed to performing the leaching followed by the metals and volatile analysis. In several memos, EPA stresses the use of totals analysis followed by calculations to estimate the amount of material available for leaching in order to meet the Toxicity Characteristic Leaching Procedure for all wastes (EPA 1993). Although many methods are specified in this SAP, the following discussion applies only to methods required for regulatory purposes. The following methods are being performed to meet regulatory requirements:

- Volatiles by 5021/8260B and 5030B/8260B (headspace purge for solids and purge and trap for liquids followed by gas chromatograph/mass spectroscopy)
- Metals by 6010B inductively coupled plasma (ICP)
- Mercury by 7470A/7471A cold vapor atomic absorption
- Cyanide (9012A)
- Anions (9056)

The aforementioned SW-846 (EPA 1997) methods are required for the determination of the characteristics and for the determination as to whether land disposal requirements will be met after final treatment. Note that ignitability has no holding time and is not discussed in this appendices.

D2.0 SAMPLE HOLDING TIME AND STORAGE CONDITIONS

The holding time and storage conditions requirements for samples must be considered together, because they are specified for regulatory analysis. The holding times vary depending on the waste matrix (solid or liquid/aqueous). In order to achieve consistency, EPA has published these holding times in the SW-846 (EPA 1997) methods. Scientists agree that holding times may vary with the waste matrices, however, those published in SW-846 are typically used. This means that the holding times specified in SW-846 vary depending on the waste matrices one analyzes. To date, EPA has not required that holding time be evaluated for each waste matrix.

Holding time limits have been established by regulatory agencies to ensure timely sample analysis and because of potential analyte loss by physical processes from the sample container, and biodegradation, and chemical change after sampling. These factors are further discussed in Sections D3.2 and D3.3. Table D-1 lists the EPA holding times for the analytes of concern.

D2.1 Holding Time Issue

The sample holding time requirements for volatile organic analysis, cyanide, mercury, and select anions, as specified in SW-846 (EPA 1997), are difficult to meet for Hanford tank wastes. The logistics of collecting samples from the tanks, arranging transport to the laboratory, and processing the sample casks in the hot cells takes more time than the holding times allowed by the SW-846 methods. The holding times for analytes other than metals by ICP will not be met during the sampling of Tank 241-Z-361. The holding time for metals analyzed by ICP will be met. The reasons for non-compliance, with respect to the times are discussed below.

D2.2 Reasons for Not Meeting Holding Times

The time required for sampling, transport, and handling of radioactive tank waste samples in the laboratory, exceeds SW-846 (EPA 1997) holding times. The major reason for this is additional precautions that are associated with the transport and handling of plutonium samples. Plutonium is an acutely toxic, alpha particle-emitting radioactive metal. Processing analytical samples containing plutonium requires stringent operational controls to prevent personnel exposure and inadvertent spread of contamination in the laboratory. It is more difficult to measure alpha emissions than beta/gamma to the appropriate dose limits. This makes detection and monitoring to assure one does not contaminate personnel or laboratory more time consuming.

Hanford Site contractors have developed sophisticated equipment and procedures for sampling and analyzing the contents of radioactive waste tanks. The procedures require the following actions, which substantially lengthen the time between sample collection and analysis.

- Collection of samples in specialized core samplers which must be stored and transported in shielded casks,
- Preliminary handling of samples in hot cells using remote manipulators to extrude sample cores from samples and prepare initial subsamples for analysis,
- Storage, handling and analysis of subsamples in a manner consistent with fissile material requirements, contamination control, and personnel exposure control.

Safety requirements for handling fissile material and the amount of alpha activity that an analyst and the laboratory may work with at one time, limits the number of samples that may be processed as a given time. In order to decrease the plutonium inventory in a given area, many analyses must be processed sequentially, as opposed to simultaneously. All of these issues cause the handling to require more time than normal sample handling, thus extending holding times beyond specified limits.

Radiation control personnel responsible for the laboratory analysis rate the estimated plutonium content in this tank as a high risk. Because of this rating, a radiological control technician (RCT) must be present during all load-in/load-out of samples, preparation, and analysis. One RCT has been assigned to be present when all samples are handled. Extensive training is required to allow a RCT to enter a new facility and to manage the handling of alpha emitting radionuclides.

