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HANFORD ENVIRONMENTAL ANALYTICAL METHODS
(METHODS AS OF MARCH 1990)

S. C. Goheen
M. McCulloch
J. L. Daniel

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Pacific Northwest Laboratory
Richland, Washington 99352

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PREFACE

The Hanford Environmental Analytical Methods (HEAM) is a compilation of analytical methods that were in use at Hanford through March of 1990. These methods were being used in environmental analytical laboratories at the Hanford Environmental Health Foundation (HEHF), Westinghouse Hanford Company (WHC), and Pacific Northwest Laboratory (PNL). Many of these methods are well established and have been published by organizations such as the U.S. Environmental Protection Agency (EPA) and the American Water Works Association (AWWA). Others have been developed internally and may or may not have undergone rigorous validation. Therefore, an analyst attempting to use any of the methods in this document should consider these differences when selecting a method to use in the laboratory.

This document is intended for informational purposes only and should be considered a compilation of environmental analytical chemistry methods available at Hanford in March of 1990. Methods developed and used subsequent to March 1990 are not included in this compilation.

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PURPOSE OF THIS DOCUMENT

The Hanford Tri-Party Agreement, signed by DOE-RL, USEPA-Region 10, and Washington State DOE, requires that analytical chemistry for materials characterization and site remediation activities be conducted by approved procedures. For that purpose, whenever possible the procedures of choice are those that are included in the EPA Laboratory Manual SW-846, "Test Methods for Evaluating Solid Waste." However, many of the analytical conditions that occur in the Hanford environment are not addressed in SW-846, so modifications, alternatives, and additions to the procedures listed there are required for laboratories conducting Hanford-related analyses. Sources of additional and alternative procedures include the Statements of Work (SOW) for the EPA Contract Laboratory Program (CLP), other EPA standard methods such as those for water pollution and drinking water laboratories, the American Water Works Association (AWWA), American Society for Testing and Materials (ASTM), and procedures (especially for radiochemistry) developed and tested in the Hanford laboratories.

This document provides information about all the pertinent analytical procedures known to be in use as of March 1990 for environmental sample analysis in the three laboratories listed: Pacific Northwest Laboratory's Chemical Measurements Laboratory (325 Building and other nearby laboratory facilities), Westinghouse Hanford Company's 222-S Laboratory, and the Hanford Environmental Health Foundation's Analytical Chemistry Laboratory. It reports the original source of the procedure (SW-846, CLP SOW, etc.), briefly describes any known departure from the reference procedure, and where possible assesses the impact of that change on each procedure. Except for the assessment of the changes, no technical evaluation of the methods is provided. The document is generic in content; that is, it includes all reported environmental analytical methods without regard for specific application on individual Hanford projects or specimens. Separate Project Procedure Manuals are expected to be prepared, for which this document can be a reference source.

Expected users of the document include the staff members of the laboratories, participating parties in the Tri-Party Agreement, and other potential clients of the Laboratories. The document is designed to be an open-ended living document. That is, it will be updated, extended and revised on a regular schedule to keep the information current and complete. Input from users, especially corrections and suggestions for improvement, are welcomed by the editors of the document.

SOURCES OF INFORMATION

The following sources of information have been utilized to date for the document:

- interviews and discussions with laboratory management and staff
- copies of written procedures provided directly by the respective laboratory personnel
- various lists of procedure titles, and the written procedures included in other manuals published by the laboratories
- the Waste Characterization Plan for the Hanford Site Single-Shell Tanks (WHC-EP-0210)
- EPA's published procedures in SW-846, the EPA Contract Laboratory Program (CLP) Statements of Work, and EPA's Water Quality publications
- other published information.

CONTENT AND ORGANIZATION

Table 1 (beginning on page 1.7) summarizes the methods included in the document, identifying them by method description, reference source, laboratory where used, frequency of application, and document page number for further information. A glossary of terms follows the summary table. The next three sections contain technical information about the methods used by each of the laboratories, and reference the extensive appendices, which provide copies of most of the methods that are not readily available in published literature. A Quality Assurance/Quality Control section follows the procedures information. The detailed indexes at the end of this document enable the reader to find information in the text for any laboratory relative to either individual analytes or specified methods.

Laboratory Sections

Sections 2.0, 3.0 and 4.0 present the methods information separately for each of the three laboratories. The order of presentation is: PNL-325 (procedures for organic, inorganic and radioisotope analytes in radioactive and nonradioactive materials); WHC-222-S (procedures for inorganic and radioisotope analytes in radioactive and nonradioactive materials); and HEHF (procedures

for organic and inorganic analytes in nonradioactive materials). Within each of the three laboratory sections, the information is organized in the following way:

X.0 LABORATORY NAME (with brief summary of lab capability, emphasis and limitations)

MAJOR ANALYTE CLASS (Organics, Inorganics, Radioisotopes)

Analyte Sub-class (Sample Preparation, Volatiles, Metals, etc)

Individual Analytes (where appropriate)

(Example Method Entry)

- 1 SW-846: 7061 - Arsenic (AA-Gaseous Hydride)
- 2 Lab No.: LA-355-131 Arsenic Analysis by Hydride Generation Atomic Absorption
- 3 Other: (Method number here)

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Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-355-131	X		X	X		X	X	X	X

- 5 Purpose: Atomic absorption method analyzing the gaseous hydride.
- 6 Analytes: As
- 7 Differences from SW-846: NaBH_4 solution is used to reduce As to its trivalent form in a MHS-20 Mercury/Hydride system. Sample prep on complex matrices is a cation exchange cleanup step that improves efficiency of method.
- 8 Reference: SW-846 11/86 Vol. 1A.
Appendix A2-I.100.

Method Description: (see example above)

- 1 Primary Reference Method number and title. This method number identifies this entry for index purposes.

- 2 Lab Number and Title. When a procedure has been written by laboratory personnel, either as a revision or an original method, it has been assigned a separate lab number. Followed procedures are so indicated in bold. If there are any known differences between the lab method and the method listed in 1, it will be indicated in item 7.
- 3 Other references (sources which are similar, or on which method is based)
- 4 Method matrix-applications table. Nonradioactive matrices are defined here as containing less than 400 picocuries/g of beta or gamma or 100 picocuries/g of alpha radiation, or less than that which is measurable on a portable counter. The method followed in the laboratory is listed here. The method number in the method table may be abbreviated for clarity.
- 5 Purpose of method
- 6 Analytes to which method is applicable
- 7 Differences from SW-846 or appropriate established method (brief descriptive summary). Justification for these deviations are also described here, when that information is available.
- 8 Reference to information in the appendices of this manual, SW-846, or other source.

Each method discussed is identified by the number assigned to that method by the laboratory itself. The number may be the same as that for the corresponding reference method (SW-846, ASTM, etc.), or a unique number assigned by the laboratory that developed the method. Each method module can contain several method numbers. Some of these are references; one is the actual procedure that is followed in the lab. To differentiate, the method followed in the laboratory is indicated in bold and listed in the matrix table.

Within each module, methods are listed using method numbers that the editors felt were most likely to be recognized by the reader. For this purpose, CLP and SW-846 method numbers were chosen as primary references, when available. Other reference method numbers that were used were from EPA, ASTM, and AWWA, respectively in decreasing order of preference. When less common references were known, they were listed after "Other."

QA/QC Plans and Procedures

Section 5.0 provides copies of representative documents for Quality Assurance and Quality Control guidance in participating laboratories. Additional detailed QC specifications appear in Procedures or in other laboratory documents not referenced here.

Indexes

Two complete indexes are provided to facilitate use of this document. Section 6.0 lists all analytes alphabetically, and directs the reader to specific method descriptions in Sections 2.0, 3.0 or 4.0. Section 7.0 is an index by method source (CLP, SW-846, In-house, etc.) and by individual method number.

Appendices

Copies of methods that are not easily accessible as published procedures are contained in the appendices of this document. EPA's SW-846 publications, ASTM methods, etc., are readily available elsewhere, and are not included in the Appendices.

Each appendix volume is designated by an "A" number, e.g., A3-0. Each contains all the available written procedures from one laboratory for either organic, inorganic, or radiochemical analyses. In this example, the "3" represents the facility from which the method was obtained: 3 = PNL/325, 2 = WHC/222-S, and 1 = HEHF. For each laboratory, there are potentially 3 different appendix volumes corresponding to organic (O), inorganic (I), and radiochemistry (R) procedures. These are indicated as the third character of the appendix reference. In each reference to the appendix, the volume is indicated first, then the procedure number. For example, A2-I.100 corresponds to inorganic procedure number 100 in the A2-I volume of the appendix. This would be in inorganic analytical procedure performed by personnel in WHC/222-S.

Each appendix volume has a table of contents. Appendix volume number and method reference number are shown in references to the appendices. Method reference numbers in the appendices refer to the section and pages in the appendix. They have been assigned only for the convenience of finding methods in the appendix and do not correspond to other method numbers.

LIMITATIONS

For a few of the methods, only titles and a brief summary of the method were available from the responsible laboratory. In those cases, the available limited data are given, with the additional notation of "information not available." Subsequent revisions of this document will include any further information provided from the respective laboratories.

This compendium of methods may not address all Hanford analytical requirements, since it emphasizes initially the EPA's SW-846 and CLP target list compounds and elements, which do not necessarily include all of the Hanford concerns. Similarly, for purposes of this document, no technical evaluation has been made of applicability of the procedures listed to specific Hanford wastes or other related materials; information shown is only that which was provided by the respective laboratory staff members. Additional procedures and applications information will be added to subsequent revisions as those needs are identified and addressed by the individual projects and laboratories.

PLANNED UPDATES AND REVISIONS

This document is expected to be maintained as a "living document," with additional and revised information entered in subsequent revisions as new or more complete data are obtained. In particular, more laboratory-specific information will be provided to allow independent readers to accurately compare the existing EPA procedures with those in use in the Hanford laboratories. Additional Hanford-related laboratories also may be included in subsequent revisions. Finally, it is important for the users of this document to notify the editors of suggested changes, improvements and corrections.

Table 1. Summary of the Methods Used at Hanford for Analysis of Environmental Samples.

This summary table is an overview of environmental analytical capabilities at Hanford. It provides 1) a summary of methods, 2) a side-by-side comparison of the capabilities of the three labs, 3) an indication of how frequently each method is used, 4) the page number in this manual on which each method is described, and 5) the origin of the method used by each laboratory (e.g., CLP, SW-846, etc.).

The table also indicates the organization of the Manual (the analyte categories and the order in which they are presented in Sections 2.0, 3.0, and 4.0). All methods in this Manual are referenced in this table. Refer to the pages indicated in parenthesis for information on these or related procedures.

The present estimated frequency of use of each method is indicated as follows:

R - routine (>30 samples per year)

O - occasional (1 to 30 samples per year)

U - method in place but not used in 1989.

Method Description	PNL/325	WHC/222-S	HEHF
ORGANICS			
Volatiles			
GC			R (4.4, 5) ^a
GC/MS	R (2.5) ¹		
Sample Prep	R (2.4) ¹		R (4.4) ^a
Screening	R (2.4) ¹ (2.5) ²		
Semivolatiles			
GC			R (4.9) ^a O (4.10) ^a
GC/MS	R (2.9) ¹		
Liquid-liquid extraction			O (4.8) ^a
Petroleum hydrocarbons			R (4.11) ^a
HPLC for PAHs			O (4.12) ^a
Sample storage and prep	R (2.8) ¹		
Screening	R (2.8) ¹		
Sulfur cleanup			O (4.8) ^a
PCBs and Pesticides			
Acid/base partition cleanup			O (4.16) ^a
GC	R (2.12) ^a		R (4.17) ^a O (4.18) ^a O (4.19) ^a O (4.20) ^a R (4.20) ^a O (4.21) ^a
GC/EC and GC/MS	R (2.12) ¹		
Liquid-liquid extraction			R (4.22) ^a
Microextraction			O (4.19) ^a
Screening	R (2.11) ¹		
Soxhlet extraction			R (4.22) ^a
Storage and Preparation	R (2.11) ¹		
Other Organic Methods			
GC/MS direct injection			R (4.24) ^a
Oil and Grease			R (4.23) ^a
Morpholine			O (4.24) ^a
Phenols			O (4.23) ^a
Total organic halides	R (2.13) ^a		

¹CLP method; ²SW-846 method; ^aOther EPA method; ⁴ASTM method; ⁵AWWA method; ⁶In-house method

Table 1. Continued

Method Description	PNL/325	WHC/222-S	HEHF
INORGANICS			
Sample Preparation	U (2.15) ^a R (2.14, 15) ^a R (2.16) ^a	R (3.1, 2) ^a R (3.2, 3) ^a R (3.16) ^a	R (4.25-28) ^a
Metals			
Colorimetric analysis of Cr VI		R (3.6) ^a	O (4.63) ^a
Cold vapor AA	R (2.20, 21) ^a	R (3.5) ^a	R (4.61) ^a
Flame AA (direct aspiration)			R (4.29-43, 4.45, 4.46, 4.47-49, 60) ^a
Flame Emission			R (4.44) ^a
Furnace AA	R (2.6-20) ^a R (2.22) ^a		R (4.50-60) ^a R (4.62) ^a
Gas hydride AA		R (3.4, 3.5) ^a	
ICP	R (2.21, 22) ^a	R (3.4) ^a	
Laser-excited fluorimetry	(2.23) ^a		
Phosphorus		R (3.15) ^a	O (4.64) ^a
Standard additions AA		R (3.10) ^a	
Anions			
Colorimetric CN ⁻	R (2.23) ^a	R (3.6) ^a	O (4.65) ^a
Coulometric CO ₃ ²⁻		R (3.7) ^a	
F ⁻	R (2.24)		R (4.66) ^a
IC method	R (2.24) ^a (2.25) ^a	R (3.7) ^a (3.15, 16) ^a	R (4.66) ^a
NO ₂ (spectrophotometric)		R (3.8) ^a	O (4.67) ^a
Other Inorganics and Miscellaneous			
Alkalinity			O (4.73) ^a
Biological oxygen demand			R (4.77) ^a
Carbon	R (2.26) ^a	R (3.9) ^a	
Chemical oxygen demand			R (4.73) ^a
Color			O (4.75) ^a
Conductivity			R (4.71) ^a
Corrosivity			O (4.74) ^a
Dissolved solids			R (4.72) ^a
EP toxicity	R (2.25) ^a		R (4.26) ^a
Flash point			R (4.67, 68) ^a
Hardness			R (4.71) ^a
Hydrazine			O (4.74) ^a
LAS			(4.76) ^a
NH ₃		R (3.14) ^a	R (4.75) ^a
NOx			O (4.70) ^a
Operation of the Link XR-300 for XRF		R (3.17) ^a	
Operation of the D/Max diffractometer		R (3.17) ^a	
Particulates			O (4.69) ^a
pH		R (3.8, 9) ^a	R (4.68, 69) ^a
SO ₂ content in air			O (4.70) ^a O (4.77) ^a

^aCLP method; ^bSW-846 method; ^cOther EPA method; ^dASTM method; ^eAWWA method; ^fIn-house method

Table 1. Continued

Method Description	PNL325	WHC222-S	HEHF
Softening point		R (3.11) ^a	
% Solids	R (2.26) ¹	R (3.12) ^a	
Specific gravity of high beta-gamma caustics		R (3.10) ^a	
Thorium		R (3.14) ^a	
Thermal analysis		R (3.11) ^a	
Turbidity			O (4.73) ²
% Water		R (3.12, 13) ^a	
RADIOCHEMISTRY METHODS			
Total Alpha			
Alpha proportional counters		R (3.19) ^a	
Alpha spectrometry	R (2.28) ^a		
Canberra Jupiter system		R (3.18) ^a	
Counting procedure	R (2.27) ^a		
H ₂ O samples		R (3.19) ^a	
Liquid scintillation	R (2.28) ^a		
Sample preparation	R (2.27) ^a	R (3.18, 19) ^a	
Total alpha	R (2.29) ^a		
Total Beta			
Counting system	R (2.30) ^a		
Evaporation method		R (3.20) ^a	
Liquid scintillation	R (2.31) ^a		
Sample preparation	R (2.30, 32) ^a		
Total beta	R (2.31) ^a		
Total Gamma			
Evaporation method		R (3.21) ^a	
Gamma spectrometry	R (2.33) ^a		
Low-level Ge(Li)		R (3.21) ^a	
QC and counting (RSD methods)	(2.33) ^a		
Solutions analysis	R (2.32) ^a		
Individual Radionuclides			
Alpha single isotopes	R (2.51) ^a		
Americium-241, -243	R (2.38) ^a	R (3.24) ^a	
Carbon-14	R (2.43-45) ^a	R (3.27) ^a	
Cesium-135 and -137	R (2.49) ^a		
Curium-242/244	R (2.37) ^a		
Iodine-129	R (2.45, 46) ^a	R (3.27, 28) ^a	
	U (2.46) ^a		
Neptunium-237	R (2.38) ^a	R (3.24) ^a	
Nickel-59 and -63	R (2.48) ^a		
Plutonium (total)	R (2.35) ^a	R (3.22, 23) ^a	
Plutonium-238		R (3.22) ^a	
Plutonium-239/240	R (2.34) ^a	R (3.22) ^a O (3.23) ^a	
Plutonium-240	R (2.34, 40) ^a		
Plutonium-241	R (2.40) ^a		

¹CLP method; ²SW-846 method; ³Other EPA method; ⁴ASTM method; ⁵AWWA method; ⁶In-house method

Table 1. Continued

Method Description	PNL/325	WHC/222-S	HEHF
Polonium-210	O (2.41) ^a		
Radium-224, -226, -228	R (2.41) ^a		
Selenium-79	R (2.48) ^a		
Strontium (total)	R (2.52) ^a		
Strontium-90	R (2.47) ^a	R (3.26-30) ^a	
Strontium-89		R (3.26-30) ^a	
Technetium-99	R (2.42, 43) ^a	R (3.26) ^a	
Thorium-228, -230, -232, -234	O (2.39) ^a		
Tin-126	R (2.49) ^a		
Tritium	R (2.50) ^a	R (3.31) ^a	
Uranium (total)	R (2.50) ^a	R (3.25) ^a	
Uranium isotopes (chemical separation)	R (2.38) ^a		
Uranium isotopes (mass spectrometry)	R (2.39) ^a		
Uranium-234	R (2.36-40) ^a		
Uranium-235	R (2.36, 39) ^a		
Uranium-236	R (2.40) ^a		
Uranium-238	R (2.36, 39) ^a		
Miscellaneous Radionuclide Methods			
Cesium stripping	R (2.53) ^a		
Liquid scintillation		R (3.31, 32) ^a	
Solution properties	R (2.52) ^a		

^aCLP method; ^bSW-846 method; ^cOther EPA method; ^dASTM method; ^eAWWA method; ^fIn-house method

GLOSSARY

AA	Atomic absorption
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BOD	Biological oxygen demand
CAS	Chemical Abstracts Service Registry
CLP	Environmental Protection Agency Contract Laboratory Program protocol.
CLP-SOW	Contract Laboratory Program Statement of Work.
COD	Chemical oxygen demand
DOE	Department of Energy
DSC	Differential Scanning Calorimeter
EC; ECD	Electron capture detection
EHS	Environmental Health Sciences
EPA	Environmental Protection Agency
EP TOX	Extraction Procedure Toxicity
ESM	Environmental Survey Manual (issued by U.S. DOE)
FE	Flame Emission
GC	Gas chromatography
GC/MS	Gas chromatography coupled to Mass Spectrometry
HDEHP	Di-2-ethylhexyl phosphoric acid
HEHF	Hanford Environmental Health Foundation. (In this manual, HEHF refers to

	their Environmental Health Sciences analytical chemistry laboratory.)
HPLC; LC	High-performance liquid chromatography.
IC	Ion chromatography
ICP; ICP/AES	Inductively coupled plasma atomic emission spectrometry
LAS	Linear alkyl sulfonate (a detergent)
MS	Mass spectrometry
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute for Standards and Technology
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PNL/325	Pacific Northwest Laboratory (PNL) Chemical Measurements Laboratory. (Includes laboratory in 325 building and satellite laboratories that perform environmental analytical chemistry.)
SW-846	Analytical methods developed by the Environmental Protection Agency for solid waste analysis.
TGS-ANSA	Triethanolamine, Guaiacol and Sodium metabisulfite-8-Anilino-1-naphthalenesulfonic Acid Ammonium Salt.
TIOA	Triisooctylamine
TTA	Thenoyltrifluoroacetone
WHC/222-S	Westinghouse Hanford Company Environmental Analytical Chemistry Laboratory.

2.0 PROCEDURES USED BY PNL CHEMICAL MEASUREMENTS LABORATORIES (PNL/325)

The Chemical Measurement Laboratories, a portion of the Pacific Northwest Laboratory, are located in and near the 325 building of the 300 Area on the Hanford Reservation. In this document, the abbreviation PNL/325 or 325 is used to refer to these analytical laboratories, comprising the only organization at Hanford that has full-service analytical capability with methods in place to analyze organics, inorganics and radionuclides. They are also equipped with hot cells and qualified personnel to use these cells for environmental samples.

ORGANIC METHODS

PNL/325 laboratory is using the organic methods defined in the Environmental Protection Agency (EPA) Contract Laboratory Program statement of work (CLP-SOW) issued in February, 1988. These methods are being used for both radioactive and nonradioactive matrices when appropriate. CLP methods are in many ways similar to SW-846, and are issued by the EPA to specify procedures that need to be followed to accomplish a specific task. Only selected CLP methods are being used currently by PNL/325.

It is the intention of PNL/325 staff to follow the EPA methods exactly. However, some deviations are necessary. The deviations are usually due to sample conditions such as radioactivity, contamination in the sampling process, sample size, the sampling process itself, etc. The most significant effects of the deviations are likely to be on sensitivity and some of the QA/QC features of the methods. Not all the deviations are described in this Manual. Until more experience is attained, PNL/325 will not be able to completely define these procedure modifications.

PNL/325 has the potential capability to perform most of the SW-846, 500 series, and 600 series EPA methods, although not all these methods are listed here or are in current use. To utilize any of these methods, a moderate implementation effort would be required.

Volatiles

The EPA publishes a list of volatile organics that are considered hazardous. These "target" volatile organics are indicated both by name and Chemical Abstracts Service Registry (CAS) number in the table below. All of the methods in this section pertain to this list of analytes.

Table 2.1
EPA Target Volatile Organics

<u>Name</u>	<u>CAS Number</u>
Chloromethane	74-87-3
Bromomethane	74-83-9
Vinyl Chloride	75-01-4
Chloroethane	75-00-3
Methylene Chloride	75-09-2
Acetone	67-64-1
Carbon Disulfide	75-15-0
1,1-Dichloroethene	75-35-4
1,1-Dichloroethane	75-34-3
Trans-1,2-Dichloroethene	156-60-5
Chloroform	67-66-3
1,2-Dichloroethane	107-06-2
2-Butanone	78-93-3
1,1,1-Trichloroethane	71-55-6
Carbon Tetrachloride	56-23-5
Vinyl Acetate	108-05-4
Bromodichloromethane	75-27-4
1,2-Dichloropropane	78-87-5
Trans-1,3-Dichloropropene	10061-02-6
Trichloroethene	79-01-6
Dibromochloromethane	124-48-1
1,1,2-Trichloroethane	79-00-5
Benzene	71-43-2
cis-1,3-Dichloropropene	10061-01-5
2-Chloroethylvinylether	110-75-8
Bromoform	75-25-2
4-Methyl-2-Pentanone	108-10-1
2-Hexanone	591-78-6
Tetrachloroethene	127-18-4
1,1,2,2-Tetrachloroethane	79-34-5
Toluene	108-88-3
Chlorobenzene	108-90-7
Ethylbenzene	100-41-4
Styrene	100-42-5
Total Xylenes	

CLP Method: Exhibit D SECTION II; SOW 2/88 D5/VOA Sample Storage and Preparation.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
D-5/VOA	X	X	X	X	X	X	X	X	X

Purpose: Sample handling and preparation.

Analytes: Volatile organics (see Table 2.1).

Differences from CLP: None.

Reference: Appendix A3-0.10.

CLP Method: Exhibit D SECTION III; SOW 2/88 D10/VOA Screening of Volatiles.

Lab No.: PNL-ALO-330 Screening of Hexadecane Extracts for Volatile Organic Compounds.

Other: SW-846-3820 Hexadecane Extraction and Screening of Purgeable Organics.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-330	X	X	X	X	X	X	X	X	X

Purpose: Screening. Optional hexadecane extraction and analysis of volatiles from samples from water and soil/sediments.

Analytes: Volatile organics (see Table 2.1).

Differences from CLP: None.

Reference: Appendix A3-0.20.

CLP Method: Exhibit D SECTION IV; SOW 2/88 D14/VOA GC/MS of Volatiles.
 Lab No.: PNL-ALO-335 GC/MS Analysis of Volatile Organic Compounds.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-335	X	X	X	X	X	X	X	X	X

Purpose: GC/MS analysis of volatiles.

Analytes: Volatile organics (see Table 2.1).

Differences from CLP: None.

Reference: Appendix A3-0.30.

SW-846 Method: 3810 Headspace.

Lab No.: PNL-ALO-331 Headspace Screen for Volatile Organic Compounds.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-331	X	X	X	X	X	X	X	X	X

Purpose: Screening test.

Analytes: Volatile organics (see Table 2.1).

Differences from SW-846: None.

Reference: SW-846 11/86 Vol. 1B.

Semivolatiles

The EPA publishes a list of semivolatile organics that are considered hazardous. These "target" semivolatile organics are indicated both by name and CAS number in the table below. All of the procedures in this section pertain to this list of analytes.

Table 2.2
EPA Target Semivolatile Organics

<u>Semivolatile Organic</u>	<u>CAS Number</u>
Phenol	108-95-2
bis(-2-Chloroethyl)Ether	111-44-4
2-Chlorophenol	111-44-4
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Benzyl Alcohol	100-51-6
1,2-Dichlorobenzene	95-50-1
2-Methylphenol	95-48-7
bis(2-Chloroisopropyl)Ether	39638-32-9
4-Methylphenol	106-44-5
N-Nitroso-Di-n-Propylamine	621-64-7
Hexachloroethane	67-72-1
Nitrobenzene	98-95-3
Isophorone	78-59-1
2-Nitrophenol	88-75-5
2,4-Dimethylphenol	105-67-9
Benzoic Acid	65-85-0
bis(-2-Chloroethoxy)Methane	111-91-1
2,4-Dichlorophenol	120-83-2
1,2,4-Trichlorobenzene	120-82-1
Naphthalene	91-20-3
4-Chloroaniline	57-74-9
Hexachlorobutadiene	87-68-3
4-Chloro-3-Methylphenol	106-47-8
2-Methylnaphthalene	91-57-6
Hexachlorocyclopentadiene	77-47-4
2,4,6-Trichlorophenol	88-06-2
2,4,5-Trichlorophenol	95-95-4
2-Chloronaphthalene	91-58-7
2-Nitroaniline	88-74-4
Dimethylphthalate	131-11-3
Acenaphthylene	208-96-8
3-Nitroaniline	99-09-2

Table 2.2 (contd)

<u>Semivolatile Organic</u>	<u>CAS Number</u>
Acenaphthene	83-32-9
2,4-Dinitrophenol	51-28-5
4-Nitrophenol	100-02-7
Dibenzofuran	132-64-9
2,4-Dinitrotoluene	121-14-2
2,6-Dinitrotoluene	606-20-2
Diethylphthalate	84-66-2
4-Chlorophenyl-phenylether	7005-72-3
Fluorene	86-73-7
4-Nitroaniline	100-01-6
4,6-Dinitro-2-Methylphenol	534-52-1
N-Nitrosodiphenylamine (cannot be separated from diphenylamine)	86-30-6
4-Bromophenyl-phenylether	101-55-3
Hexachlorobenzene	118-74-1
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Anthracene	120-12-7
Di-n-Butylphthalate	84-74-2
Fluoranthene	206-44-0
Pyrene	129-00-0
Butylbenzylphthalate	85-68-7
3,3'-Dichlorobenzidine	91-94-1
Benzo(a)Anthracene	56-55-3
bis(2-Ethylhexyl)Phthalate	117-81-7
Chrysene	
Di-n-Octylphthalate	
Benzo(b)Fluoranthene	205-99-2
Benzo(k)Fluoranthene	207-08-9
Benzo(a)Pyrene	218-01-9
Indeno(1,2,3-cd)Pyrene	193-39-5
Dibenz(a,h)Anthracene	53-70-3
Benzo(g,h,i)Perylene	191-24-2

CLP Method: Exhibit D SECTION II; SOW 2/88 D5/SV Sample Storage and Preparation.

Lab No.: **PNL-ALO-341** GPC Sample Extract Cleanup for GC/MS Analysis for Extractable Semivolatile Organic Compounds.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-341	X	X	X	X	X	X	X	X	X

Purpose: Specifics of storage, handling, and sample preparation.

Analytes: Semivolatile organics (see Table 2.2).

Differences from CLP: None.

Reference: Appendix A3-0.40.

CLP Method: Exhibit D SECTION III; SOW 2/88 D27/SV Screening of Semivolatiles.

Lab No.: **PNL-ALO-340** Screening of Semivolatile Organic Extracts.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-340	X	X	X	X	X	X	X	X	X

Purpose: Screening method for semivolatile organic extracts.

Analytes: Semivolatile organics (see Table 2.2).

Differences from CLP: None.

Reference: Appendix A3-0.50.

CLP Method: Exhibit D SECTION IV; SOW 2/88 D31/SV GC/MS of Semivolatiles.
Lab No.: PNL-ALO-345 GC/MS Analysis for Extractable Semivolatile
Organic Compounds.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-345	X	X	X	X	X	X	X	X	X

Purpose: GC/MS analysis of semivolatiles.

Analytes: Semivolatile organics (see Table 2.2).

Differences from CLP: None.

Reference: Appendix A3-0.60.

PCBs and Pesticides

A list of hazardous pesticides and PCB's from the EPA are indicated both by name and CAS number in the table below. The methods in this section refer to these analytes.

Table 2.3
EPA Target PCBs and Pesticides

<u>Name</u>	<u>CAS Number</u>
Alpha-BHC	319-84-6
Beta-BHC	319-85-7
Delta-BHC	319-86-8
Gamma-BHC(Lindane)	58-89-9
Heptachlor	76-44-8
Aldrin	309-00-2
Heptachlor Epoxide	1024-57-3
Endosulfan I	959-98-8
Dieldrin	60-57-1
4,4'-DDE	72-55-9
Endrin	72-20-8
Endosulfan II	33213-65-9
4,4'-DDD	72-54-8
Endosulfan Sulfate	1031-07-8
4,4'-DDT	50-29-3
Methoxychlor	72-43-5
Endrin Ketone	53494-70-5
Chlordane	57-74-9
Toxaphene	8001-35-2
Aroclor-1016	12674-11-2
Aroclor-1221	11104-28-2
Aroclor-1232	11141-16-5
Aroclor-1242	53469-21-9
Aroclor-1248	12672-29-6
Aroclor-1254	11097-69-1
Aroclor-1260	11096-82-5

CLP Method: Exhibit D SECTION II; SOW 2/88 D5/PEST Sample Storage and Preparation.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
D-5/PEST	X	X	X	X	X	X	X	X	X

Purpose: Sample storage and holding times, sample preparation for pesticides/PCBs in water, and protocols for soil/sediment.

Analytes: Pesticides and PCBs (see Table 2.3).

Differences from CLP: None.

Reference: Appendix A3-0.70.

CLP Method: Exhibit D SECTION III; SOW 2/88 D31/PEST Screening Method.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
D-31/PEST	X	X	X	X	X	X	X	X	X

Purpose: Screening of pesticide/PCB extracts.

Analytes: Pesticides and PCBs (see Table 2.3).

Differences from CLP: None.

Reference: A3-0.80.

CLP Method: **Exhibit D SECTION IV; SOW 2/88 D33/PEST** GC/EC and GC/MS Analysis.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
D-33/PEST	X	X	X	X	X	X	X	X	X

Purpose: GC/EC and GC/MS analysis of pesticides/PCBs.

Analytes: Pesticides and PCBs (see Table 2.3).

Differences from CLP: None.

Reference: Appendix A3-0.90.

SW-846 Method: **8080** Analysis for Organochlorine Pesticides and PCB's.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
8080	X	X	X	X	X	X	X	X	X

Purpose: Gas chromatographic analysis.

Analytes: Pesticides and PCBs (see Table 2.3).

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1B.

Other Organic Methods

SW-846 Method: 9020 Total Organic Halides.

Lab No.: PNL-ALO-321 Analysis for Total Organic Halides in Aqueous Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ALO-321	X		X	X		X			

Purpose: Analysis of total organic halides.Analytes: Organic halides.Differences from SW-846: None.Reference: SW-846 11/86 Vol 1C.

INORGANIC METHODS

PNL/325 follows several SW-846 methods for inorganic analysis without modification. In these cases, references are made directly to the appropriate version of SW-846.

Sample Preparation

CLP Method: Exhibit D Section III; SOW 7/88 Section III Part A and B
Sample Preparation.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
SOW 7/88	X	X	X	X	X	X	X	X	X

Purpose: Sample preparation for analysis by ICP, graphite furnace AA, and flame AA.

Analytes: Metals.

Differences from CLP: None.

Reference: Appendix A3-I.100.

CLP Method: Exhibit D Section IV; SOW 7/88 Section III Part D Cold Vapor
Methods for
Hg Analysis.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
SCW-7/88	X	X	X				X		

Purpose: Sample preparation for cold vapor analysis.

Anlytes: Hg.

Differences from CLP: None.

Reference: Appendix A3-I.110.

SW-846 Method: 3005 Acid Digestion of Waters for Total Recoverable or
Dissolved Metals for Analysis by Flame Absorption
Spectroscopy or Inductively Coupled Plasma
Spectroscopy.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3005	X	X	X	X	X	X	X	X	X

Purpose: Acid digestion method.

Analytes: Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zr.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol. 1A.

Lab No.: PNL-SP-12 (same as WVS-3) Potassium Hydroxide Fusion.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-12		X			X		X	X	

Purpose: Potassium hydroxide fusion method.

Analytes: Solid samples that do not require potassium or nickel analysis.

Reference: Appendix A3-I.20.

Lab. No.: HWVP-1 Sample Preparation for Chemical Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HWVP-1	X	X	X	X	X	X	X	X	X

Purpose: Sample preparation protocol.

Analytes: Inorganic ions.

Reference: Appendix A3-I.30.

Metals

SW-846 Method: **7060** Arsenic (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7060	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: As.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: **7041** Antimony (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7041	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: Sb.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7131 Cadmium (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7131	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: Cd.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7191 Chromium (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7191	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: Cr.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7421 Lead (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7421	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: Pb.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7740 Selenium (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7740	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: Se.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7841 Thallium (AA, Furnace Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7841	X	X	X	X	X	X	X	X	X

Purpose: Furnace atomic absorption method.

Analytes: Tl.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7470 Mercury in Liquid Waste (Manual Cold-Vapor Technique).
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7470	X		X						

Purpose: Cold-vapor atomic absorption method.

Analytes: Hg.

Differences from SW-846: Digestion is done in hot cells. Permanganate is used to digest the organic Hg.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method 7471 Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique).

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7471					X		X	X	X

Purpose: Cold-vapor atomic absorption method.

Analytes: Hg.

Differences from SW-846: Digestion is done in hot cells. Permanganate is used to digest the organic Hg.

Reference: SW-846 11/86 Vol 1A.

Lab No. PNL-SP-6-R0-3 ICP Analysis Using Jarrell-Ash in 3720 Building.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-6	X	X	X						

Purpose: Analysis of inorganic ions by ICP/AES.

Analytes: Inorganic ions.

Reference: Appendix A3-I.10.

Lab No.: PNL-SP-7 ICP Analysis (325 Building).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-7				X	X	X	X	X	X

Purpose: ICP analysis method for direct and sequential analysis.

A n a l y t e s b y D i r e c t I C P :
Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Si, Th, Ti, Tl, U, V, Zn.

Reference: Appendix A3-I.40.

Lab No.: PNL-SP-11-R0-1 Atomic Absorption Using the Perkin-Elmer
Model 5000 Spectrophotometer and Graphite Furnace.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-11	X	X	X						

Purpose: Graphite furnace atomic absorption method.

Analytes: Cs.

Reference: Appendix A3-I.50.

Lab No.: HTA-4-16 Rev.3 Solutions Analysis: Uranium by Laser-Excited Fluorescence.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-16	X	X	X	X	X	X	X	X	X

Purpose: Laser-excited fluorimetry method.

Analytes: U.

Reference: Appendix A3-I.60.

Anion Methods

SW-846 Method: 9010 Total and Amenable Cyanide (Colorimetric, Manual).
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
9010	X		X	X		X			X

Purpose: This is a CN⁻ preparation and analysis method.

Analytes: CN⁻

Differences from SW-846: More sulfamic acid is used because of high nitrates in samples. MgSO₄ is used in place of MgCl₂ to improve recovery.

Reference: SW-846 9/86 Vol 1A.

EPA Method: **300.0** Test Method: The Determination of Inorganic Anions in Water by Ion Chromatography.

Lab No.: None.

Other: ESM D-449 Determination of Inorganic Anions in Aqueous and Solid Samples by Ion Chromatography.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
300.0	X	X	X	X	X	X	X	X	X

Purpose: Anion method.

Analytes: NO_3^- , NO_2^- , SO_4^{2-} , PO_4^{3-} , Cl^- .

Differences from EPA 300.0: Undetermined.

Reference: EPA: Method of Chem. Anal. of Water and Wastes.
Doc. EPA 600/4-79-020, pages 300.0-1 through 5.
Appendix A3-I.85.

Lab No.: **HWVP-2** Fluoride Ion in Aqueous Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HWVP-2	X	X	X	X	X	X	X	X	X

Purpose: Ion-specific electrode method.

Analytes: F^- .

Reference: A3-I.90.

Lab No.: PNL-MA-597, 7-40.8, Rev. 0 Solutions Analysis: Anions by Ion Chromatography

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7-40.8	X	X	X	X	X	X	X	X	X

Purpose: General ion chromatography method for anions.

Analytes: F^- , Cl^- , NO_2^- , PO_4^{3-} , Br^- , SO_4^{2-} , NO_3^- .

Reference: Appendix A3-I.70.

Other Inorganic Methods

SW-846 Method: 1310 Extraction Procedure (EP) Toxicity Test Method and Structural Integrity Test.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
1310	X	X	X	X	X	X	X	X	X

Purpose: Extraction procedure (EP) toxicity test method and structural integrity test. This method may be used to simulate leaching from a waste disposal site.

Analytes: Leachable ions.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

CLP Method: Exhibit D Section III; SOW 7/88 Section IV Part F % Solids.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
SOW 7/88	X	X	X	X	X	X	X	X	X

Purpose: Determination of % solids.

Analytes: % solids.

Differences from CLP: None.

Reference: Appendix A3-I.120.

Lab No.: PNL-MA-597, 7-40.7, Rev. 0 Solutions Analysis: Carbon

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7-40.7	X								

Purpose: Inorganic carbon and total carbon in aqueous solutions.

Analytes: C.

Reference: Appendix A3-I.80.

RADIOCHEMISTRY METHODS

EPA has not published appropriate methods for radiochemistry analysis. Therefore, radioanalytical methods are listed here by analyte.

Total Alpha

Lab No.: **PNL-SP-31** Sample Preparation for Gross Alpha Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-31	X	X	X	X	X	X			

Purpose: Sample preparation prior to gross alpha analysis.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A3-R.10.

Lab No.: **PNL-SP-34** Alpha Counting Procedure.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-34	X	X	X	X	X	X			

Purpose: General alpha counting procedure.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A3-R.50.

Lab No.: HTA-4-4. Rev. 4 Solutions Analysis: Liquid Scintillation.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-4				X	X	X	X	X	X

Purpose: Measurement of alpha or beta activity by liquid scintillation.

Analytes: Alpha, beta emitting radionuclides.

Reference: Appendix A3-R.40.

Lab No.: HTA-4-5, Rev. 4 Solutions Analysis: Alpha Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-5				X		X	X	X	X

Purpose: General method for alpha spectrometry. Analysis is for samples prepared in procedures HTA-4-13, HTA-4-14, HTA-4-15, and HTA-4-22.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A3-R.70.

Lab. No.: HTA-4-6, Rev. 4 Solutions Analysis: Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-6				X	X	X	X	X	X

Purpose: Alpha activity in hydrothermal test solutions.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A3-R.60.

Lab No.: HTA-4-22, Rev. 3 Solutions Analysis: Preparation of Alpha Sources by Direct Evaporation.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-22				X	X	X	X	X	X

Purpose: Preparation of alpha sources by direct evaporation of solutions.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A3-R.30.