In order to evaluate the effect of processing the mercury, anions, and cyanide with short holding times presented in this appendices, an alternate approach and schedule were generated. The alternate approach required that each segment be subsampled before compositing to evaluate whether holding times could be met. The holding times still could not be met using this approach and collecting small subsamples before compositing does not generate as representative a sample of the waste. The alternate approach also required that the sampling crew be put on hold for two weeks while the laboratory processed the samples from the first core. Leaving the trucks on the tank for two weeks poses greater safety concerns than the holding time issue. Based on this, the approach of compositing and taking the subsamples for mercury, anions, and cyanide from the composite was selected. Note that volatiles are subsampled before compositing in order to minimize loss of volatiles.

D3.0 STORAGE CONDITION ISSUE

In addition to meeting holding times, the storage conditions and preservation requirements of SW-846 (EPA 1997) must be considered. The storage conditions and preservation requirements are included in the methods to minimize biodegradation, effects of degradation caused by light and minimize loss by vaporization. Table D-2 shows the storage conditions required by the relevant SW-846 methods.

D3.1 Problems

Storage temperature during transport and work in hot cells is difficult to control. Storage of the segments in large OTCs may be either outside or in rooms in the laboratory. Refrigerators cannot be placed in the hot cells, because of heat overloading on the air handling systems for the hot cells. The samples, therefore, cannot be preserved or stored under cold conditions as typically required for volatiles, cyanide for solids and liquids, anions, and mercury on solids until the segment is extruded and waste is subsampled for analysis.

D3.2 Impact

The following discussion presents the storage conditions required by the methods and potential impacts on the Tan 241- Z-361 samples. Storage condition requirements were published by regulatory agencies in an effort to diminish degradation of the target analytes by chemical and biological processes. Storage conditions that may affect sample data quality include

- temperature,
- exposure to light,
- exposure to oxidants (e.g., air),
- use of preservatives, and
- sample container headspace and materials of construction.

The potential affect on analytical results from altering these SW-846 specified conditions to allow for handling radioactive waste and waste of high-salt concentrations is discussed below. The discussion is based primarily on current standard industry practices for these materials. Cool temperatures and preservatives are used to slow down biological processes of analyte degradation and some types of chemical change. This is especially important for trace levels of organics and inorganics in dilute aqueous solution. Biological processes are likely of little concern with Tank 241-Z-361 waste samples because of their expected high salinity, radioactive constituents and acidity. The planning basis for this work does not address biological processes.

In general, the regulatory requirement for sample storage is 4 °C for volatiles, cyanide for solids and liquids, anions, and mercury on solids, and room temperature (~21 to 27 °C) for metals other than mercury for solids. The transport cask for radioactive samples is exposed to ambient temperature which can range from approximately -23 to +66 C. These temperatures are estimates based on typical weather conditions plus increases due to solar heating of casks. The casks are used during transport and storage at the sample site.

The storage of volatiles at ambient and higher temperatures will reduce the volatiles. However, the volatiles in the head space of the tank were measured during venting and are being measured during core sampling in order to compensate for the chance of loss during storage.

Methods for many of the anions of interest also require storage at 4 °C followed by analysis as soon as possible. These anions include cyanide, chloride, nitrite/nitrate, sulfate, fluoride, ammonia, and phosphate. The waste in Tank 241-Z-361 has large quantities of sodium and other salts as discussed in Section 1.3. If the supernate samples, and/or the water leach performed on the solids, are cooled, the salts will precipitate and may not go back into solution. Therefore, for technical reasons, cooling is not recommended for liquid samples.

The sample casks will be maintained within the range of normal temperatures for the time of year when the samples are collected. The ambient temperature outdoors will be noted at the time of collection and daily temperature highs while casks are outside will be noted. The temperature of the hot cell during compositing/extrusion will be noted.