Total BetaLab No.: **PNL-SP-25** Beta Counting Procedure.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-25	X	X	X	X	X	X			X

Purpose: Gives both specific and general information regarding the operation of the beta counting system.

Analytes: Beta emitting radionuclides.

Reference: Appendix A3-R.120.

Lab No.: **PNL-SP-32** Sample Preparation for Gross Beta Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-32	X	X	X	X	X	X			X

Purpose: Sample preparation method for gross beta analysis.

Analytes: Beta emitting radionuclides.

Reference: Appendix A3-R.90.

Lab No.: HTA-4-4, Rev. 4 Solutions Analysis: Liquid Scintillation.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-4				X	X	X	X	X	X

Purpose: Provides instructions for measuring alpha or beta activity by liquid scintillation.

Analytes: Alpha, beta emitting radionuclides.

Reference: Appendix A3-R.40.

Lab No.: HTA-4-8, Rev. 4 Solutions Analysis: Beta Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-8				X	X	X	X	X	X

Purpose: Beta counting procedure.

Analytes: Beta emitting radionuclides.

Reference: Appendix A3-R.100.

Lab No.: HTA-4-23, Rev. 3 Solutions Analysis: Preparation of Beta Sources by Direct Evaporation.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-23				X	X	X	X	X	X

Purpose: Preparation of beta sources by direct evaporation of solutions.

Analytes: Beta emitting radionuclides.

Reference: Appendix A3-R.110.

Total Gamma

Lab No.: HTA-4-9, Rev. 4 Solutions Analysis: Gamma Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-9				X	X	X	X	X	X

Purpose: General gamma spectrometry method.

Analytes: Gamma emitting radionuclides.

Reference: Appendix A3-R.130.

Lab No.: RSD-51-DEQ 10 Rev. 0 Counting Procedure and Quality Control for Gamma Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ 10	X	X	X	X	X	X			X

Purpose: Quality control of gamma spectrometers.

Analytes: Gamma emitters.

Reference: Appendix A3-R.140.

Lab No.: RSD-51-DEQ 13 Rev. 0 Instrumental Counting of Cores by Gamma Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ 13	X	X	X	X	X	X			X

Purpose: Analysis by gamma spectrometers.

Analytes: ^{238}U , ^{235}U , ^{230}Th , ^{210}Pb , ^{232}Th , ^{40}K .

Reference: Appendix A3-R.20.

Lab No.: RSD-51-DEQ 14 Rev. 0 Instrumental Neutron Activation Analysis of
Briney Groundwaters and Core Samples by
Gamma Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ 14	X	X	X						

Purpose: Analysis by gamma spectrometers.

Analytes: Gamma emitters.

Reference: Appendix A3-R.80.

Individual Radionuclides

$^{238,239/240}\text{Pu}$

Lab No.: HTA-4-15, Rev. 5 Separation of Plutonium by Solvent Extraction
Prior to Measurement by Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-15				X	X	X	X	X	X

Purpose: Solvent extraction prior to measurement by alpha counting.

Analytes: Pu isotopes.

Reference: Appendix A3-R.160.

Lab No.: **PNL-040** Determination of Plutonium, Americium, and Curium in Solid and Liquid Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-040	X	X	X						

Purpose: Determination of plutonium, americium, and curium in liquid and solid samples.

Analytes: Pu, Am, Cm.

Reference: Appendix A3-R.170.

Lab No.: **PNL-MA-597, 2-30.6, Rev. 0** Isotopic Composition of Plutonium and Uranium by Mass Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
2-30.6				X	X	X	X	X	X

Purpose: Determination of plutonium and uranium isotopes by thermal ionization mass spectrometry.

Analytes: Pu and U isotopes.

Reference: Appendix A3-R.180.

^{241,243}Am

Lab No.: HTA-4-13, Rev. 6 Separation of Americium-241 and Curium-244 by Anion Exchange Prior to Measurement by Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-13				X	X	X	X	X	X

Purpose: Separation of americium and curium prior to alpha counting.

Analytes: ²⁴¹Am and ²⁴⁴Cm.

Reference: Appendix A3-R.190.

Lab No.: PNL-040 Determination of Plutonium, Americium and Curium in Solid and Liquid Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-040	X	X	X						

Purpose: Determination of plutonium, americium and curium in liquid samples.

Analytes: Pu, Am, Cm.

Reference: Appendix A3-R.170.

$^{242/244}\text{Cm}$

Lab No.: HTA-4-13, Rev. 6 Separation of Americium-241 and Curium-244 by Anion Exchange Prior to Measurement by Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-13				X	X	X	X	X	X

Purpose: Separation of americium from plutonium prior to alpha counting.

Analytes: ^{241}Am and ^{244}Cm .

Reference: Appendix A3-R.190.

Lab No.: PNL-040 Determination of Plutonium, Americium and Curium in Solid and Liquid Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-040	X	X	X						

Purpose: Determination of plutonium, americium and curium in liquid and solid samples.

Analytes: Pu, Am, Cm.

Reference: Appendix A3-R.170.

^{237}Np

Lab No.: HTA-4-14, Rev. 5 Separation of Neptunium by Cation Exchange and Solvent Extraction Prior to Measurement by Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-14				X	X	X	X	X	X

Purpose: Separation of neptunium by cation exchange and solvent extraction prior to measurement by alpha counting.

Analytes: ^{237}Np .

Reference: Appendix A3-R.200.

Uranium Isotopes

Lab No.: RSD-51-DEQ 2, Rev. 1 Chemical Separation and Analysis Procedure for Uranium (^{238}U , ^{235}U , ^{234}U).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ-2	X	X							

Purpose: Chemical separation and analysis procedure for uranium isotopes in groundwater and cores.

Analytes: U isotopes.

Reference: Appendix A3-R.210.

Lab No. PNL-MA-597, 2-30.6, Rev. 0 Isotopic Composition of Plutonium and Uranium by Mass Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
2-30.6				X	X	X	X	X	X

Purpose: Determination of plutonium and uranium isotopes by thermal ionization mass spectrometry.

Analytes: Pu and U isotopes

Reference: Appendix A3-R.180.

$^{229/230,232}\text{Th}$

Lab No.: RSD-51-DEQ 3, Rev. 1 Chemical Separation and Analysis Procedure for Thorium (^{234}Th , ^{232}Th , ^{230}Th , ^{228}Th).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ 3	X	X							

Purpose: Chemical separations and analysis procedure for groundwater and cores.

Analytes: Th isotopes.

Reference: Appendix A3-R.220.

$^{240,241}\text{Pu}$

Lab No. PNL-MA-597, 2-30.6, Rev. 0 Isotopic Composition of Plutonium and Uranium by Mass Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
2-30.6				X	X	X	X	X	X

Purpose: Determination of Pu and U isotopes by thermal ionization mass spectrometry.

Analytes: Pu and U isotopes.

Reference: Appendix A3-R.180.

 $^{234,236}\text{U}$

Lab No. PNL-MA-597, 2-30.6, Rev. 0 Isotopic Composition of Plutonium and Uranium by Mass Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
2-30.6				X	X	X	X	X	X

Purpose: Thermal ionization mass spectrometry.

Analytes: Pu and U isotopes.

Reference: Appendix A3-R.180.

$^{228,226}\text{Ra}$

Lab No.: RSD-51-DEQ 4, Rev. 1 Chemical Separation and Analysis Procedure for Radium (^{228}Ra , ^{226}Ra , ^{224}Ra).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ-4	X	X		X	X	X	X	X	X

Purpose: Chemical separations and analysis procedure for radium isotopes in groundwater and cores.

Analytes: Ra isotopes.

Reference: Appendix A3-R.230.

 ^{210}Po

Lab No.: RSD-51-DEQ-8, Rev. 1 Chemical Separation and Analysis Procedure for Polonium (^{210}Po).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
DEQ-8	X	X		X	X	X	X	X	X

Purpose: Chemical separations and alpha spectrometry procedure for groundwater and cores.

Analytes: ^{210}Po .

Reference: Appendix A3-R.250.

⁹⁹TcLab No.: PNL-MA-597, 7-40.39 Rev. 0 Determination of ⁹⁹Tc.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7-40.39	X		X						

Purpose: Ion exchange method prior to beta counting.Analytes: ⁹⁹Tc.Reference: Appendix A3-R.260.

Lab No.: PNL-SP-47 Determination of Technetium-99 by Resin Method for Solid and Liquid Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-47				X	X	X	X	X	X

Purpose: Resin method for ⁹⁹Tc.Analytes: ⁹⁹Tc.Reference: Appendix A3-R.270.

Lab No.: HTA-4-12, Rev. 4 Separation of Technetium by Cation Exchange and Solution Extraction Prior to Measurement by Beta Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-12				X	X	X	X	X	X

Purpose: Cation separation method for ^{99}Tc prior to measurement by beta counting.

Analytes: ^{99}Tc .

Reference: Appendix A3-R.290.

^{14}C

Lab No.: HTA-4-17, Rev. 4 Solutions Analysis: Carbon-14 by Distillation Separation Prior to Measurement by Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-17				X	X	X	X	X	X

Purpose: Distillation and liquid scintillation counting method for ^{14}C .

Analytes: ^{14}C .

Reference: Appendix A3-R.300.

Lab No.: HTA-4-4, Rev. 4 Solutions Analysis: Liquid Scintillation.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-4				X	X	X	X	X	X

Purpose: Liquid scintillation method for ^{14}C .

Analytes: ^{14}C .

Reference: Appendix A3-R.40.

Lab No.: PNL-SP-33 Liquid Scintillation Counting Procedure.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-33				X	X	X	X	X	X

Purpose: General liquid scintillation method.

Analytes: ^3H , ^{14}C , ^{32}P and other beta emitting radionuclides.

Reference: Appendix A3-R.310.

Lab No.: PNL-110 Radionuclide Separation and Analysis Procedure for Carbon-14.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-110	X	X	X	X	X	X			

Purpose: Separation and analysis.

Analytes: ^{14}C .

Reference: Appendix A3-R.320.

^{129}I

Lab No.: PNL-MA-597, 7-40.26, Rev. 2 Separation of Iodine-129 by Solvent Extraction and Distillation from Chloride Solutions Prior to Measurement by Gamma (X-Ray) Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7-40.26				X	X	X	X	X	X

Purpose: Separation of iodine from brine solutions and the subsequent counting using a Ge(Li) well gamma spectrometer.

Analytes: ^{129}I .

Reference: Appendix A3-R.330.

Lab No.: PNL-SP-49 Radionuclide Separation and Analysis Procedure for Iodine-129.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-49				X	X	X	X	X	X

Purpose: Separation and analysis procedure.

Analytes: ^{129}I .

Reference: Appendix A3-R.340.

Lab No.: PNL-MA-597, 7-40.17, Rev. 2 Separation of Iodine-129 by Cation Exchange and Distillation Prior to Measurement by Gamma (X-Ray) Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7-40.17				X	X	X	X	X	X

Purpose: Separation method prior to gamma counting.

Analytes: ^{129}I .

Reference: Appendix A3-R.350.

⁹⁰Sr

Lab No.: PNL-SP-39A Determination of Strontium-90 by 90y Decay Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-39A	X	X	X	X	X	X			

Purpose: Determination of ⁹⁰Sr by ⁹⁰Y decay.

Analytes: ⁹⁰Sr.

Reference: Appendix A3-R.360.

Lab No.: HTA-4-11, Rev. 5 Separation of Strontium-90 by Cation Exchange Prior to Measurement by Beta Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-11	X	X	X	X	X	X			

Purpose: Cation exchange separation prior to beta counting method.

Analytes: ⁹⁰Sr.

Reference: Appendix A3-R.370.

^{59,63}Ni

Lab No.: PNL-SP-38 Determination of ⁵⁹Ni and ⁶³Ni in Solid and Liquid Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-38				X	X	X	X	X	X

Purpose: Initial radionuclide separation and purification.

Analytes: ⁵⁹Ni and ⁶³Ni.

Reference: Appendix A3-R.380.

⁷⁹Se

Lab No.: PNL-MA-597, 7-40.15, Rev. 6 Selenium-79 by Ion Exchange and Distillation Separation Prior to Measurement by Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
7-40.15	X	X	X	X	X	X	X	X	X

Purpose: Ion exchange method prior to liquid scintillation counting.

Analytes: ⁷⁹Se.

Reference: Appendix A3-R.390.

^{126}Sn

Lab No.: HTA-4-21-1, Rev. 3 Separation of Tin-126 by Anion Exchange Prior to Measurement by Gamma Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-21-1				X	X	X	X	X	X

Purpose: Gamma counting method for ^{126}Sn .

Analytes: ^{126}Sn .

Reference: Appendix A3-R.400.

 $^{135,137}\text{Cs}$

Lab No.: HTA-4-40, Rev. 1 Separation of Cesium Prior to Measurement of Cs-135 by Mass Spectrometry and Gamma Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-40				X	X	X	X	X	X

Purpose: Separation of cesium from spent fuel solutions. ^{135}Cs is measured by mass spectrometry and gamma spectrometry.

Analytes: ^{135}Cs , ^{137}Cs .

Reference: Appendix A3-R.410.

^3H

Lab No.: **PNL-SP-30** Radionuclide Separation and Analysis Procedure for Tritium.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-30	X	X	X	X	X				

Purpose: Separation and analysis method for ^3H .

Analytes: ^3H .

Reference: Appendix A3-R.420.

Other Radiochemistry Methods

Total U

Lab. No.: **HTA-4-36, Rev. 2** Separation of Uranium from Brine Solutions by Ion Exchange.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-36				X	X	X	X	X	X

Purpose: Describes the separation of uranium from brine solutions.

Analytes: Total U.

Reference: Appendix A3-R.440.

Lab No.: HTA-4-16, Rev. 3 Solutions Analysis: Uranium by Laser-Excited Fluorescence.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-16				X	X	X	X	X	X

Purpose: Laser-excited fluorescence method.

Analytes: Total U.

Reference: Appendix A3-R.430.

Alpha Individual Isotopes

Lab No.: PNL-SP-24 Counting Procedure for Alpha Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-SP-24	X	X	X	X	X	X	X	X	X

Purpose: Alpha energy analysis counting method.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A3-R.450.

Total Radioactive Sr

Lab No.: **PNL-091** Total Strontium in Test Wells and Water Samples
(Oxalate-Nitric Acid Method).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
PNL-091				X					

Purpose: Total Sr by oxalate-nitric acid method.

Analytes: Total Sr.

Reference: Appendix A3-R.460.

Physical Properties

Lab No.: **WHC-053-1** Laboratory Procedure for Measurement of Physical and Rheological Properties of Solutions, Slurries and Sludges.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
WHC-053-1				X	X	X	X	X	X

Purpose: Measurement of physical properties of radioactive samples.

Analytes: Solutions, slurries, and sludges.

Reference: Appendix A3-R.480.

Cesium Stripping

Lab No.: HTA-4-10, Rev. 0 Solutions Analysis: Cesium Stripping for Gamma Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
HTA-4-10				X	X	X	X	X	X

Purpose: Method for stripping cesium from samples prior to gamma spectrometry.

Analytes: Gamma emitting radionuclides.

Reference: Appendix A3-R.490.

3.C PROCEDURES USED BY WHC/222-S LABORATORY

The WHC/222-S Laboratory is located on the Hanford Reservation in the 200 West area. Inorganic methods are based largely upon SW-846 procedures tailored to the needs of Westinghouse. Radiochemistry methods are also listed in both this document and Appendix A2-B. The 222-S Laboratory does not currently conduct organic analyses.

ORGANIC METHODS

There are currently no organic methods in place at WHC/222-S.

INORGANIC METHODS**Sample Preparation**

SW-846 Method: 3010 Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Flame Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy.

Lab No.: LA-505-158.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-505-158	X		X						

Purpose: Acid digestion.

Analytes: Metals.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 3050 Acid Digestion of Sediment, Sludges and Soils.
 Lab No.: LA-505-159 (draft method).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-505-159		X			X				

Purpose: Acid digestion procedure for flame AA, furnace AA, or ICP analysis.

Analytes: Ag, Al, As, Ba, Bi, B, Ca, Cd, Ce, Cr, Co, Cu, Eu, Fe, Hg, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, Pu, S, Se, Si, Sm, Sn, Sr, Ta, Th, Ti, U, W, Zn, Zr.

Differences from SW-846: Smaller sample sizes and a CLP modification of the method are used. Smaller samples are used for highly radioactive samples for worker safety.

Reference: SW-846 11/86 Vol 1A.
 Appendix A2-I.30.

Lab No.: LA-505-122 Sample Preparation and Analysis, High Activity AA-6
 Atomic Absorption Spectrophotometer.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-505-122	X		X	X		X	X	X	X

Purpose: Sample preparation and analysis method using the high-activity AA-6 atomic absorption spectrophotometer.

Analytes: Metals.

Reference: Appendix A2-I.380.

Lab No.: LA-549-141 Fusion with Alkali Metal Hydroxide.
Other: PNL-SP-12.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-549-141					X		X	X	

Purpose: Total Dissolution of solid samples.

Analytes: Nonvolatile (will not vaporize at 350-450°C) radionuclides.

Reference: Appendix A3-I.20.

Lab No.: LA-504-101 Tank Core Water Soluble Solids.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-504-101							X		

Purpose: Sample preparation for water leachables.

Analytes: IC anions, TOC, carbonate, and ICP metals.

Reference: None.

Metals

SW-846 Method: 6010 ICP Inductively Coupled Plasma Atomic Emission Spectrometry.

Lab No.: LA-505-151 Inductively Coupled Plasma (ICP) Emission Spectrometer Operations and Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-505-151	X	X	X	X	X	X	X	X	X

Purpose: General method for ICP analysis.

Analytes: Ag, Al, As, Ba, Bi, B, Ca, Cd, Ce, Cr, Co, Cu, Eu, Fe, Hg, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, Pu, S, Si, Sm, Sn, Sr, Ta, Th, Ti, U, W, Zn, Zr.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
A2-I.20.

SW-846 Method: 7061 Arsenic (AA-Gaseous Hydride) .
Lab No.: LA-355-131 Arsenic Analysis by Hydride Generation Atomic Absorption.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-355-131	X		X	X		X	X	X	X

Purpose: Atomic absorption method analyzing the gaseous hydride.

Analytes: As.

Differences from SW-846: NaBH_4 solution is used to reduce As to its trivalent form in a MHS-20 Mercury/Hydride system. Sample prep on complex matrices is a cation exchange cleanup step that improves the efficiency of the method.

Reference: SW-846 11/86 Vol 1A.
Appendix A2-I.100.

SW-846 Method: 7470 Mercury in Liquid Waste (Manual Cold-Vapor Technique).
 Lab No.: LA-325-102 Mercury Analysis by Hydride Generation Atomic Absorption.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-325-102	X		X	X		X	X	X	X

Purpose: Cold-vapor atomic absorption method.

Analytes: Hg.

Differences from SW-846: A gold amalgam attachment to the AA spectrometer is used as an absorbant for aqueous samples.

Reference: SW-846 11/86 Vol 1A.
 Appendix A2-I.60.

SW-846 Method: 7741 Selenium (AA, Gas Hydride) .
 Lab No.: LA-365-131 Selenium Analysis by Hydride Generation Atomic Absorption.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-365-131	X		X	X		X	X	X	X

Purpose: Atomic absorption method analyzing the gaseous hydride.

Analytes: Se.

Differences from SW-846: NaBH_4 solution is used to reduce Se to its trivalent form in a MHS-20 Mercury/Hydride System. Sample prep on complex matrices is a cation exchange cleanup step that improves the efficiency.

Reference: SW-846 11/86 Vol 1A.
 Appendix A2-I.110.

SW-846 Method: 7196 Chromium, Hexavalent (colorimetric).
 Lab No.: LA-265-101 Spectrophotometric Determination of Hexavalent Chromium.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-265-101	X		X	X		X	X	X	X

Purpose: Colorimetric method.

Analytes: Cr VI.

Differences from SW-846: This analysis is performed if total chromium concentration is greater than 5 mg/L. Sulfamic acid is added to decompose nitrites.

Reference: SW-846 11/86 Vol 1A.
 Appendix A2-I.70.

Anions

SW-846 Method: 9010 Total and Amenable Cyanide (Colorimetric Manual).
 Lab No.: LA-695-101 Spectrophotometric Determination of Cyanide.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-695-101	X		X	X(a)		X(a)	X(a)	X(a)	X(a)

Purpose: Colorimetric method.

Analytes: Total CN⁻.

Differences from SW-846: A modified distillation matrix is used.

Reference: SW-846 11/86 Vol 1A.
 Appendix A2-I.90.

(a) Sample size and equipment are scaled for samples with significant radioactivity.

EPA Method: 300.0 Test Method: The Determination of Inorganic Anions in Water by Ion Chromatography.
 Lab No.: LA-533-105 Anion Analysis on Dionex Model 4000i.
 Other: ESM D-449 Determination of Inorganic Anions in Aqueous and Solid Samples by Ion Chromatography.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-533-105	X		X	X		X	X	X	X

Purpose: Ion chromatographic analysis.

Analytes: NO_3^- , NO_2^- , SO_4^{2-} , PO_4^{3-} , Cl^- .

Differences from EPA 300.0: None.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 pages 300.0-1 through 5.
 Appendix A2-I.80.
 Appendix A3-I.85.

Lab. No.: LA-622-102 Determination of Carbonate in Solutions by Coulometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-622-102	X		X	X		X	X	X	X

Purpose: Coulometric determination of carbonate.

Analytes: CO_3^{2-} .

Reference: None.

Lab. No.: **LA-645-001** Spectrophotometric Determination of Nitrite

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-645-001	X		X	X		X	X	X	X

Purpose: Spectrophotometric method.

Analytes: NO_2^- .

Reference: Appendix A2-I.290.

Lab. No.: **LA-661-102** Determination of Hydroxide Ion in Solutions
Containing Hydrolyzable Anions by Potentiometric
Titration (Automatic).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-661-102	X		X	X		X	X	X	

Purpose: Hydroxide ion concentrations in solutions containing hydrolyzable anions by potentiometric titration.

Analytes: OH^- .

Reference: Appendix A2-I.320.

Other Inorganic Methods

Lab No.: LA-212-103 Determination of pH on Single-Shell Tank Core Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-212-013							X		

Purpose: pH of samples.

Analytes: pH.

Reference: A2-I.10.

Lab. No.: LA-344-105 Determination of Carbon in Solutions by Combustion and Coulometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-344-105	X		X	X		X	X	X	X

Purpose: Carbon concentration by combustion and coulometry.

Analytes: C.

Reference: Appendix A2-I.340.

Lab No.: **LA-505-124** Application of the Method of Standard Additions to Atomic Absorption.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-505-124	X		X	X		X	X	X	X

Purpose: Application of the method of standard additions to atomic absorption.

Analytes: Metals.

Reference: Appendix A2-I.400.

Lab. No.: **LA-510-112** Specific Gravity of High Beta-Gamma Caustic Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-510-112						X	X	X	X

Purpose: Determination of specific gravity of high beta-gamma caustic samples by weighing a known volume of nonviscous liquid.

Analytes: Specific gravity.

Reference: Appendix A2-I.210.

Lab. No.: LA-514-112 Differential Thermal Analysis of Caustic Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-514-112	X		X	X		X	X	X	X

Purpose: Qualitative data on endothermic and exothermic processes occurring within a sample using a differential scanning calorimeter.

Analytes: Thermal analysis.

Reference: Appendix A2-I.250.

Lab. No.: LA-514-121 Softening Point Determination by DSC.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-514-121							X	X	

Purpose: Softening point determination using a differential scanning calorimeter.

Analytes: Softening point.

Reference: Appendix A2-I.240.

Lab. No.: LA-519-132 Percent Solids by Centrifuge.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-519-132	X		X	X		X	X	X	X

Purpose: Determination of percent solids by centrifugation.

Analytes: Solids.

Reference: Appendix A2-I.260.

Lab. No.: LA-560-101 Percent Water, Bulk Density and Particle Density of Waste Tank Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-560-101						X	X	X	X

Purpose: Determination of water content, bulk density, and particle density.

Analytes: Water and solids.

Reference: Appendix A2-I.230.

Lab. No.: LA-560-111 Determination of Percent Water by Thermogravimetric Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-560-111	X	X	X	X	X	X	X	X	X

Purpose: Thermogravimetric method for determining percent "free" and "bound" water.

Analytes: Water.

Reference: Appendix A2-I.200.

Lab. No.: LA-564-101 Percent Water in Tank Farm Samples and Pilot Evaporatory Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-564-101	X		X	X		X	X	X	X

Purpose: Gravimetric method for determining percent water.

Analytes: Water.

Reference: Appendix A2-I.190.

Lab. No.: LA-634-102 Ammonia by Kjeldahl.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-634-102				X					

Purpose: Determination of ammonia by the Kjeldahl method.

Analytes: NH₃

Reference: Appendix A2-I.360.

Lab. No.: LA-905-101 Spectrophotometric Determination of Thorium with Arsenazo III.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-905-101				X					

Purpose: Total thorium concentrations by absorption of light by the thorium complex of arsenazo III.

Analytes: Total Th.

Reference: Appendix A2-I.280.

Lab No.: LA-355-101 Spectrophotometric Determination of Phosphorous in High-Salt Waste Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-355-101					X		X	X	X

Purpose: Measure phosphorous in high salt matrix.

Analytes: P, PO_4^{3-} .

Reference: Appendix A2-I.40.

EPA Method: 300.0 Test Method: The Determination of Inorganic Anions in Water by Ion Chromatography.
 Lab No.: LA-533-101 Anion Analysis on Dionex Model 10.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-533-101	X	X	X	X	X	X	X	X	X

Purpose: Ion chromatographic analysis.

Analytes: F^- , Cl^- , NO_2^- , NO_3^- , PO_4^{3-} , SO_4^{2-} .

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 pages 300.0-1 through 5.
 Appendix A2-I.50.

EPA Method: 300.0 Test Method: The Determination of Inorganic Anions in Water by Ion Chromatography.

Lab No.: LA-533-103 Anion Analysis on Dionex Model 2020i.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-533-103	X	X	X	X	X	X	X	X	X

Purpose: Ion chromatographic analysis.

Analytes: F^- , Cl^- , NO_2^- , NO_3^- , PO_4^{3-} , SO_4^{2-}

Differences from EPA: None.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 pages 300.0-1 through 5.
Appendix A2-I.120.

Lab No.: LA-507-121 Sample Preparation for X-Ray Fluorescence.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-507-121		X			X				

Purpose: Sample preparation of solids for X-Ray fluorescence analysis.

Analytes: Elements Na and higher atomic weight.

Reference: Appendix A2-I.130.

Lab No.: LA-507-141 Operation of the Link XR300 for Quantitative X-Ray Fluorescence Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-507-141	X	X	X	X	X	X	X	X	X

Purpose: Quantitative analysis of elements Na and higher atomic weight.

Analytes: Na and above.

Reference: Appendix A2-I.140.

Lab No.: LA-507-151 Operation of the D/Max Diffractometer.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-507-151		X			X				

Purpose: Qualitative analysis of minerals and other crystalline materials.

Analytes: N/A.

Reference: Appendix A2-I.150.

RADIOCHEMICAL METHODS

EPA has not published appropriate methods for radiochemistry analysis. Therefore, radioanalytical methods are listed here by analyte.

Total Alpha

Lab No.: **LA-508-051** Alpha Energy Analysis Using the Canberra Jupiter Systems.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-508-051				X	X	X	X	X	X

Purpose: Alpha analysis procedure.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A2-R.20.

Lab No.: **LA-508-101** Low Level Alpha and Beta in Water Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-508-101				X	X	X	X	X	X

Purpose: Gross alpha and gross beta measurement method.

Analytes: Alpha and beta emitting radionuclides.

Reference: Appendix A2-R.70.

Lab No.: LA-508-104 Total Alpha Counting by Alpha Proportional Counters.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-508-104				X		X	X	X	X

Purpose: Alpha proportional counting.

Analytes: Alpha emitting radionuclides.

Reference: A2-R.50

Lab No.: LA-548-101 Preparation of Aqueous Mounts for Total Alpha and/or Alpha Energy Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-548-101				X	X	X	X	X	X

Purpose: Total alpha using an Alpha Simpson Proportional Counter.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A2-R.30.

Lab No.: LA-548-102 Preparation of Organic Mounts for Total Alpha and/or Alpha Energy Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-548-102				X		X	X	X	X

Purpose: Procedure for measuring total alpha activity.

Analytes: Alpha emitting radionuclides.

Reference: Appendix A2-R.10.

Total Beta

Lab No.: LA-548-103 Gross Beta by Evaporation-Direct Mount.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-548-103				X	X	X	X	X	X

Purpose: Gross beta method.

Analytes: Beta emitting radionuclides.

Reference: Appendix A2-R.80.

Total Gamma

Lab No.: **LA-548-121** Preparation of Sample Mounts for Ge(Li) Gamma Energy Analysis - Low Level.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-548-121				X	X	X	X	X	X

Purpose: Preparation of sample mounts for low level Ge(Li) gamma analysis.

Analytes: Gamma emitting radionuclides.

Reference: Appendix A2-R.120.

Lab No.: **LA-548-122** Preparation of Samples for Gamma Energy Analysis - Dry Mount.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-548-122				X	X	X	X	X	X

Purpose: Preparation of samples for high level samples for gamma energy analysis.

Analytes: Gamma emitting radionuclides.

Reference: Appendix A2-R.90.

Individual Radionuclides

238,239/240Pu

Lab No.: LA-503-156 Determination of Pu and Am by Ion Exchange and Solvent Extraction.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-503-156							X	X	X

Purpose: Ion exchange and solvent extraction method.

Analytes: Pu and Am isotopes.

Reference: Appendix A2-R.140.

Lab No.: LA-943-101 Total Plutonium or Isotopic Plutonium by TTA Extraction and Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-943-101							X	X	X

Purpose: TTA extraction and alpha counting method.

Analytes: Total and isotopic Pu.

Reference: Appendix A2-R.170.

Lab No.: LA-943-123 Separation of Pu and Am by Ion Exchange.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-943-123				X	X	X			

Purpose: Ion exchange and alpha energy analysis method.

Analytes: $^{239/240}\text{Pu}$.

Reference: Appendix A2-R.40.

Lab No.: LA-943-105 Determination of Total Plutonium in High Concentrations of ^{95}Zr - ^{95}Nb by TTA Extraction and Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-943-105									X

Purpose: TTA extraction and alpha counting.

Analytes: Total Pu.

Reference: Appendix A2-R.160.

²⁴¹Am

Lab No.: LA-953-102 Americium-241 by HDEHP Extraction.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-953-102							X	X	X

Purpose: HDEHP extraction method.Analytes: ²⁴¹AmReference: Appendix A2-R.200.²³⁷Np

Lab No.: LA-933-141 Determination of Neptunium-237 by TIOA-TTA Extraction and Alpha Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-933-141							X	X	X

Purpose: TIOA-TTA extraction and alpha counting procedure.Analytes: ²³⁷Np.Reference: Appendix A2-R.210.

Total Uranium

Lab No.: LA-925-107 Uranium by Laser Induced Kinetic Phosphorescence Analyzer.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-925-107				X	X	X	X	X	X

Purpose: Laser fluorometry method.

Analytes: Total U.

Reference: Appendix A2-R.220.

Lab No.: LA-925-106 Determination of Uranium by Laser Fluorometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-925-106				X		X	X	X	X

Purpose: Laser fluorometry method.

Analytes: Total U.

Reference: Appendix A2-R.240.

⁹⁹Tc

Lab No.: LA-438-101 Determination of Technetium-99 by Solvent Extraction and Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-438-101							X	X	X

Purpose: Solvent extraction and liquid scintillation counting procedure.

Analytes: ⁹⁹Tc.

Reference: Appendix A2-R.260.

Lab No.: LA-438-111 Determination of TC-99 by Solvent Extraction and Liquid Scintillation Counting for Effluents.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-438-111				X		X			

Purpose: Solvent extraction and liquid scintillation counting procedure.

Analytes: ⁹⁹Tc.

Reference: Appendix A2-R.270.

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^{14}C

Lab No.: LA-348-101 Carbon-14 by Distillation and Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-348-101				X		X	X	X	X

Purpose: Distillation and liquid scintillation counting method.

Analytes: ^{14}C .

Reference: Appendix A2-R.280.

 ^{129}I

Lab No.: LA-378-103 Determination of Iodine-129 in Waste Tank Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-378-103							X	X	X

Purpose: Sodium hypochlorite oxidization/carbon tetrachloride extraction method.

Analytes: ^{129}I .

Reference: Appendix A2-R.290.

Lab No.: LA-378-101 Iodine-129 by Liquid-Liquid Extraction and Gamma Energy Analysis.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-378-101				X		X			

Purpose: Sodium hypochlorite oxidation/carbon tetrachloride extraction method.

Analytes: ^{129}I .

Reference: Appendix A2-R.300.

$^{89,90}\text{Sr}$

Lab No.: LA-220-105 Fast Analysis for Strontium-89,90 in Small Volume Sample.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-220-105						X			

Purpose: Fast analysis method for small volume samples.

Analytes: $^{89,90}\text{Sr}$.

Reference: Appendix A2-R.310.

Lab No.: LA-220-101 High Level Strontium-89,90 in Aqueous Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
LA-220-101							X	X	X

Purpose: High level Sr in aqueous samples.

Analytes: $^{89,90}\text{Sr}$.

Reference: Appendix A2-R.320.

Lab No.: LA-220-102 Fast Analysis for Strontium-89,90 in Aqueous Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
LA-220-102				X		X			

Purpose: Fast analysis of Sr in aqueous samples (screening).

Analytes: $^{89,90}\text{Sr}$.

Reference: Appendix A2-R.330.

Lab No.: LA-220-103 Strontium-89,90 and/or Strontium-89 and 90 from Leachates of Soil, Vegetation, Air Filters, and Other Solid Samples.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-220-103					X				

Purpose: Analysis of Sr in soils and solid sample.

Analytes: ^{89,90}Sr.

Reference: Appendix A2-R.332.

HEHF Lab No.: LA-220-104 Strontium-89,90 and/or Strontium-89 and 90 in Water by Carbonate Precipitation.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-220-104				X		X			

Purpose: Analysis of Sr in H₂O by carbonate precipitation.

Analytes: ^{89,90}Sr.

Reference: Appendix A2-R.335.

^3H

Lab No.: LA-218-111 Tritium Analysis by Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-218-111				X		X			

Purpose: Liquid scintillation method.Analytes: ^3H .Reference: Appendix A2-R.340.**Other Radiochemistry Methods**

Lab No.: LA-613-111 Determination of Promethium-147 in Effluent Water Samples by Solvent Extraction and Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-613-111				X		X			

Purpose: Solvent extraction and liquid scintillation counting method.Analytes: ^{147}Pm .Reference: Appendix A2-R.350.

Lab No.: LA-613-101 Determination of Promethium-147 in Waste Samples by
Solvent Extraction and Liquid Scintillation Counting.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
LA-613-101							X	X	X

Purpose: Solvent extraction and liquid scintillation counting method.

Analytes: ^{147}Pm .

Reference: Appendix A2-R.370.

4.0 PROCEDURES USED BY HEHF ANALYTICAL CHEMISTRY LABORATORY

The HEHF Laboratory, a Hanford Contractor, is located in Richland, off the Hanford Reservation, at 805 Goethals, Richland, Washington. They perform a significant number of environmental sample analyses for the Hanford contractors, as well as a large number of industrial hygiene sample analyses. HEHF is accredited by several regulatory agencies and organizations for their analytical work. Only environmental methods are addressed in this manual. Radioactive samples (containing more than 400 picocuries per gram of beta or gamma or 100 picocuries of alpha radiation, or enough to be measured on a portable counter) are not analyzed in the HEHF laboratory.

Most of HEHF environmental procedures are based on EPA SW-846 methods. HEHF has also adapted a number of their own methods from other sources, such as The American Water Works Association (AWWA), the American Society for Testing and Materials (ASTM) and the EPA (methodology other than described in SW-846). When other sources have been used, they are noted with method numbers at the top of each method section.

ORGANIC METHODS

The EPA SW-846 organic analytical methods are generally followed by HEHF. They use the third edition of the SW-846 manual (9-86) which was published in 1986. This facility analyzes non-radioactive (see above for definition) organic samples from the Hanford site, but is not equipped to analyze radioactive samples.

Several of the SW-846 methods are followed precisely. Other methods deviate to some extent from SW-846, with most differences outlined and discussed in each method description.

HEHF has the capability to perform many SW-846 methods that are not listed in this section. The methods listed here are conducted routinely.

Volatiles

The volatile organics indicated below by both name and CAS number can be analyzed by HEHF. The list is derived from EPA method 502.2.

Table 4.1
Volatile Organics

Name	CAS Number
Benzene	71-43-2
Bromobenzene	108-86-1
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform	75-25-2
Bromomethane	74-83-9
n-Butylbenzene	104-51-8
sec-Butylbenzene	135-98-8
tert-Butylbenzene	98-06-6
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
Chloromethane	74-87-3
2-Chlorotoluene	95-49-8
4-Chlorotoluene	106-43-4
Dibromochloromethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8
1,2-Dibromoethane	106-93-3
Dibromomethane	74-95-3
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Dichlorodifluoromethane	75-71-8
1,1-Dichloroethane	75-34-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethene	75-35-4
cis-1,2-Dichloroethene	156-59-4
trans-1,2-Dichloroethene	156-60-5
1,2-Dichloropropane	78-87-5
1,3-Dichloropropane	142-28-9
2,2-Dichloropropane	590-20-7
1,1-Dichloropropene	563-58-6
cis-1,3-Dichloropropene	10061-01-5
trans-1,3-Dichloropropene	10061-02-6
Ethylbenzene	100-41-4

Table 4.1. (contd)

<u>Name</u>	<u>CAS Number</u>
Hexachlorobutadiene	87-68-3
Isopropylbenzene	98-82-8
4-Isopropyltoluene	99-87-6
Methylene chloride	75-09-2
Naphthalene	91-20-3
Propylbenzene	103-65-1
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethene	127-18-4
Toluene	108-88-3
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,1,1-Trichloroethane	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
1,2,3-Trichloropropane	96-18-4
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
Vinyl chloride	75-01-4
o-Xylene	95-47-6
m-Xylene	108-38-3
p-Xylene	106-42-3

SW-846 Method: 5030 Purge and Trap.

Lab No.: EHS V-2 Volatile Organic Chemical Analysis by Purge and Trap GC.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS V-2	X	X	X						

Purpose: Purge and trap/sample preparation.

Analytes: Volatile organics (Table 4.1).

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1B.
Appendix A1-0.120.

SW-846 Method: 8000 Gas Chromatography.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
8000	X	X	X						

Purpose: Analysis of both volatile and semivolatile organics by gas chromatography (GC).

Analytes: All organics that can be analyzed by GC. For this section analytes include volatiles (Table 4.1).

Differences from SW-846: A megabore capillary column is used in place of a packed column. This gives higher resolution and more reliable data than the packed column.

Reference: SW-846 11/86 Vol 1B.

SW-846 Method: 8021 (Proposed by EPA; identical to EPA 502.2).
Lab No.: EHS V-2 Volatile Organic Chemical Analysis by Purge and Trap GC.
Other: EPA 502.2 Volatile Organic Compounds in Water by Purge and Trap
Capillary Column GC with Photoionization and Electrolytic
Conductivity Detectors in Series.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS V-2	X	X	X						

Purpose: Analysis of volatile organics.

Analytes: Volatile organics (see Table 4.1).

Differences from SW-846: An alternate 30 M x 0.53 mm DB-624 capillary column is used in place of VOCOL capillary column. This change results in no loss of performance, and the enhanced stability of the column increases the precision of the analytical technique. The use of alternate columns is allowed in Section 4.2 of method 8000, which covers all GC methods in SW-846. All QA/QC requirements of section 8.6 of this method are followed.

Reference: SW-846 11/86 Vol 1B.
Appendix A1-0.120.
Appendix A1-0.10.

Semivolatiles

The EPA publishes a list of hazardous semivolatile organics that can be analyzed by SW-846 Methods. These semivolatile organics are indicated both by name and CAS number in the table below. The methods in this section apply to the analytes in Table 4.2 unless otherwise indicated.