The physical loss of analytes occurs from the thermal expansion and contraction of the sample material caused by temperature fluctuations. These expansion and contraction cycles can result in loss of gas-phase constituents due to the volatilization of gas into the headspace of the sample containers. The extent of this problem depends on

- pressure tightness of the sample containers,
- amount of headspace in the containers,
- vapor pressure of the target analyte(s),
- range of temperature change,
- phase of the sample (liquid, slurry, solid),
- storage time before preparation,
- potential loss during extrusion or transfer of sample from grab sample, and
- ventilation rate in hot cell.

Volatile analytes are particularly vulnerable to loss in sample handling, extrusion, and compositing. Industry practice for collection of solid samples requires collection via a coring device similar to the push core to be used in sampling Tank 241-Z-361; the sample is scooped or poured into vials or wide mouth glass jars. Loss of volatiles is generally accepted using this approach.

Industry practice for soil coring acknowledges loss of volatiles due to removal of material but cannot in practice negate loss. In industry either soil samples are collected in cores or *in-situ* soil gas is monitored. *In-situ* analysis within the waste is not possible, therefore, coring of the waste must be done.

Removal of sample from cores is generally by one of two methods. In the first method, the core is capped and sealed with plastic and tape, shipped to the laboratory, and the laboratory removes the sample for volatiles from the end of the core. The laboratory typically does this with a small diameter, clean cork borer and places the soil in a wide mouth jar with minimal headspace or places the material directly in a volatile organic analyte vial for analysis. Under the second approach, the core is opened (e.g., split spoon) or extruded in the field and aliquots of soil placed in glass containers without headspace. The latter approach is more similar to the collection of cores in the tanks. As the cores are extruded the volatile sample must be selectively removed before compositing the remainder of the core for analysis. Because compositing requires stirring, the waste used for volatile analysis must be removed before mixing. When using the waste tank core sampler planned for this activity, the waste sample is contained within the sampler which is closed at the inlet (bottom) end by a ball valve, and at the top by the tightly fitted pintle rod/piston assembly, diminishing the loss of volatiles (see Figure 2-6).

To summarize, tank samples will be handled with similar care to that used in soil sampling. Losses in core sampling do occur. Care will be taken to ensure that losses in tank waste sample collection are no greater than that typically observed in soil core sampling. The subsamples collected from the segments will be stored under refrigeration if the samples are not purged within 24 hr after subsampling.

Analytes other than volatiles will be stored at ambient hot cell temperatures once the samples arrive from the field. Due to the radioactivity and the plutonium content, the samples must be stored in the hot cell until preparation occurs. Investigations of placing a refrigerator in the hot cell have indicated that the added heat load to the cell to from the refrigerator would not allow the cell to be maintained at reasonable temperatures.

D3.3 Preservation

Table D-2 identifies the RCRA preservation requirements for the relevant methods. RCRA does not require preservation for solids analysis, with the exception of the 5021 headspace volatile method. This method requires aliquoting either in the field or laboratory and adding internal standards during subsampling. The internal standards will be added during subsampling in the hot cell. The samples will not be extruded in the field because the activity levels warrant being handled in the hot cell.

RCRA preservation requirements are listed in Table D-2. The Tank 241-Z-361 supernate will be collected during extrusion and has high salt content. The RCRA methods assume low-salt aqueous solutions, however, the tank waste contains high concentrations of salt. One sample of the liquid was collected and measured at a pH of 4 many years before most of the liquid was removed from the tank. Given the high salt content and the chance for precipitation, it is not recommended that acid be added to the supernate for preservation of volatiles. Volatiles acidification is for the purpose of preventing biodegradation. Given the type of waste present, biological activity is highly unlikely; therefore, acidification is not recommended.

No preservations are recommended for supernate for metals. Waste with high salt will precipitate out the metals and the precipitate may not return to solution. Process knowledge has indicated that no cyanide has been added, but the analysis was requested to confirm whether the reactivity limits are exceeded. If the waste is pH 4 no cyanide will remain at low pH and no preservation is required. If the supernate is basic, the supernate will be preserved per the method.