Table 4.2
EPA Target Semivolatile Organics

<u>Semivolatile Organic</u>	<u>CAS Number</u>
Phenol	108-95-2
bis(-2-Chloroethyl)Ether	111-44-4
2-Chlorophenol	95-57-8
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Benzyl Alcohol	100-51-6
1,2-Dichlorobenzene	95-50-1
2-Methylphenol	95-48-7
bis(2-Chloroisopropyl)Ether	39638-32-9
4-Methylphenol	106-44-5
N-Nitroso-Di-n-Propylamine	621-64-7
Hexachloroethane	67-72-1
Nitrobenzene	98-95-3
Isophorone	78-59-1
2-Nitrophenol	88-75-5
2,4-Dimethylphenol	105-67-9
Benzoic Acid	65-85-0
bis(-2-Chloroethoxy)Methane	111-91-1
2,4-Dichlorophenol	120-83-2
1,2,4-Trichlorobenzene	120-82-1
Naphthalene	91-20-3
4-Chloroaniline	57-74-9
Hexachlorobutadiene	87-68-3
4-Chloro-3-Methylphenol	106-47-8
2-Methylnaphthalene	91-57-6
Hexachlorocyclopentadiene	77-47-4
2,4,6-Trichlorophenol	88-06-2
2,4,5-Trichlorophenol	95-95-4
2-Chloronaphthalene	91-58-7
2-Nitroaniline	88-74-4
Dimethyl Phthalate	131-11-3
Acenaphthylene	208-96-8
3-Nitroaniline	99-09-2
Acenaphthene	83-32-9

Table 4.2. (contd)

<u>Semivolatile Organic</u>	<u>CAS Number</u>
2,4-Dinitrophenol	51-28-5
4-Nitrophenol	100-02-7
Dibenzofuran	132-64-9
2,4-Dinitrotoluene	121-14-2
2,6-Dinitrotoluene	606-20-2
Diethylphthalate	84-66-2
4-Chlorophenyl-phenylether	7005-72-3
Fluorene	86-73-7
4-Nitroaniline	100-01-6
4,6-Dinitro-2-Methylphenol	534-52-1
N-Nitrosodiphenylamine (cannot be separated from diphenylamine)	86-30-6
4-Bromophenyl-phenylether	101-55-3
Hexachlorobenzene	118-74-1
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Anthracene	120-12-7
Di-n-Butylphthalate	84-74-2
Fluoranthene	206-44-0
Pyrene	129-00-0
Butylbenzylphthalate	85-68-7
3,3'-Dichlorobenzidine	91-94-1
Benzo(a)Anthracene	56-55-3
bis(2-Ethylhexyl)Phthalate	117-81-7
Chrysene	218-01-9
Di-n-Octyl Phthalate	
Benzo(b)Fluoranthene	205-99-2
Benzo(k)Fluoranthene	207-08-9
Benzo(a)Pyrene	218-01-9
Indeno(1,2,3-cd)Pyrene	193-39-5
Dibenz(a,h)Anthracene	53-70-3
Benzo(g,h,i)Perylene	191-24-2

SW-846 Method: 3510 Separatory Funnel Liquid-Liquid Extraction.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3510	X		X						

Purpose: Separation of semivolatiles from nonvolatiles by a separatory funnel using a liquid-liquid extraction technique.

Analytes: Semivolatile organics (see Table 4.2).

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1B.

SW-846 Method: 3660 Sulfur Cleanup.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3660	X	X	X						

Purpose: Sulfur cleanup method.

Analytes: Semivolatile organics (see Table 4.2).

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1B.

SW-846 Method: 8000 Gas Chromatography.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
8000	X	X	X						

Purpose: Analysis of both volatile and semivolatile organics by gas chromatography (GC).

Analytes: Semivolatile organics (see Table 4.2). (Volatile organics can also be analyzed by this method, see page 4.4).

Differences from SW-846: HEHF uses a capillary megabore column in place of the packed column that is described in this method. This difference is likely to improve the accuracy and reliability of the method since capillary columns generally give better resolution than packed columns.

Reference: SW-846 11/86 Vol 1B. (This method is also listed under volatile organic methods.)

SW-846 Method: 8060 Phthalate Esters.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
8060	X	X	X						

Purpose: Gas chromatographic analysis.Analytes:

Name	CAS Number
Benzyl butyl phthalate	85-68-7
Bis(2-ethylhexyl)phthalate	117-81-7
Di-n-butyl phthalate	84-74-2
Diethyl phthalate	84-66-2
Dimethyl phthalate	131-11-3
Di-n-octyl phthalate	117-81-7

Differences from SW-846: QA/QC procedures (consisting of method blanks and matrix spikes) are less stringent than those specified in the SW-846 method. No surrogates are used. Methyl t-butyl ether (MTBE) is used in place of diethyl ether and a 30 m x 0.53 mm DB-608 capillary column is used, which enhances method performance by increasing chromatographic resolution and reproducibility.

Reference: SW-846 11/86 Vol 1B.

EPA Method: 418.1 Petroleum Hydrocarbon, Total Recoverable.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
418.1	X	X	X						

Purpose: Analysis of petroleum hydrocarbons.

Analytes: Petroleum hydrocarbons.

Differences from EPA: None.

Reference: Methods for Chemical Analysis of Water and Wastes.
Doc EPA 600/4-79-020 pages 418.1-1.

SW-846 Method: 8310 Polynuclear Aromatic Hydrocarbons.

Lab No.: None.

Other: NIOSH: 5506 5/15/85 Polynuclear Aromatic Hydrocarbons.

EPA: 610 Polynuclear Aromatic Hydrocarbons.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
5506	X	X	X						

Purpose: HPLC method.

Analytes:

Name	CAS Number
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	218-01-9
Benzo(b)fluoranthene	205-99-2
Benzo(ghi)perylene	191-24-2
Benzo(k)fluoranthene	207-08-9
Chrysene	218-01-9
Dibenzo(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

Differences from SW-846: A scanning UV detector is used for all analytes. This may raise the detection limits for some components.

Reference: SW-846 - 11/86 Vol 1B.
NIOSH: Appendix A1-0.70.
EPA: Appendix A1-0.60.

PCBs and Pesticides

The Pesticides and PCB's that can be analyzed by HEHF are indicated both by name and CAS number in the tables below. Each method in this section refers to one of these analyte tables unless otherwise indicated.

Table 4.3
EPA Target PCBs and Pesticides

<u>Name</u>	<u>CAS Number</u>
Alpha-BHC	319-84-6
Beta-BHC	319-85-7
Delta-BHC	319-86-8
Gamma-BHC(Lindane)	58-89-9
Heptachlor	76-44-8
Aldrin	309-00-2
Heptachlor Epoxide	1024-57-3
Endosulfan I	959-98-8
Dieldrin	60-57-1
4,4'-DDE	72-55-9
Endrin	72-20-8
Endosulfan II	33213-65-9
4,4'-DDD	72-54-8
Endosulfan Sulfate	1031-07-8
4,4'-DDT	50-29-3
Methoxychlor	72-43-5
Endrin Ketone	53494-70-5
Chlordane	57-74-9
Toxaphene	8001-35-2
Aroclor-1016	12674-11-2
Aroclor-1221	11104-28-2
Aroclor-1232	11141-16-5
Aroclor-1242	53469-21-9
Aroclor-1248	12672-29-6
Aroclor-1254	11097-69-1
Aroclor-1260	11096-82-5

Table 4.4
Organohalide Pesticides and Andors

<u>Name</u>	<u>CAS Number</u>
Alachlor	15972-60-8
Aldrin	309-00-2
Atrazine	1912-24-9
Chlordane	57-74-9
alpha-Chlorodane	5103-71-9
gamma-Chlorodane	5103-74-2
Dieldrin	60-57-1
Endrin	72-20-8
Heptachlor	76-44-8
Heptachlor Epoxide	1024-57-3
Hexachlorobenzene	118-74-1
Hexachlorocyclopentadiene	77-74-4
Lindane	58-89-9
Methoxychlor	72-43-5
cis-Nonachlor	
trans-Nonachlor	39765-80-5
Simazine	122-34-9
Toxaphene	8001-35-2
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5

Table 4.5
Chlorinated Pesticides

<u>Name</u>	<u>CAS Number</u>
Aldrin	309-00-2
Chlordane-alpha	5103-71-9
Chlordane-gamma	5103-74-2
Chlorneb	2675-77-6
Chlorobenzilate	501-15-6
Chlorothalonil	2921-88-2

Table 4.5 (contd)

<u>Name</u>	<u>CAS Number</u>
DCPA	1897-45-6
4,4-DDD	72-54-8
4,4-DDE	72-55-0
4,4-DDT	50-29-3
Dieldrin	60-57-1
Endosulfan I	959-98-8
Endosulfan II	33213-65-9
Endosulfan sulfate	1031-07-8
Endrin	72-20-8
Endrin aldehyde	7421-93-4
Etridiazole	2593-15-9
HCH-alpha	319-84-6
HCH-beta	319-85-7
HCH-delta	319-86-8
HCH-gamma	58-89-9
Heptachlor	76-44-8
Heptachlor epoxide	1024-57-3
Hexachlorobenzene	118-74-1
Methoxychlor	72-43-5
cis-Permethrin	52645-53-1
trans-Permethrin	52645-53-1
Propachlor	1918-16-7
Trifluralin	1582-09-8

Table 4.6
Chlorinated Acids

<u>Name</u>	<u>CAS Number</u>
Acifluorfan	50594-66-6
Bentazon	25057-89-0
Chloramben	133-90-4
2,4-DDT	94-75-7
Dalapon	75-99-0
2,4-DB	94-82-6
DCPA acid metabolites	
Dicamba	1918-00-9
3,5-Dichlorobenzoic acid	51-36-5

Table 4.6 (contd)

<u>Name</u>	<u>CAS Number</u>
Dichlorprop	120-36-5
Dinoseb	88-85-7
5-Hydroxydicamba	7600-50-2
4-Nitrophenol	100-02-7
PCP	87-86-5
Picloram	1918-02-1
2,4,5-T	93-76-5
2,4,5-TP	93-72-1

SW-846 Method: 3650 Acid-Base Partition Cleanup.
Lab No.: None.

<u>Method Number</u>	<u>Non-radioactive matrices</u>			<u>Radioactive matrices</u>					
	<u>Water, Surface & Ground</u>	<u>Soils</u>	<u>Liquid Effluents</u>	<u>Water, Surface & Ground</u>	<u>Soils & Grout</u>	<u>Liquid Effluents</u>	<u>Single Shell Tanks</u>	<u>Double Shell Tanks</u>	<u>Complex Conc.</u>
3650	X	X	X						

Purpose: Acid/base partition cleanup.

Analytes: Phenoxy herbicides and acidic organic compounds (see Table 4.3).

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1B.

SW-846 Method: 8080 Organochlorine Pesticides and PCBs.
 Lab No.: EHS P-8 Polychlorinated Biphenyls in Soil and Sediment.
 Other: 8080 method as modified by EPA Region 10.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS -8		X							

Purpose: Gas chromatographic analysis.

Analytes: Chlorinated pesticides and PCBs (Table 4.3).

Differences from SW-846: No surrogates are used and QA/QC is somewhat limited. Methyl t-butylether (MTBE) is used in place of diethyl ether and a 30 m x 0.25 mm, DB-5 column is used. This column enhances resolution and reproducibility.

Reference: SW-846 - 11/86 Vol 1B.
 Appendix A1-0.130.

SW-846 Method: 8150 Chlorinated Herbicides.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
8150		X							

Purpose: Gas chromatographic analysis.

Analytes:

<u>Name</u>	<u>CAS Number</u>
2,4-D	
2,4-DB	94-82-6
2,4,5-T	93-76-5
2,4,5-TP (Silvex)	93-72-1
Dalapon	
Dicamba	1918-00-9
Dichloroprop	120-36-5
Dinoseb	88-85-7
MCPA	
MCPP	

Differences from SW-846: No surrogates are used and QA/QC is limited to matrix spikes and blank samples. A DB-608, 30 m x 0.53 mm capillary column with a 0.83 μ m coating is used. Methyl t-butyl ether is used in place of diethyl ether for personnel safety and solvent purity (peroxides). This substitution should not influence results and is recommended in similar EPA methods. The use of alternative columns is allowed in Section 4.2 of method 8000. The capillary column enhances resolution and reproducibility. Additional QA/QC would be employed if the frequency of requests for this analysis increased.

Reference: SW-846 - 11/86 Vol 1B.

EPA Method: 505 Analysis of Organohalide Pesticides and Aroclors in Water by Microextraction and Gas Chromatography.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
505	X								

Purpose: Microextraction method.

Analytes: Organohalide pesticides and aroclors (see Table 4.4).

Differences from EPA: A 30 M x 0.53 mm DB-608 fused silica with a 0.83 μ m film thickness is being used as an alternative column. The QA/QC procedures are limited.

Reference: Appendix A1-0.20.

EPA Method: 508 Determination of Chlorinated Pesticides in Water by Gas Chromatography with an Electron Capture Detector.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
508	X								

Purpose: Gas chromatographic analysis.

Analytes: Chlorinated pesticides (see Table 4.5).

Differences from EPA: A 30 M x 0.53 mm DB-608 FSCC with a 0.83 μ m film thickness is being used as an alternative column. The QA/QC procedures are limited.

Reference: Appendix A1-0.90.

EPA Method 515.1 Determination of Chlorinated Acids in Water by Gas Chromatography with an Electron Capture Detector.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
515.1	X								

Purpose: Gas chromatographic analysis.

Analytes: Chlorinated acids (see Table 4.6).

Differences from EPA: A 30 M x 0.53 mm DB-608 FSCC with a 0.83 μ m film thickness is being used as an alternative column. The QA/QC procedures are limited.

Reference: Appendix A1-0.30.

EPA Method: 600/4-81-045 The Determination of Polychlorinated Biphenyls in Transformer Fluid and Waste Oils.

Lab No.: EHS P-9 Polychlorinated Biphenyls in Oil and Waste Liquids.

Other: ASTM: D4059-83 Analysis of Polychlorinated Biphenyls in Mineral Insulating Oil by Gas Chromatography.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS P-9			X (oils)						

Purpose: Analysis of PCB's in oil and waste liquids using a gas chromatographic analysis with an electron capture detector.

Analytes: PCBs (see Table 4.3).

Differences from EPA: None.

Reference: EPA: Appendix A1-0.40.
Appendix A1-0.140.
ASTM: 1983 vol 10.03 pages 546-554.

AWWA Method: **6630C** Organochlorine Pesticides and PCBs.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
6630C	X								

Purpose: Analysis of organochlorine pesticides & PCBs in water.

Analytes: Organochlorine pesticide and PCBs (see Table 4.3).

Differences from EPA: A 30 m x 0.53 mm DB-608 FSCC with a 0.83 μ m film thickness is used as an alternative column.

Reference: Standard Methods for the Examination of Water and Wastewater 1989 17th Edition, pages 6-158 through 169.

ASTM Method: **D3478-85** Test Method for Chlorinated Phenoxy Acid Herbicides in Water.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
D3478-85	X								

Purpose: Gas chromatographic analysis.

Analytes: Chlorinated phenoxy acid herbicides (see Table 4.3).

Differences from ASTM: Methyl t-butyl ether is used in place of diethyl ether. A 30 m x 0.53 mm DB-608 FSCC with a 0.83 μ m film thickness is used as an alternative column.

Reference: ASTM 1988 Vol 11.02 pg 153-157.

SW-846 Method: 3510 Separatory Funnel Liquid-Liquid Extraction.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3510	X		X						

Purpose: Separatory funnel liquid-liquid extraction.

Analytes: Semivolatile organics, PCBs, and pesticides (Tables 4.2 and 4.3).

Differences from SW-846: When this method is used for extracting herbicides, methyl-t-butyl ether (MTBE) rather than ethyl ether is used. MTBE has a greater resistance to peroxide formation and thus increases the safety of the method. This method not routinely used at HEHF but it could be performed if requested.

Reference: SW-846 - 11/86 Vol 1B.

SW-846 Method: 3540 Soxhlet Extraction.
Lab No.: EHS P-8 Polychlorinated Biphenyls in Soil and Sediment.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS-P-8		X							

Purpose: Soxhlet extraction.

Analytes: PCBs in solids (Table 4.3).

Differences from SW-846: Hexane, acetone and H₂SO₄ are used for cleanup when this method is used for PCB extraction. The SW-846 method 3540 is described in the sample preparation section of method P-8.

Reference: SW-846 - 11/86 Vol 1B.
Appendix A1-0.130.

Other Organic Methods

EPA Method: 420.1 Phenolic (Total Recoverable).

Lab No.: EHS P-2 Phenols in Water - Chloroform Extraction.

Other: AWWA: 510 A = Cleanup Procedure.

B = HCl_3 Extraction Procedure.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS P-2	X								

Purpose: Analysis of phenols in H_2O .Analytes: Phenols.Differences from EPA: Unknown.Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 420.1-1-3.

Appendix A1-0.110.

AWWA: Standard Methods for the Examination of Water and
Wastewater. 1985. 16th edition pages 557-560.

AWWA Method: 503B Partition-Infrared Method (Oil and Grease).

Lab No.: EHS O-4 Oil and Grease in Water - Infrared.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS O-4	X								

Purpose: IR method for analyzing oil and grease.Analytes: Oil and grease.Differences from AWWA: Unknown.Reference: AWWA: Standard methods for the examination of water and
wastewater. 1985. 16th edition pages 498-499.
Appendix A1-0.80.

Lab No.: EHS G-1 Organic Waste Characterization Using Direct GC/MS Injection.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS G-1	X		X						

Purpose: GC/MS direct injection waste characterization.

Analytes: Volatile and semivolatile organics (Tables 4.1 and 4.2).

Reference: AI-0.100.

ASTM Method: D1942-80 Test Method for Morpholine in Water.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
ASTM D19242-80	X	X	X	X	X	X	X	X	X

Purpose: Morpholine content in water.

Analytes: Morpholine.

Differences from ASTM: None.

Reference: ASTM. 1988. Vol 11.02 pages 165-167.

INORGANIC METHODS

HEHF relies exclusively on AA and flame emission methods for metals analyses. HEHF uses SW-846 method 3050 as their standard sample pretreatment method.

Sample Preparation

SW-846 Method: 3010 Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Flame Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy.

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3010	X								

Purpose: Acid digestion of aqueous samples.

Analytes: Metals.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

SW-846 Method: 1310 Extraction Procedure (EP) Toxicity Test Method.
 Lab No.: EHS E-1 Extraction Procedure Toxicity Test-Metals.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS E4		X							

Purpose: Extraction procedure toxicity.

Analytes: Metals.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1C.
 Appendix A1-I.60.

SW-846 Method: 3005 Acid Digestion of Water for Total Recoverable or
 Dissolved Metals by Flame Atomic Absorption
 Spectroscopy or Inductively Coupled Plasma
 Spectroscopy.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3005	X		X						

Purpose: Sample preparation by acid digesting.

Analytes: Metals.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1C.

SW-846 Method: 3040 Dissolution Procedures for Oils, Greases or Waxes.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
3040			X (oils)						

Purpose: Sample dissolution for oils, greases or waxes.

Analytes: Metals.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

SW-846 Method: 3050 Acid Digestion of Sediments, Sludges and Soils.
 Lab No.: EHS M-3 Mercury in Soil.
 EHS M-12 Metals in Waste Organic Matrices by AA Spectroscopy

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
EHS M-3, M-11, M-12		X	X						

Purpose: Acid digestion procedure for flame AA or furnace AA.

Analytes: Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, K, Na, Pb, Se, Tl, V, Zn.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.80.
 Appendix A1-I.90.

Metals

SW-846 Method: 7020 Aluminum (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 202.1 Aluminum AA Direct Aspiration.

AWWA: 303C Determination of Cations by Direct Aspiration into a Nitrous Oxide Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X	X	X	X	X	X	X	X

Purpose: Atomic absorption using direct aspiration.Analytes: Al.Differences from SW-846: None.Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

EPA: Methods of Chemical Analysis of Water and Wastes.

Doc EPA 600/4-79-020 202.1-1-2.

AWWA: Standard Methods for the Examination of Water and Wastewater 1985. 16th edition pages 162-164.

SW-846 Method: 7040 Antimony (AA, Direct Aspiration).
Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Sb.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
Appendix A1-I.100.

SW-846 Method: 7080 Barium (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 208.1 Barium (AA, Direct Aspiration).
 AWWA: 303C Determination of Cations by Direct Aspiration into a
 Nitrous Oxide-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Ba.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.100.

EPA: Methods of Chemical Analysis of Water and Wastes.
 Doc EPA 600/4-79-020 108.1-1-2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th edition pages 162-164.

SW-846 Method: 7090 Beryllium (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA 210.1 Beryllium (AA, Direct Aspiration).

AWWA: 303C Determination of Cations by Direct Aspiration into a Nitrous Oxide-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Be.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 210.1-1-2.