D4.0 REFERENCES

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

EPA, 1993, *Technical Assistance Document for Complying with the TC Rule and Implementing the Toxicity Characteristic Leaching Procedure (TCLP)*, May 1993, Region II EPA, Volume II, Appendix VI, Memorandum #36.

EPA, 1997, *Test Methods for Evaluation of Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, as amended by Updates I (July, 1992), IIA (August, 1993), IIB (January, 1995), and III (1997), U.S. Environmental Protection Agency, Washington, D.C.

Federal Register, November 20, 1997, Volume 62, Number 224, "Joint NRC/EPA Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste."

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Table D-1. Initial Target Maximum Tank Waste Sample Holding Times.

Constituent	Current RCRA Holding Times (days)	
	Liquid waste	Solid
Volatile organics	14	14
Mercury	28	28
Metals(1)	180	180
Cyanide	7	NS
Anions	ASAP	ASAP

(1) Holding times will be met on Tank 241-Z-361 samples for metals by ICP.

Table D-2. Storage and Preservation Listed in SW-846 Versus the Actual Conditions Proposed.

Method (1)	SW-846 Methods			Proposed for Tank 241-Z-361		
	Container	Storage condition	Preservation	Container	Storage condition	Preservation
Volatiles, solid	Glass vial with septa	Cool 4 °C	Matrix modifier or organic free water	Glass vial with septa	Cool 4 °C	Matrix modifier will be added in the hot cell to the subsample per the method.
Volatiles, liquid, no residual chlorine present	Glass vial with septa	Cool 4 °C	Adjust pH <2 with sulfuric acid, or HCl, or solid NaHSO4	Glass vial with septa	Cool 4 °C	None
Cyanide (supernate)	Plastic/ glass	Cool 4 °C	Adjust pH>12 with NaOH, check for oxidizers and add ascorbic acid	Plastic	Ambient in hot cell	Measure pH supernate with pH paper. IF the pH ≥7 Adjust pH>12 with NaOH. If pH<7 no NaOH should be added.
Cyanide (solid)	Plastic/glass	Cool 4 °C	None	Plastic	Ambient in hot cell	None
Anions (supernate)	Plastic	Cool 4 °C	None	Plastic	Ambient in hot cell	None
Mercury and Metals (solid)	Plastic	Cool 4 °C (+/-2 degrees for solid)	None	Plastic	Ambient in hot cell	None
Mercury and Metals (liquid)	Plastic	None	HNO_3 to pH<2	Plastic	Ambient in hot cell	None

(1) Methods are those listed in the introduction of this appendix.

APPENDIX E

REPORT CONTENT

Summary Report Section.

Introduction. The report should contain a summary that either clearly states that no criteria were exceeded or identifies those parameters that exceeded the established criteria. The summary shall identify (1) the tank; (2) the core; (3) segment or samples and subsegments or subsamples included in the report; and (4) the Sampling and Analysis Plan (SAP) or other work-authorizing documentation used as the basis for the analyses.

Description of the Samples. Briefly describe the sample's physical characteristics (color, homogeneity, texture). Identify any unusual properties of the sample and any problems associated with subsampling or preparation. For core samples, the mass of recovered drainable liquid and the mass of recovered solids should be provided.

Discussion of Analytical Results. The following items should be discussed in this section.

- Description of the analytical methods used (e.g., cyanide quantitation by titration or spectrophotometry) and any changes to the SAP-referenced procedure that may have been necessary to analyze the samples. The procedure number and revision will also be referenced in this section.
- Brief description of digestion/dissolution, preparation/separation, or extraction and analytical methods used.
- Identification of any sample quality control (QC) or method problems (i.e., precision, accuracy, sensitivity) encountered during the analysis that may impact the results and their use for making safety, operations, or other decisions.
- Discussion of any observations that impact the overall quality of the analytical results (i.e., sample integrity).
- Describe any activities (reruns, replicate analyses, procedure modifications) that may have been used to verify the data.
- Description of any assumptions, corrections applied to the data, use of the method of standard additions, or calculations that may be important to interpretation of the data.
- Identification of any samples not analyzed or analyses required by the respective SAP or other work-authorizing document that were not performed, and on what sample each missing analysis was to be run.