AWWA: Standard Method for the Examination of Water and Wastes. 1985. 16th edition pages 162-164.

SW-846 Method: 7130 Cadmium (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

EHS M-12 Metals in Waste Organic Matrices by AA Spectroscopy.

Other: EPA: 213.1 Cadmium (AA, Direct Aspiration).

AWWA: 303A Determination of Cations by Direct Aspiration in Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11, M-12	X	X	X						

Purpose: Atomic absorption using direct aspiration.

Analytes: Cd.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

Appendix A1-I.90.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 213.1-1-2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 157-160.

SW-846 METHOD: 7140 Calcium (AA, Direct Aspiration).
Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Ca.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
Appendix A1-I.100.

SW-846 Method: 7190 Chromium (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

EHS M-12 Metals in Waste Organic Matrices by AA Spectroscopy.

Other: EPA: 218.1 Chromium (AA, Direct Aspiration).

AWWA: 303A Determination of Cations by Direct Aspiration in Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11, M-12	X	X	X						

Purpose: Atomic absorption using direct aspiration.

Analytes: Cr.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

Appendix A1-I.90.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 218.1-1+2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7200 Cobalt (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 219.1 Cobalt (AA, Direct Aspiration).

AWWA: 303A Determination of Cations by Direct Aspiration in Air-Actylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Co.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 219.1-1+2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7210 Copper (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 220.1 Copper (SS, Direct Aspiration).
 AWWA: 303A Determination of Cations by Direct Aspiration in
 Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Cu.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc. EPA 600/4-79-020 220.1-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7380 Iron (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 236.1 Iron (AA, Direct Aspiration).
 AWWA: 303A Determination of Cations by Direct Aspiration in
 Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Fe.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 236.1-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7420 Lead (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

EHS M-12 Metals in Waste Organic Matrices by AA Spectroscopy.

Other: EPA: 239.1 Lead (AA, Direct Aspiration).

AWWA: 303A Determination of Cations by Direct Aspiration in Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11, M-12	X	X	X						

Purpose: Atomic absorption using direct aspiration.

Analytes: Pb.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

Appendix A1-I.90.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 239.1-1+2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7450 Magnesium (AA, Direct Aspiration).
Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Mg.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
Appendix A1-I.100.

SW-846 Method: 7460 Manganese (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 243.1 Manganese (AA, Direct Aspiration).

AWWA: 303A Determination of Cations by Direct Aspiration in Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Mn.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 243.1-1+2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7480 Molybdenum (AA, Direct Aspiration).

Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 246.1 Molybdenum (AA, Direct Aspiration).

AWWA: 303A Determination of Cations by Direct Aspiration in Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Mo.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.

Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 246.1-1+2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 162-164.

SW-846 Method: 7520 Nickel (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 249.1 Nickel (AA, Direct Aspiration).
 AWWA: 303A Determination of Cations by Direct Aspiration in
 Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Ni.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 249.1-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 157-160.

SW846 Method: 7610 Potassium (AA, Direct Aspiration)
AWWA Method: 3500-KD Potassium (FE, Direct Aspiration).
Lab No.: EHS M-9 Metals in H₂O - Flame Emission

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-9, M-11	X	X							

Purpose: Flame emission using direct aspiration.

Analytes: K.

Differences from SW-846: Flame emission is used in place of atomic absorption spectroscopy.

Reference: SW846 11/86 Vol 1A
Standard Methods for the Examination of Water and
Wastewater, 1989. 17th Edition, pages 3-125 and 126.

SW-846 Method: 7760 Silver (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other: EPA: 272.1 Silver (AA, Direct Aspiration).
 AWWA: 303A Determination of Cations by Direct Aspiration in
 Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Ag.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 272.1-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 157-160.

SW846 Method: 7770 Sodium (AA, Direct Aspiration)

AWWA Method: 3500-Na D Sodium.

Lab No.: EHS M-9 Metals in H₂O - FE

Other:

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-9, M-11	X	X							

Purpose: Flame emission using direct aspiration.

Analytes: Na.

Differences from SW-846: Flame emission is used in place of atomic absorption spectroscopy.

Reference: SW-846 11/86 Vol 1A.

SW-846 Method: 7840 Thallium (AA, Direct Aspiration)
Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Tl.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
Appendix A1-I.100.

SW-846 Method: 7870 Tin (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Sn.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.100.

SW-846 Method: 7910 Vanadium (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: V.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol. 1A.
 Appendix A1-I.100.

SW-846 Method: 7950 Zinc (AA, Direct Aspiration).
 Lab No.: EHS M-1 Metals in H₂O - AA - Flame.

Other References: EPA Method: 289.1 Zinc (AA, Direct Aspiration).
 AWWA Method: 303A Determination of Cations by Direct
 Aspiration in Air-Acetylene Flame.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11	X	X							

Purpose: Atomic absorption using direct aspiration.

Analytes: Zn.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.100.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 289.1-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 157-160.

SW-846 Method: 7041 Antimony (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other References: EPA Method: 204.2 Antimony (AA, Furnace Technique).
 AWWA Method: 304 Determination of Microquantities of
 Cations by Electrothermal Atomic
 Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Sb.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.110.
 EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 pages 204.2-1 and 2.
 AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7060 Arsenic (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.
 EHS M-12 Metals in Waste Organic Matrices by AA Spectroscopy.

Other: EPA: 206.2 Arsenic (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-1, M-11, M-12	X	X	X						

Purpose: Atomic absorption using graphite furnace.

Analytes: As.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.110.
 Appendix A1-I.90.
 EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 206.2-1+2.
 AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7091 Beryllium (AA, Furnace Technique).
Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Be.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
Appendix A1-I.110.

SW-846 Method: 7131 Cadmium (AA, Furnace Technique)
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 213.2 Cadmium (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Cd.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.110.
 EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 213.2-1-2.
 AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7191 Chromium (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 218.2 Chromium (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Cr.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.110.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 218.2-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7201 Cobalt (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 219.2 Cobalt (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Co.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.110.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 219.2-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7421 Lead (AA, Furnace Technique)
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 239.2 Lead (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations of
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Pb.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

Appendix A1-I.110.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 239.2-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7481 Molybdenum (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA Method: 246.2 Molybdenum (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Mo.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.110.
 EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 246.2-1+2.
 AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7740 Selenium (AA, Furnace Technique)
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 270.2 Selenium (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Se.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-1.110.

EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 270.2-1-3.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7841 Thallium (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 279.2 Thallium (AA, Furnace Technique).
 AWWA: 304 Determination of Microquantities of Cations by
 Electrothermal Atomic Absorption Spectrometry.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Tl.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

Appendix A1-I.110.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 279.2-1+2.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 173-179.

SW-846 Method: 7911 Vanadium (AA, Furnace Technique).
Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Other: EPA: 286.2 Vanadium (AA, Furnace Technique).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: V.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

Appendix A1-I.110.

EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 286.2-1+2.

SW-846 Method: 7470 Mercury in Liquid Waste (Manual Cold-Vapor Technique)
 Lab No.: EHS M-3 Mercury in Soil.
 EHS M-4 Total Mercury (Organic and Inorganic) in Water by
 Flameless AA.

Other: EPA: 245.1 Mercury (Manual Cold-Vapor Technique).
 AWWA: 303F Determination of Mercury by Cold Vapor Technique.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-3, M-4	X	X	X						

Purpose: Manual cold-vapor analysis of total mercury.

Analytes: Hg.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.
 Appendix A1-I.80.
 Appendix A1-I.120.
 EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 245.1-1-6.
 AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 171-173.

SW-846 Method: 7761 Silver (AA, Furnace Technique).
 Lab No.: EHS M-10 Metals in Water - Graphite Furnace AA.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS M-10, M-11	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Ag.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1A.
 Appendix A1-I.110.

EPA Method: 249.2 Nickel (AA, Furnace Technique).

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
249.2	X	X							

Purpose: Atomic absorption using graphite furnace.

Analytes: Ni.

Differences from SW-846: None.

Reference: Methods of Chem. Anal. of Water and Wastes
 Doc EPA 600/4-79-020 pages 249.2-1 and 2.

SW-846 Method: 7196 Chromium Hexavalent (Colorimetric).
Lab No.: EHS C-2-1 Hexavalent Chromium-Water and Air.
Other: AWWA: 312B Colorimetric Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS C-2	X								

Purpose: Colorimetric analysis of Cr^{+6} in H_2O and air.

Analytes: Hexavalent Cr.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1A.

Appendix A1-I.130.

AWWA: Standard Methods for the Examination of Water and
Wastewater. 1985. 16th Edition pages 201-204.

EPA Method: 365.2 Phosphorous, all forms. Colorimetric, Ascorbic Acid, Single Reagent.

Lab No.: None

Other: AWWA: 424F Ascorbic Acid Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
365.2	X								

Purpose: Analysis of orthophosphate and total phosphorous in water.

Analytes: Orthophosphate and phosphorous.

Differences from SW-846: None.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 365.2-1-6.

AWWA: Standard Methods for the Examination of Water and
Wastewater. 1985. 16th Edition pages 201-204.

Anions

SW-846 Method: 9010 Total and Amenable Cyanide (Colorimetric, Manual).

Lab No.: EHS C-3 Cyanide-Colorimetric Water and Air.

Other: EPA: 335.1 Cyanides, Amenable and Chlorination.

AWWA: 415 B Amperametric Titration Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS C-3	X								

Purpose: Colorimetric analysis of CN in H₂O and air.

Analytes: CN⁻.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1C.

Appendix A1-I.140.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 335.1-1+2.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 371+372.

EPA Method: 300.0 The Determination of Inorganic Anions in Water by Ion Chromatography.

Lab No.: EHS A-7 Inorganic Anions in Water Using Ion Chromatography.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS A-7	X								

Purpose: Ion chromatographic analysis.

Analytes: NO_3^- , NO_2^- , SO_4^{2-} , PO_4^{2-} , Cl^- .

Differences from EPA: None.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 300.0-1 through 5.
Appendix A1-I.150.

EPA Method: 340.2 Fluoride, Potentiometric Ion Selective Electrode.

Lab No.: EHS F-2-1 Fluoride - Specific Ion Electrode.

Other: AWWA: 4500-F-C Ion Selective Electrode Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS F-2	X								

Purpose: Analysis of fluoride in H_2O .

Analytes: F^- .

Differences from EPA: Unknown.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 340.2-1-3.
Appendix A1-I.160.
AWWA: Standard Methods for the Examination of Water and
Wastewater. 1989. 17th Edition pages 4-87-89.

EPA Method: EQN-1277-028 TGS-ANSA Method for the Determination of Nitrogen Dioxide in the Atmosphere.

Lab No.: EHS N-7 TGS-ANSA Method for the Determination of Nitrogen Dioxide in the Atmosphere.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.

EHS N-7

Purpose: NO_2^- concentration in air using a colorimetric method.

Analytes: NO_2^- .

Differences from EPA: Unknown.

Reference: Appendix A1-I.50.
Appendix A1-I.180.

Other Inorganic Methods

SW-846 Methods: 1010 - Pensky-Martens Closed-Cup Method for Determining Ignitability.

Lab No.: EHS F-8 Flash Point Determination.

Other: ASTM: D93-80: Flash Point by Pensky-Martens closed tester.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.

EHS F-8

X

X

Purpose: Analysis of hazardous waste for flash point.

Analytes: Flash point.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1C.
Appendix A1-I.170.
ASTM: D93-80 1980 Vol 15 pages 161-173.

SW-846 Method: 1020 Setaflash Closed-Cup Method for Determining Ignitability.

HEHF Lab No.: EHS F-8 Flash Point Determination.

Other: ASTM: D3278-82 Flash Point Determination by Setaflash Closed Cup.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS F-8	X	X	X						

Purpose: Analysis of hazardous waste for flash point.

Analytes: Flash point.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1C.

Appendix A1-I.170.

ASTM: D3278-82: 1988 Vol. 34 pages 566-572.

SW-846 Methods: 9040 - pH Electrometric Method.

Lab No.: None.

Other: EPA Method: 150.1 Electrometric Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
150.1	X								

Purpose: pH in H₂O.

Analytes: H⁺.

Differences from SW-846: None.

Reference: SW-846 11/86 Vol 1C.

EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 150.1-1 through 3.

SW-846 Method: 9041 pH Paper Method.

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
9041	X		X						

Purpose: pH in H₂O.

Analytes: H⁺.

Differences from SW-846: None.

Reference: SW-846 - 11/86 Vol 1C.

EPA Methods: 5 - Determination of Particulate Emissions from
Stationary Sources.
17 - Determination of Particulate Emissions from
Stationary Sources (In stack filtration method).

Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	

5, 17

Purpose: Analysis of particulates in stationary sources (stacks).

Analytes: Particulates.

Differences from EPA: None.

Reference: Appendix A1-I.10.
Appendix A1-I.40.

EPA Method: 6 Determination of Sulfur Dioxide Emissions from Stationary Sources.

Lab No.: EHS S-6 SO₂ in Air and Stacks Samples Using Barium Perchlorate Titration.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.

EHS S-6

Purpose: SO₂ content in air and stacks using a barium perchlorate titration.

Analytes: SO₂.

Differences from EPA: None.

Reference: Appendix A1-I.20.
Appendix A1-I.190.

EPA Method: 7C Determination of Nitrogen Oxide Emissions from Stationary Sources-Alkaline-Permanganate/Colorimetric Method.

Lab No.: EHS N-1 Determination of NO_x an Stack Gas.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.

EHS N-1

Purpose: Analysis of NO_x in stack gas.

Analytes: NO_x.

Differences from EPA: None.

Reference: Appendix A1-I.30.
Appendix A1-I.200.

HANFORD ENVIRONMENTAL ANALYTICAL METHODS

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EPA Method: 120.1 Conductance.

Lab No.: None.

Other: AWWA Method: 205 Conductivity.

Method Number	<u>Non-radioactive matrices</u>			<u>Radioactive matrices</u>					
	<u>Water, Surface & Ground</u>	<u>Soils</u>	<u>Liquid Effluents</u>	<u>Water, Surface & Ground</u>	<u>Soils & Grout</u>	<u>Liquid Effluents</u>	<u>Single Shell Tanks</u>	<u>Double Shell Tanks</u>	<u>Complex Conc.</u>
120.1	X	X	X						

Purpose: Analysis for conductivity.Analytes: Total electrolytes.Differences from EPA: None.Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 120.1-1-3.AWWA: Standard Methods for the Examination of Water and
Wastewater. 1985. 16th Edition pages 76-80.

EPA Method: 130.2 Hardness.

Lab No.: EHS H-1-1 Hardness (EDTA).

Other: AWWA: 314B EDTA-Titrimetric Method.

	<u>Non-radioactive matrices</u>			<u>Radioactive matrices</u>					
<u>Method</u> <u>Number</u>	<u>Water,</u> <u>Surface</u> <u>& Ground</u>	<u>Soils</u>	<u>Liquid</u> <u>Effluents</u>	<u>Water,</u> <u>Surface</u> <u>& Ground</u>	<u>Soils</u> <u>& Grout</u>	<u>Liquid</u> <u>Effluents</u>	<u>Single</u> <u>Shell</u> <u>Tanks</u>	<u>Double</u> <u>Shell</u> <u>Tanks</u>	<u>Complex</u> <u>Conc.</u>
EHS H-1-1	X								

Purpose: Hardness using EDTA.Analytes: Ca, Mg, Na.Differences from EPA: Unknown.Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
Doc EPA 600/4-79-020 130.2-1-5.

Appendix A1-I.210.

AWWA: Standard Methods for the Examination of Water and
Wastewater. 1985. 16th Edition pages 210-214.

EPA Method: 160.1 Residue, Filterable.
 Lab No.: EHS F-1-1 Filterable Residue (Total Dissolved Solids).
 Other: AWWA: 208B Total Dissolved Solids at 180°C.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS F-1-1	X								

Purpose: Total dissolved solids in H₂O. Determination of filterable residues.

Analytes: Total dissolved solids.

Differences from EPA: None.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 160.1-1+2.

Appendix A1-I.220.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 14th Edition pages 92-93.

EPA Method: 180.1 Turbidity.

Lab No.: None.

Other: AWWA: 214A Nephelometric Method-Nephelometric Turbidity Units.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
180.1	X								

Purpose: Turbidity in H₂O.

Analytes: Turbidity.

Differences from EPA: None.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.
 Doc EPA 600/4-79-020 180.1-1-4.

AWWA: Standard Methods for the Examination of Water and
 Wastewater. 1985. 16th Edition pages 134-136.

EPA Method: 310.1 Alkalinity (Titrimetric, pH 4.5).

Lab No.: None.

Other: AWWA: 403 Alkalinity.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
310.1	X								

Purpose: Alkalinity in H₂O.

Analytes: OH⁻.

Differences from EPA: None.

Reference: EPA: Methods of Chem Anal of Water and Wastes.

Doc. EPA 600/4-79-020 pages 310.1-1-3.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 269-273.

EPA Method: 410.1 & 2 COD-Titrimetric, Mid Level, Low Level.

Lab No.: EHS C-11 Chemical Oxygen Demand (COD) Hach Closed-Tube Method.

Other: AWWA: 508A Open Reflux Method.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
EHS C-11	X								

Purpose: Determination of chemical oxygen demand.

Analytes: COD.

Differences from EPA: The method is a scaled down version approved by EPA. It generates far less chemical waste thus helping toward waste minimization.

Reference: EPA: Methods of Chem. Anal. of Water and Wastes.

Doc EPA 600/4-79-020 410.1-1-3, 410.2-1-3.

Appendix A1-I.230.

AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 533-535.

ASTM Method: D1385-78 Standard Test Method for Hydrazine in Water.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
D1385-78	X								

Purpose: Hydrazine content in water.

Analytes: Hydrazine.

Differences from ASTM: None.

Reference: ASTM: 1978 Vol 31 pages 354-357.

AWWA Method: 203 Calcium Carbonate Saturation.
 Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
203	X								

Purpose: Analysis for corrosivity.

Analytes: Nonspecific.

Differences from AWWA: None.

Reference: AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 63-66.

AWWA Method: 204A Visual Comparison Method.
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
204A	X								

Purpose: Color analysis.

Analytes: Color.

Differences from AWWA: None.

Reference: AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 67-69.

AWWA Method: 417 Ammonia in Water
(A) Preliminary Distillation Step.
(B) Nesslerization Method (Direct and Following Distillation).
Lab No.: None.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.
417 A&B	X								

Purpose: Analysis of NH_3 in H_2O .

Analytes: NH_3 .

Differences from AWWA: None.

Reference: AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition. (A) pages 377-379;
(B) pages 379-382.

AWWA Method: 507 Oxygen Demand (Biochemical).

Lab No.: EHS B-4 Biochemical Oxygen Demand (BOD) DO Probe.

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
EHS B-4	X								

Purpose: Biological oxygen demand (BOD) using a dissolved oxygen probe.

Analytes: O₂.

Differences from AWWA: Incomplete information available.

Reference: AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 525-532.
Appendix A1-I.240.

AWWA Method: 512B Anionic Surfactants as MBAS.

Lab No.: EHS L-1 Linear Alkylbenzene Sulfonate-Methylene Blue Active Substances (MBAS).

Method Number	Non-radioactive matrices			Radioactive matrices					Complex Conc.
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	
EHS L-1	X								

Purpose: Linear alkyl sulfonate (LAS) (detergent) content in water.

Analytes: LAS.

Differences from AWWA: None.

Reference: AWWA: Standard Methods for the Examination of Water and Wastewater. 1985. 16th Edition pages 581-585.
Appendix A1-I.250.

Lab No.: EHS S-3 SO₂-Ambient Air.

Method Number	Non-radioactive matrices			Radioactive matrices					
	Water, Surface & Ground	Soils	Liquid Effluents	Water, Surface & Ground	Soils & Grout	Liquid Effluents	Single Shell Tanks	Double Shell Tanks	Complex Conc.

EHS S-3

Purpose: Analysis of SO₂ in ambient air.

Analytes: SO₂.

Reference: None.

5.0 QUALITY ASSURANCE/QUALITY CONTROL PLAN AND PROCEDURES

Each of the analytical laboratories conducts its own Quality Assurance and Quality Control programs according to the general policies and practices specified by the respective companies. In addition, they are each responsible for compliance with the additional specific analytical QA/QC requirements of the individual laboratory programs and projects to which they contribute.

This section reports some representative written plans and practices for QA and QC in each laboratory that apply to analytical laboratory work conducted within the general scope of this Manual. The QA/QC information is not intended to be comprehensive. Additional QA/QC requirements not included here may be specified in the individual analytical procedures, in the separate Project Procedure Manuals, or in other guidance and instructions received directly from sponsors and clients.