References. Any references (e.g., the SAP, Letter of Instruction, or extrusion logbook used in the hot cells) should be listed in this section.

Data Summary.

The data summaries have many common areas for each type of analysis. These summaries may be presented in different formats depending on the type of analysis and the customer's need. The QC results, which should be reported, are those needed to evaluate the sample, results (duplicates, spikes, control standards, and preparation blanks). The following information is considered important to the data summaries for most chemical and radiochemical measurements:

- Sample identification, including the laboratory sample number, sample location (segment/core number, auger or grab sample number), and sample type (composite, subsegment, drainable liquid, field blank, preparation);
- Laboratory control standard, including percent recovery;
- Preparation blanks, including identity and concentration of each constituent identified;
- Sample and duplicate results, as well as results from replicate analyses;
- Results of spikes and tracers, including amount spiked, percent recovery, and relative percent different for each duplicate sample in the analytical batch;
- Surrogate analysis (gas chromatography/mass spectroscopy, gas chromatography, and high performance liquid chromatography analyses) including amount of spike and percent recovery for each surrogate;
- Internal standard results;
- Detection limits; and
- Counting errors.

The raw data from each characterization activity or each type of measurement will vary depending on the activity (hot cell, sample receipt) or the analytical instrumentation. The raw data will be used to confirm that the results of the sample and QC analyses were performed and calculated properly and that the analytical system was in control while the data were being generated.

At a minimum, the raw data associated with the results discussed in the Summary Report Section are to be included in this section. The record copy of the remaining supporting data for the Format IV data package is retained by the laboratory, although it may not be included in the data package at the discretion of the laboratory. Supporting data includes, but are not limited to, the following information:

- Results of standard additions,
- Results of serial dilutions,
- All raw data necessary to check calculation of analyte concentration (e.g. calibration data),
- Mass spectrum, including spectra of standards (one for each report for each compound detected) and spectra of analytes detected,
- Calculation sheets for sample and QC sample measurement that document the amount of sample/spike/standard used in the measurement and the instrument data output (if manual). These work sheets shall identify the instrument or analytical system used and any special operating parameters;
- Laboratory control standard concentrations and all raw data (including logbook pages) needed to check the calculation of the percent recovery,
- All raw data needed to check the calculation of the reported blanks,
- All raw data needed to check the relative percent differences and percent recoveries reported,
- Inductively coupled plasma/atomic emission spectroscopy and inductively coupled plasma/mass spectroscopy sensitivity factors and linear ranges (when applicable),
- Metal interference check-sample results,
- Initial and continuous calibration raw data,
- Instrument tuning data and instrument run logs,
- Column performance check with the standard, including the chromatogram,
- Chromatograms (for organic analyses)

  - Sample identification
  - Method identification
  - Retention time of analyte(s) identified

- Quantitative chromatogram report

  - Analyte retention time
  - Amount of sample injected
  - Results of response factors
  - Surrogate recovery results
  - concentration of analyte found
  - Data and time of injection

- Calibration data

  - Calibration curve or empirical equation for the curve
  - Correlation coefficient of the linear calibration
  - Concentration and/or response factor data for calibration check standards including dates of analysis
  - gas chromatography/mass spectroscopy daily tuning results.

Recommended Data Package Structure.

The preferred organization of the data will depend on the data user. Some users may want to see all the analyte data on a single sample (organized by sample), whereas another data user may want to see a single analyte (organized by analyte) for all the samples taken in the sampling activity. The following outline is recommended for the structure of the data package. If the SAP does not specify an alternative format, this outline should be used as the default data package format.

I. Table of contents
  - List of tables
  - List of sample analysis worklists

II. Narrative
  - Reference to work directives
  - Tank and sample identification

- Sample description
- Subsample identification
- Analytical procedures used for each analysis
- Range or average results per analysis, including any results which exceed the QC specifications or SAP notification limits

III. Sample breakdown figures or other attachments that are identified in the SAP

IV. Data Summary Tables

V. Sample Photographs

VI. Chain-of-Custody Forms

Raw data sorted by analysis, including extrusion and sample preparation worklists.

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