The QA/QC information in this section is arranged by laboratory in the same order as is followed in the preceding Procedures sections. That is, a one-page summary of each laboratory's QA/QC policies and practices is followed by copies of specific QA and QC plans that pertain to application of environmental sample analyses in that laboratory. Reference may be made there also to the general QA plans reported in other documents published by each company.

PNL CHEMICAL MEASUREMENTS LABORATORY

PNL CHEMICAL MEASUREMENTS LABORATORY (325 BUILDING)

The quality assurance program for PNL is described in detail in QA Manual PNL-MA-70. PNL-MA-70 uses ANSI/ASME NQA-1-1986 Edition, Quality Assurance Program Requirements for Nuclear Facilities, as the basis of the QA program. PNL-MA-70 provides management controls for projects, construction projects, services and facilities.

Quality Assurance Project Plan (QAPjP) No. SA-001 addresses the requirements specified by the applicable regulatory agencies. QAPjP SA-001 has been prepared according to the Data Quality Objective Guidance for Remedial Response Activities (EPA 540, G-87-003) and the Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80) of the U.S. Environmental Protection Agency (EPA). The project addressed in this QAPjP is the analysis of all samples related to the Tri-Party Agreement (Hanford Federal Facility Agreement and Consent Order). This Plan is supplemented with the requirements specified in the PNL Laboratory Quality Assurance Manual PNL-MA-70. The Plan provides guidance and control required for three levels of analytical support designated by EPA: Level III [laboratory analysis using methods other than CLP Routine Analytical Services (RAS)], Level IV (CLP routine analytical services), and Level V (non-standard methods including Special Analytical Services)

Technical Procedure PNL-ALO-010 is an example of a program-specific procedure addressing a single aspect of QC, namely, sample receiving and sample numbering practices. In this case, it also lists other analytical procedures that may be applied in the single-shell tank (SST) program to which this procedure applies. Some of the technical procedures listed are still in preparation.

EPA Contract Laboratory Program (CLP) protocols are available on an as-required basis. The CLP protocols include sample tracking, security, organization of files, refrigerator temperature monitoring, proper cleaning of plastics or glassware, chain-of-custody, and proper use of significant figures and rounding. The purpose of the protocols is to ensure legal defensibility of data provided by the laboratory.

WHC/222-S LABORATORY

WHC/222-S LABORATORY

WHC/222-S operates under a quality assurance program plan based on the requirement of NQA-1. The Laboratory Quality Assurance Plan (WHC-SD-CP-QAPP-001 Analytical Chemistry Services Laboratories Quality Assurance Plan) is written to the description of ASTM C-1009 and contains a Quality Assurance Implementation plan. In addition a Quality Assurance Program Plan (WHC-SD-CP-QAPP-003 Quality Assurance Program Plan For Chemical Analyses Performed by the 222-S/RCRA Analytical Laboratory in Support of Environmental Activities on the Hanford Site) based on the EPA requirements in QAMS-004 is in development. Also a Quality Assurance Project Plan (WHC-SD-CP-QAPP-002 Quality Assurance Project Plan for Chemical Analysis of Highly Radioactive Mixed Waste Samples in Support of Environmental Activities on the Hanford Site) based on the EPA requirements in QAMS-005 has been issued. The two QAMS based documents cover 222-S/RCRA Analytical Laboratory activities as they pertain to the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) for environmental samples.

These Quality Assurance documents provide the information often requested by regulators pertaining to the laboratory programs. The information is indexed to the rules that pertain to each regulatory body.

The specific laboratory procedures, instructions and other documents are compatible with all Quality Control Plans.

The analytical laboratories use computer data bases to manage analytical data. The "Laboratory Measurement Control System" (LCCS) provides for the logging, tracking, reporting and trend evaluation of samples. The "Laboratory Measurement Control System" (LMCS) provides for the logging, tracking, reporting and statistical evaluation of standard analysis.

The approach in the QA plans is that everyone responsible for the analysis has a responsibility for quality assurance and control of the data produced. Each QA plan identifies the support groups that are responsible for the quality assurance and quality control of the laboratory. The Data Measurement and Control section (DMC) has the overall responsibility to provide a broad spectrum review of the specific measurement systems within the laboratory. The scientists in the Applied Technology (AT) section provide internal surveillance of the laboratory practices, and

interpret data. The scientists in DMC provide an overview of the LCCS and LMCS, identify problems and coordinate corrective actions.

The QAPP for the Tri-Party Agreement outlines the regulatory requirements for performing environmental analysis. The QAPP includes requirements for documentation, accuracy (what intervals for each sample group spikes, blanks, and duplicates are to be performed), precision, holding and turn-around times, sample handling and preparation, sample custody, calibration procedures (including used of Shewart control charts to document calibration and control of instrumentation) and calibration frequency. The QAPP describes reporting requirements, data management including data reduction and validation.

A copy of both SD-CP-QAPP-001 (Rev. 0) and SD-CP-QAPP-002 (Rev. 0) follows.

HEMF ANALYTICAL CHEMISTRY LABORATORY

HEHF ANALYTICAL CHEMISTRY LABORATORY (747 BUILDING)

The HEHF lab is accredited by American Industrial Hygiene Association (AIHA), National Institute of Standards and Technology (NIST NVLAP), and the Washington State Department of Health Services (DHS). Routine laboratory practices are described in the Laboratory Operating Procedures Manual. This document contains many of the elements of a QA plan in a less formal format. Quality control documentation is kept for the analyses most commonly performed. This documentation consists of results on all types of control samples such as matrix spikes, surrogate recoveries, blank values, and instrument performance check samples where these types of QC samples are appropriate to the method being used. Shewart control charts are kept for recording accuracy and precision parameter results for many of the most common analyses and for determining if these parameters for each analyses are in control. It is also standard practice for all sample results to go through at least two levels of review before the results are approved and reported.

The legal defensibility required for analyses performed in support of the Hanford Site cleanup effort will mandate an increased level of quality control over that currently used at HEHF. Increased documentation of procedures and a systemization of the quality control effort will be required to meet these legal requirements. HEHF is currently actively working to improve this documentation and to develop a formal QA plan and QC program which will systemize and formalize the quality control activities currently performed.

No detailed quality assurance and quality control plans or protocols for HEHF have been received yet for inclusion in this manual.

QAPJP No. SA-001

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Revision No. 1A
Date: 08/01/89
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Quality Assurance Project Plan

for

Analytical Activities in the Materials & Chemical Sciences Center
in Support of the Tri-Party Agreement

Prepared By

Pacific Northwest Laboratory
Richland, Washington 99352

Quality Assurance Impact Level I

Approvals:

<u>2 E Jones</u>	T. E. Jones, Project Manager	<u>July 21, 1989</u> Date
<u>P. F. Salter</u>	P. F. Salter, Manager, Analytical Laboratory Operations	<u>25 July 89</u> Date
<u>W. C. Weimer</u>	W. C. Weimer, Manager, Chemical Measurements Laboratory	<u>7/21/89</u> Date
<u>B. J. Kaiser</u>	B. J. Kaiser, Manager, Materials and Chemical Applications Department	<u>7/25/89</u> Date
<u>J. W. Smith</u>	J. W. Smith, Group Leader, Process Quality Department	<u>7/27/89</u> Date
EPA Project Officer		Date
EPA QA Officer		Date
Washington Department of Ecology		Date

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INTRODUCTION

This Quality Assurance Project Plan (QAPJP) has been prepared to meet the requirements of the Environmental Protection Agency (EPA). This QAPJP has been prepared according to the Data Quality Objective Guidance for Remedial Response Activities (EPA 540, G-87-003) and the Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80) of the U.S. Environmental Protection Agency. The Project addressed in this QAPJP is the analysis of PNL samples related to the Tri-Party Agreement (Hanford Federal Facility Agreement and Consent Order). This plan is supplemented with the requirements specified in the Pacific Northwest Laboratory Quality Assurance Manual, PNL-MA-70.

The Project Plan and PNL-MA-70 comprise the direction for this project. Hanford area samples are expected to require a wide range of analytical requirements, entailing different requirements for various end purposes. This Plan is intended to provide guidance and control required for 3 levels of analytical support designated by EPA: Level III (Laboratory analysis using methods other than CLP Routine Analytical Services (RAS), Level IV (CLP Routine Analytical Services), and Level V (Non-standard methods including Special Analytical Services (SAS)).

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D. Trader, DOE-RL
P. Day, EPA, Region 10
R. Stanley, Washington Dept. of Ecology

3.0 PROJECT DESCRIPTION

This project shall encompass those analytical samples submitted to PNL for analyses related to the Tri-Party Agreement. These samples may be from within PNL or received from another Hanford contractor via a work order or an outside client. They may require organic, inorganic and/or radiochemical analyses. The data generated shall be used for various functions: process control, environmental control, environmental monitoring, general information, etc. The laboratories performing EPA analyses are strictly controlled and monitored for compliance with EPA requirements.

Although the work effort may involve a multitude of different work orders, work packages, and a variety of samples, it has been established under the organizational description as a "project" to facilitate one-point contact, ultimate responsibility, and tracking.

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4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

An organization chart showing the project organization, PNL management overview, and QA interface is provided in Figure 4.1.

AUTHORITY AND RESPONSIBILITIES

Dr. T. E. Jones has been designated as the Project Manager and as such has the overall responsibility for implementation of the QA requirements identified in the Quality Assurance Project Plan. He shall be the primary point of contact to assure that a clear channel of communication will be available during all phases of the work. He shall be responsible for tracking the progress of work efforts and reviewing all data packages before release.

Technical responsibilities for the individual analyses shall rest with identified Technical Leaders for the organic, inorganic, and radiochemical analyses. The quality goal is achieved by the active participation of all technical personnel in the QA and QC program. All project staff are responsible for the performance of the requirements applicable to their individual contributions to the project.

The Analytical Data Quality Office will designate a QC Coordinator who is responsible for reviewing all QC data generated within this project. The purpose is to verify compliance with the Quality Control Limits required for this project and to overview for potential problems and corrective action.

A Quality Programs Representative has been assigned from the independent Process Quality Department to assist project staff in implementing QA program requirements, provide independent QA review of procedures and documents generated, and provide independent verification of compliance to the requirements.

_____ Line Management Guidance
 - - - - - QA Support/Overview
 Programmatic/QC Guidance
 _____ Client Guidance

*Staff are assigned to the project from the Chemistry and Analysis Section.

Note: This organization chart may be modified periodically as necessary to accurately reflect the current staff assignments.

FIGURE 4.1 Project Organization and Line Authority

5.0 QUALITY ASSURANCE OBJECTIVES

The level of control (especially precision, accuracy and quantitation limits) designated for each sample group will depend in part on the designated analytical support level. The objective of the laboratory Quality Assurance Program is to assure that data of known and acceptable quality are generated consistent with stated data quality objectives. To accomplish this, the laboratory personnel shall comply with the following standard practices:

- Assure that every sample is assigned a specific analytical support level before analyses begin, and that QA/QC is exercised to the required level.
- Maintain an effective, ongoing quality control (QC) program to measure and verify laboratory performance, relative to assigned analytical support levels. When Level IV analytical support is specified, the specific QC requirements stated in the current CLP Statements of Work shall prevail as a minimum.
- Meet data requirements for accuracy, precision, and completeness through the use of proven methodologies and quality control. When Level IV analytical support is specified, the specific CLP SOW requirements for accuracy and precision shall be maintained.
- Provide sufficient flexibility to allow controlled changes in routine methodology to meet specific data requirements.
- Identify method QC outliers as soon as possible and provide corrective action.
- Audit system performance on a routine basis and provide corrective action as needed.
- Maintain a records management system to include records of sample receipt, laboratory performance, and completed analyses to provide legally defensible data.

5.1 Precision

Data quality objectives for precision will be established for each measurement parameter, based on prior knowledge of the measurement system employed and method validation studies using replicates, spikes, standards, calibrations, recovery studies, etc., and the requirements of the specific client/project.

5.2 Accuracy

Data quality objectives for accuracy will be established for each measurement parameter based on prior knowledge of the measurement system employed, method validation studies and the requirements of the client/project. For Level IV work, the capability of the measurement system shall be verified capable of meeting CLP SOW requirements by the appropriate analysis of standards before sample analyses are conducted.

5.3 Completeness

The QC objective for completeness as determined by the percentage of valid data generated, shall be $\geq 80\%$. Precision and accuracy determinations, if outside the QA objectives due to sample-related causes, may be regarded as qualifying, rather than invalidating, the associated data.

5.4 Representativeness

The selection of a "representative" solid sample may require a complex sample treatment process, depending on the inhomogeneity of the sample. Any unusual method used to prepare/select a representative sample will be determined by the Technical Leader and approved by the Project Manager before the analyses are conducted. The technical procedure used will be documented in laboratory record books.

5.5 Comparability

To provide comparability with other analyses and other laboratories, PNL shall demonstrate traceability of standards to NIST or EPA sources, whenever possible, use standard methodology and reporting units, apply appropriate levels of quality control, and participate in interlaboratory studies.

6.0 SAMPLING PROCEDURES

This project plan addresses only the laboratory analyses and resultant data. Sample collection shall be performed by other organizations outside the jurisdiction of this QA Plan.

It is recognized that representative sampling is a prerequisite for meaningful analytical data. QA/QC reviews of laboratory analyses must be alert to any evidence of sampling problems, and include such information if observed as part of the final analytical report. Disagreement exceeding known laboratory precision limits between data from field duplicate samples needs special scrutiny.

7.0 SAMPLE CUSTODY

Chain-of-Custody

The purpose of the chain-of-custody program shall be to document sample possession from the time of receipt to disposal. The audit trail shall consist of not only the Chain-of-Custody documents, but also freight bills of lading, internal sample custody forms, analytical benchsheets, analysts' notebooks, and disposal records and manifests. If samples are received without Chain-of-Custody documents, PNL shall document such and implement Chain-of-Custody procedures within the lab.

Laboratory Custody

In the laboratory, a sample custodian shall be assigned to receive the samples. Upon receipt of a sample, the custodian shall inspect the condition of the custody seals and the sample, reconcile the information on the sample label against that on the Chain-of-Custody, assign a laboratory number, log in the sample in the laboratory Master Log Book or a computerized sample management system, and store the sample in a secured sample storage area. If sample leakage or documentation discrepancies are found, they shall be noted on the Chain-of-Custody, a nonconformance shall be initiated, and the appropriate analytical or QA manager shall be notified in order to resolve the discrepancy in a timely manner.

The sample custodian shall inform responsible personnel samples have arrived for analysis. The assigned analyst/technician shall sign and date an internal sample tracking log before the sample custodian shall relinquish the samples for analysis. The analyst/technician shall carefully record all pertinent sample identification on a benchsheet or in an analytical notebook used. When finished with the sample, the analyst/technician shall relinquish possession back to the sample custodian. All sample tracking records, benchsheets, and analytical notebooks shall be considered sample custody documentation.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used by PNL are controlled by a calibration program. The program verifies that equipment of the proper type, range, accuracy, and precision are used to provide data compatible with project requirements. The detailed requirements for the calibration program are specified in PNL-MA-70.

Periodic Calibration

Periodic calibration shall be performed for equipment such as balances, thermometers, pipetors, etc., that are required in the analytical methods, but which are not routinely calibrated as part of the analytical procedure. Documentation of calibration shall be kept for each equipment item, and shall include:

- ID number of equipment
- Calibration frequency and acceptable tolerances
- Date calibration was performed
- Person or external agency performing the calibration
- Reference standards/materials used for calibration
- Calibration data
- Certificates or statements of calibration provided by manufacturers and external agencies, and traceability to national standards (if applicable)
- Acceptance criteria
- Records of repair of failed equipment.

Analytical Instrument Calibration and Record Requirements

It is the responsibility of the individual analysts to assure that individual daily (as-used) instrument calibrations are performed. The Technical Leader is informed of any conditions that may adversely affect the performance of the instrument.

Calibration procedures are included in the CLP SOW 2/88 for organic analyses, and SOW 7/88 for inorganics. Calibration procedures for Radiochemistry are identified in the technical procedures.

Daily instrument calibration records are retained and included with sample analysis data. Data packages will include instrument calibration data, control standard data, and sample analysis data. These will constitute an auditable record.

Traceability of calibration standards shall be maintained.

9.0 ANALYTICAL PROCEDURES

The analytical procedures to be used with any group of environmental samples will depend on sample type and customer (i.e., analytical support level) requirements. In general, all routine analyses will be closely patterned after appropriate EPA procedures, with necessary modifications for special sample requirements (i.e., highly radioactive samples). Development and validation of specialized analytical procedures may be the first step in an analysis project. At all levels, the procedures used must be fully documented, by reference to established procedures or in details recorded in laboratory record books.

Any change in a documented procedure shall constitute a modification. The Technical Leader shall determine the significance of the modification, relative to the analytical support level specified. The QC representative shall verify that the stated accuracy and precision are maintained. Significant modifications shall require additional precision, accuracy, and detection-limit data to demonstrate that the previous estimates of the limitations are still valid or to develop the necessary data for accurately describing the new method.

For EPA Level IV work the published CLP SOW (7-88 for inorganics; 2-88 for organics) shall be the primary source of analytical procedures. For EPA Level III, the same CLP procedures, or procedures from SW-846, or other approved documented procedures may be used, without the CLP requirements for documentation. In every case, the precision, accuracy and quantitation limits described in the written procedure shall be achieved and demonstrated, or deviations fully documented.

10.0 DATA REDUCTION, VALIDATION AND REPORTING

The Project Manager shall assure that data reduction, validation, and reporting are conducted according to the following guidelines.

Data Reduction

Data reduction includes all processes involved in the transformation of raw data provided in the chemical analysis methodology to results that are meaningful to and requested by the client. Conversion of raw data to the reported values is achieved by reference to a calibration curve prepared initially from standard calibration and reference standards. Most modern analytical instruments perform the conversion via calibrated internal circuitry and computer-controlled calculations.

Data reduction frequently also includes computation of summary statistics and their standard deviation, confidence intervals, tests of hypothesis relative to the parameters, etc. Such statistical computations shall be documented in order to provide a reviewer with the information necessary for an evaluation of the reliability of the computations and the overall correctness of the data reduction. These reductions shall be recorded on the data sheets or in laboratory records books. Either method requires a second review.

Transcription

All data transcriptions for final reports are performed and reviewed before reporting.

Data Validation

Data validation includes the use of dated and signed entries by analysts and supervisors on worksheets and log books used for all samples, the use of sample tracking and numbering systems to logically follow the progress of samples through the laboratory, and the use of statistical quality control criteria to reject or accept specific data.

Steps and checks used to validate precision and accuracy on the measured parameters and to support the representativeness, comparability and completeness of the work include:

- Results of the calibration of methods and instruments
- Results of routine instrument checks (noise levels, drift, linearity, etc.)
- Documentation of traceability of instrument standards, samples and data

- Documentation of results of analytical methodology and QC methodology
- Results of applicable performance audits with appropriate audit materials
- Description and results of the controls for interference contaminants in analytical methods (use of reference blanks and check standards for method accuracy and precision) n)
- Documentation of routine maintenance to ensure analytical reliability
- Documentation of sample preservation and transport

Data Acceptance/Rejection Criteria

No analytical data are reported by the laboratory until it has been through a technical evaluation and a QC review. The technical data evaluation will involve an assessment of QC control data, results from replicate analyses, and "spike and recovery" values. The Project Manager will assure completeness of the data packages and an adherence to QC protocols. The following steps will be applied to Level IV work. They will be applied to work usually conducted at Level III or IV to the extent possible by the procedure followed.

Technical leaders will be responsible for assuring that all sample analyses are completed while the instrument/method is operating within control limits. Unless it can be objectively demonstrated that the instrument/method was within control limits when sample analysis data were generated, the sample analysis data are rejected.

Analytical results from replicate analyses of the same sample can be useful in the data evaluation. Some caution is necessary in making this evaluation because of the difficulties associated with obtaining identical replicate samples. This is particularly true for solid samples.

Another component of data evaluation is an assessment of the "spike and recovery" values. Expected % recoveries are defined in the appropriate SOW's. Recoveries that are outside the limits specified in the procedures or Statement of Work may indicate a failure in the analytical method and may cause the analytical results for that sample to be rejected. Other factors such as severe matrix effects may cause poor recoveries also. Re-analysis by the same or a different method may be appropriate, depending on wishes of the Project Manager and/or customer. Analytical results with poor % Recoveries will be flagged as such.

Analyst and Supervisory Review

The analyst and Technical Leader review the data to ensure, where appropriate, that the laboratory

- Provides recovery data of spikes
- Verifies no contaminants to spikes
- Compares duplicates for match in results
- Reviews and verifies proper instrument tuning or calibration
- Verifies all quality control criteria have been met.
- Verifies calibration performance for acceptability.
- Documents accurate sample identification and complete results

Project Manager

Upon meeting all technical criteria the results are reviewed by the Project Manager or his designee. He verifies that all quality control criteria have been met for acceptability, as follows:

- All compounds have been properly identified.
- Proper procedures have been followed.
- Quantitation limits are appropriate.
- Accuracy of calculations has been verified.
- Spikes, duplicates, and blank data have been reviewed.
- Results are documented on control charts.
- Calibration data are tabulated.

QC Coordinator

The QC Coordinator is responsible for reviewing all QC data generated within this project. The purpose is to verify compliance with the Quality Control Limits required for this project and to overview for potential problems and corrective action.

Report Review and Approvals

The report is written, formatted, and then reviewed to ensure that all data are transcribed and documented to meet client requirements. The report is further reviewed to eliminate transcription error and ensure the clarity and conciseness of the final document.

Before the final report is sent to the customer, the following personnel review the document and sign off their approval:

- a. Technical Leader
- b. Quality Programs Representative (EPA Level IV and V)
- c. Project Manager
- d. Analytical Laboratory Operations

The sample tracking, data flow, and reporting scheme is provided below:

11.0 INTERNAL QUALITY CONTROL CHECKS

An internal quality control program shall be followed to ensure the appropriate accuracy, precision, and sensitivity of all data. The applicable CLP SOW for organics and inorganics describes the QC protocols and frequencies that shall be followed for EPA Level IV work. Radiochemistry QC will be defined/described in technical procedures developed to support project specific directives.

For analyses conducted at Analytical Support EPA Level III or V, similar internal quality control shall be exercised, although it may be conducted at a lower frequency than that required for Level IV work. The governing specification is that the QC data must demonstrate with a high degree of confidence that all analyses were conducted under documented controlled conditions, and that the results for standards analyses are within specified limits of the accepted actual value. As a minimum, check standards must always be analyzed before and after analysis of sample sets.

General

The Technical Leader is responsible for ensuring that regular internal quality control checks are conducted during the generation of environmental monitoring data. The number, type and frequency of QC checks conducted during the course of the analyses will be determined by the analytical support level of the sample group. If designated as Level IV (CLP RAS), the following practices will be followed, as specified in the current CLP SOW.

- Organic analysis QC

Exhibit E, Section III, of the governing organic SOW defines the specific QC requirements to be followed. The QC requirements for volatiles (VOA), semivolatiles (SV) and pesticides/PCB's (PEST) include such issues as:

- * tuning and GC/MS mass calibration
- * calibration of the GC/MS system
- * method blank analysis
- * surrogate spike analysis
- * matrix spike/matrix spike duplicate analysis (MS/MSD)
- * sample analysis.
- * internal standards

- Inorganic analysis QC

Exhibit E of the governing inorganic SOW identifies the specific QC requirements to be met. The following QA/QC operations must be performed during each analytical run:

- * initial calibration and calibration verification
 - * continuing calibration verification
 - * preparation blank analysis
 - * interference check sample analysis
 - * matrix spike analysis
 - * duplicate sample analysis
 - * furnace AA QC analysis
 - * laboratory QC sample analysis
 - * laboratory check samples
- Radionuclide analysis QC

EPA does not have an established SOW for radionuclides analysis. PNL has implemented technical procedures that require:

- * reagent blanks
- * duplicates
- * isotopic tracers
- * spike recoveries
- * standard additions
- * initial calibration & calibration verification

Verification/Reference Standard

On a quarterly basis, the Analytical Data Quality Office representative shall introduce a group of prepared verification samples, or standard reference materials, into the analytical testing regime. Results of these data shall be summarized, evaluated, and presented to laboratory management for review and corrective actions, if appropriate. The verification sample materials shall be obtained from the EPA Performance Evaluation program, the National Institute of Standards and Technology, commercial suppliers of special standard materials and laboratory-prepared standard samples.

Corrective Measures for Outliers

All outliers of control samples and subsequent corrective actions shall be documented by a Deficiency Report (DR). Employees identifying a problem that may affect quality are responsible for initiating a DR. Many nonconformances can be corrected at the analyst/technician level; however, if the person initiating the DR is not able to take corrective action, it shall be the responsibility of the next person on the routing of the DR to attempt corrective action. All persons on the routing list shall initial and date the DR and record any corrective actions taken. The Project Manager (PNL), the QP Representative (PNL), and project file shall receive completed copies of all DR's.

Control Charts

Statistical control charts are a valuable tool in maintaining analytical laboratory performance within specified limits, when the analyses are conducted sufficiently often that reliable performance history and prior data are available. For those analyses, control charts are being developed in the Laboratory for precision, using the results from laboratory replicate analyses, and for accuracy, using the results from standard reference samples or spiked sample analyses. In general, control charts shall be designed after the ASTM STP-15d procedure for statistical control charts. Control and warning limits will be established to reflect the requirements of the client and the specified analytical support level.

For Level IV data, control limits shall reflect 99.7% (3SD) probability limits and warning limits shall reflect 95% (2SD) probability limits. For Levels III and V, the limits may be less restrictive. If the observed value plotted on the control chart falls between the warning and control limits, the Technical Leader is notified for a decision as to how to proceed. If the point plots outside the control limits, the data set is invalid and the analysis is stopped until the source of error has been determined and corrective action taken. Once the error source has been resolved, the data set is re-analyzed. Charts are updated by the Technical Leader, as data become available.

12.0 PERFORMANCE AND SYSTEM AUDITS

System Audits

The correct operation and full implementation of the internal Quality Assurance/Quality Control Procedures outlined in this project plan and in project Standard Operating Procedures shall be confirmed by annual audits conducted by an independent auditor.

The basis for the Quality Assurance Audit may include the Quality Assurance/Quality Control Procedures Manual, Standard Operation Procedures Manuals, technical specifications from the client, and good laboratory practices. Technical files, documents, facilities and personnel shall be made available to the auditor upon request. The proper functioning of the QA/QC system shall be assured by reviewing:

- Adherence to Standard Operating Procedures detailed in the procedures manual
- Organization chart identifying responsible personnel
- Sign-offs by technical and QC personnel of data sheets and sample progress records
- Document filing, storage and retrieval systems
- Evidence of report review before finalization
- Quality status reports
- Documentation of precision, accuracy, and completeness
- Records of deficiencies, analytical events out of control, and Corrective Actions required and taken
- Evidence of instrument and analyst qualification, and technical training.

The audit report submitted to the Project Manager may contain findings of deficiencies and shall request Corrective Actions to be taken and/or new procedures to be implemented. A reasonable time limit may be recommended by the auditor for completion of such action.

The Project Manager shall confirm in writing that the Corrective Action has been taken and the date of such action. A copy of this report shall be sent to the auditor.

The QC Representative shall review data obtained from the analysis of verification samples or standard reference materials introduced into the routine analytical testing regime by the Analytical Data Quality Office. Results of these data shall be summarized, evaluated and presented to laboratory management for review and corrective actions, if appropriate.

13.0 PREVENTIVE MAINTENANCE

A comprehensive preventive maintenance program shall be performed to provide an organized program of actions (including equipment cleaning, lubricating, reconditioning, adjustment and/or testing) to maintain proper instrument and equipment performance and to prevent instruments and equipment from failing during use. The preventive maintenance program shall increase reliability of the measurements. The preventive maintenance program that shall be used on this program shall cover the following:

- Instruments, equipment, and parts thereof that are subject to wear, deterioration, or other change in operational characteristics without periodic maintenance
- Spare parts that should be available within the laboratory to minimize downtime
- Identification and frequency of maintenance that is required.

Implementation

The implementation of the preventive maintenance program is dependent upon the specific instruments and equipment used.

The Technical Leaders shall be responsible for the preparation and documentation of the program. Analysts/technicians shall implement the program, and the PNL QP Representative shall review implementation to verify compliance.

The preventive maintenance program includes the following:

- A listing of the instruments and equipment that are included in the program
- The frequency of maintenance, considering manufacturer's recommendations and/or previous experience with equipment
- For each instrument, the items to be checked and/or serviced during maintenance and directions for performing maintenance (if external service is not provided, or if directions are not stated in manufacturer's instrument manuals).

Documentation

Preventive maintenance shall be documented and the records stored in accordance with Records Management Procedures. The Master Schedule shall be kept at the beginning of the maintenance records. Behind the schedule, a separate file shall be maintained for each instrument.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Precision

Precision is an index of analytical reproducibility; it will be routinely monitored on all analytical methods. Whenever appropriate, both instrument and methods precision will be tracked using Control Charts.

Precision can be expressed in a number of ways. It can be expressed as a standard deviation (S), relative standard deviation (RSD), range, or % range. Methods Precision is measured by processing two or more essentially identical samples through the entire analytical procedure from sample preparation to final measurements. Instrument Precision is determined by performing replicate final measurements upon a single sample.

For a number of replicate measurements, the arithmetic mean, $\bar{X}$, or "average" is calculated according to the equation:

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

where n = the number of measurements, and X_i is the value of the individual measurement.

Precision is a measure of the spread of the data around this mean. The precision, expressed as the standard deviation, S , is calculated according to the equation.

$$S = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$$

or as the relative standard deviation, RSD, calculated as:

$$RSD = 100 \frac{S}{\bar{X}}$$

In calculating precision for analysis of inorganics, the sample duplicate data are used. For organic analyses, the matrix spike duplicate values are used for that calculation.

In some cases, it may be appropriate to calculate the range (i.e., the difference between the largest and smallest values) or as % range, which is calculated as:

$$\% \text{ range} = 100 \frac{\{\text{range}\}}{\bar{X}}$$

Accuracy

Accuracy is an index of the degree to which an analytical results approximates the true value. Accuracy will be routinely monitored on all analytical methods.

Accuracy can be expressed as a % bias or as a % recovery.

Bias can be determined using Standard Reference Materials (SRM's) or certified QC samples, such as are available from the National Institute of Standards and Technology, EPA, and various commercial sources if such are available with a composition similar to the samples of interest. Relative bias is calculated as:

$$\% \text{ bias} = \left(\frac{|\text{true} - \text{observed}|}{\text{true}} \right) 100$$

When an authoritative reference standard is not available, the accuracy is sometimes defined in terms of percent recovery (% R), as determined by sample spike recoveries. The % R is calculated as:

$$\% R = \left(\frac{X^S - X^a}{C^t} \right) 100$$

where X^S is the observed concentration of the spiked sample, X^a is the observed concentration of the unspiked sample, and C^t is the true concentration of the spike.

Completeness

The laboratory objective is for a minimum of 80% completeness in all measurement systems. In cases where analytical data are lost, a Deficiency Report will be prepared.

Control Limits

Control limits are statistical boundaries defining the range through which data from the analytical system normally fluctuate. Since they are derived from the data themselves, the greater the data base, the greater the integrity of the limits. When sufficient data are unavailable during the establishment of a quality assurance program, interim limits are used. Such limits have been suggested by EPA for various methods of analysis. Where no other values are available, initial limits of $\pm 15\%$ are suggested.

Precision and accuracy are the two data parameters most adaptable to control limit calculations.

15.0 CORRECTIVE ACTION

Conditions adverse to quality and corrective action taken are promptly identified in nonconformance reports (NCR's), deficiency reports (DR's), surveillance reports and audit findings in accordance with PNL administrative procedures.

Significant conditions adverse to quality, the cause of the conditions, and the corrective action taken to preclude repetitions are documented and reported to immediate management and upper levels of management for review and assessment by a Corrective Action Request (CAR) administered in accordance with PNL-MA-70.

The necessary corrective action is initiated by the Project Manager or his designated laboratory representative. The QP Representative is responsible for verification and approval of the completed corrective action.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Variance and nonconformances shall be reported at the time of occurrence to the Project Manager using the surveillance reporting, deficiency reporting, nonconformance reporting, audit reporting, and corrective action request systems delineated in the PNL Quality Assurance Manual, PNL-MA-70.

Results of such reports shall be summarized in the Project Manager's monthly report to management.

The Quality Programs Representative shall prepare a semi-annual report to management that should include:

- results of system audits
- significant QA problems and status of resolutions.

The Analytical Data Quality Office shall prepare a semi-annual report to management that shall include:

- assessment of measurement data accuracy, precision, and completeness
- results of performance audits

PNL TECHNICAL PROCEDURE

TITLE: PNL-ALO-010, 325 LABORATORY SINGLE-SHELL TANK SAMPLE RECEIVING AND SUB-SAMPLE/ANALYSIS NUMBERING SYSTEM

APPLICABILITY

The object of this procedure is to control the receipt of Single-Shell Tank (SST) waste samples into the 325 Laboratory and the flow of SST sub-samples within the 325 Laboratory (see Figure 1). This procedure also provides a method for assuring that information on required analyses is conveyed to the analyst. This procedure is applicable to all samples analyzed under the SST Project.

DEFINITIONS

None

RESPONSIBLE STAFF

- Project Manager
- Task Leader
- Technical Staff
- Data Management Clerk

PROCEDURE

1.0 Sample Receipt in the 325-A Hot Cells

SST samples are shipped with chain-of-custody documentation from Westinghouse Hanford Company (WHC) to the 325-A Hot Cells. The PNL 325-A Hot Cell Task Leader receives samples from WHC, examines shipping containers and documentation, and notifies the SST Project Manager that samples have arrived. Any deviations from protocol are reported to the Project Management Office for resolution. Copies of all external chain-of-custody documentation are provided to the Project Management Office. Samples are logged into the 325-A Hot Cell records by the Task Leader or his designee.

Upon receipt of the tank sample, the sampler identifier (ID) is entered into the program records. The sample will be extruded and transferred to a labeled sample container. The sample container label contains a reference to the tank ID, the core sample, and the segment. For

Author <i>25 Gens</i>	Date <i>7/31/89</i>	Project Mgr.	Date	QAD Representative <i>SJ English</i>	Date <i>7-31-89</i>
Technical Reviewer <i>Tom Longaker</i>	Date <i>7/31/89</i>	Line Mgr. <i>Walter C. Hume</i>	Date <i>7/31/89</i>	Other	Date
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PNL TECHNICAL PROCEDURE

example, a sample from the third segment from the first core sample from tank 102SY will be labeled 102SY-C1-3. Subsamples will have a numeric added to the label chain.

The Project Management Office will provide internal chain-of-custody documentation (see Exhibit 1) for transfer of samples from the 325-A Hot Cells to the 325-B Hot Cells.

2.0 Transfer of Samples from 325-A to 325-B Hot Cells

SST Core Samples are composited and homogenized in the 325-A Hot Cells, as per the SST Waste Analysis Test Plan (Test Plan) or Statement of Work (SOW). Sub-samples of the original core sample are transferred to the 325-B Hot Cells for sample pretreatment and chemical analysis as per the Test Plan. Each sub-sample receives a unique sample number as per PNL-SA-34. PNL-SA-34 applies only to the assignment of unique sample number.

The SST Hot Cell Transfer form (see Exhibit 1) provides a clear correlation between the WHC SST core identification, 325-A Hot Cell sample numbers and 325-B Hot Cell sub-sample numbers. A brief description of 325-A sample preparation steps will accompany the completed SST Hot Cell Transfer form returned to the Project Management Office. The SST Hot Cell Transfer form is maintained in the SST Project Management Office and becomes part of the Analytical Data Package Report for the SST Core sample. Copies of completed SST Hot Cell Transfer forms are provided to the sample sender and sample receiver for their information files.

3.0 Sub-Sample Identification in 325-B Hot Cells

Each sample transferred to the 325-B Hot Cells is processed for specific analyses as defined in the Test Plan. Analyses defined in the Test Plan are subdivided into the following areas: Sample Preparation, Inorganic Analyses, Organic Analyses, Radiochemical Analyses and Physical Testing. The methodologies are numbered according to these divisions (see Exhibit 2). The SST Project Management Office provides the 325-B Hot Cell Task Leader and affected Task Leaders with a SST Sample Test Instruction (TI) for the work to be accomplished (see Exhibit 3) for each sample received. The SST Sample TI will be prepared by or approved by the Project Manager. The TI will be based on the requirements outlined in the Test Plan and/or the SOW. The TI will identify the sample preparation and analyses required and identify the responsible Task Leader for each activity.

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PNL TECHNICAL PROCEDURE

4.0 Internal Chain-of-Custody

All samples transferred from the 325-B Hot Cells to the various analytical laboratories will be transferred with formal chain-of-custody documentation. A SST Sample Chain-of-Custody form (see Exhibit 4) will be completed for each sub-sample transfer. The three carbon form is a signed by the person responsible for sending the sample and the person receiving the sample. The original is sent to the SST Project Management Office where it is maintained as the record copy. The sample sender and the sample receiver each receive a copy of the completed SST Sample Chain-of-Custody form for their information file systems.

5.0 SST Analytical Data Management

The SST Data Control form is prepared by the Project Management Office for each sample transferred to the 325-B Hot Cells (see Exhibit 5). This form will identify all analytical data to be received by the Project Management Office for the sample and a date by which the data are expected. All reviewed analytical data will be forwarded to the Project Management Office as it becomes available.

The Project Management Office will be responsible for preparation of the Data Package as per WHC requirements. Additional PNL management reviews may be required before the Data Package is transmitted to WHC.

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SST Sample and Data Flow Sheet

SST TRANSFER FORM

Transfers Between 325A and 325B Hot Cells

DATE OF TRANSFER _____

SENDER (325A Hot Cell Technical Leader)

RECEIVER
(325B Hot Cell Technical Leader)

WHC CORE IDENTIFICATION NUMBER _____

325A Hot Cell ID #

Analytical Lab Sample #This image shows a blank sheet of white paper with horizontal black ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible on each side of the central vertical fold. The paper appears slightly aged or off-white.

Exhibit 2: SST Analytical Methodologies

100 Numbers for Sample Preparation Methods
200 Numbers for Inorganics
300 Numbers for Organics
400 Numbers for Rad Chem
500 Numbers for Physical Testing

SAMPLE PREPARATION METHODS

<u>Number</u>	<u>Analyte/Method</u>	<u>Procedure</u>
101	Acid Digestion (ICP and AA)	PNL-ALO-101
102	Fusion of HTW Samples	PNL-ALO-102
103	Water Leach of HTW Samples	PNL-ALO-103
120	Semivolatile Organic Ext.	PNL-ALO-120
130	Receipt and Inspection of SST Samples	PNL-ALO-130
131	Receipt and Extrusion of Core Samples at 325A Shielded Facility	325-EXT-1
135	Homogenization of Solutions, Slurries and Sludges	PNL-ALO-135

INORGANIC METHODS

Inorganic Instrumental Methods

<u>Number</u>	<u>Analyte/Method</u>	<u>Procedure</u>
211	ICP Scan	PNL-SP-7
212	Anions by Ion Chrom.	7-40.8
213	Mercury by Cold Vapor	PNL-ALO-213
214	As by GF-AA	PNL-ALO-214
215	Se by GF-AA	PNL-ALO-215
230	Solution Analysis: Carbon	7-40.7
231	Separation of Carbon from Soil, Sediment, Sludge Samples	7-40.16

Inorganic Wet Chemical Methods

<u>Number</u>	<u>Analyte/Method</u>	<u>Procedure</u>
264	Fluoride by Electrode	HWVP-2

ORGANIC METHODS

<u>Number</u>	<u>Analyte/Method</u>	<u>Procedure</u>
320	Extractable Organic Halides	PNL-ALO-320
330	Screening/VOA	PNL-ALO-330
335	GC-MS for Volatiles (VOA)	PNL-ALO-335
340	Screening/SV	PNL-ALO-340
341	GPC Clean-Up for Semivolatiles	PNL-ALO-341
345	GC-MS for Semivolatiles (SV)	PNL-ALO-345
350	Organic Analysis Report Prep.	PNL-ALO-350

RADIOCHEMICAL ANALYSES

<u>Number</u>	<u>Analyte/Method</u>	<u>Procedure</u>
420	Total Alpha	HTA-4-22, HTA-4-6
421	Pu-238, 239/240	HTA-4-15, HTA-4-5, HTA-4-6
422	Am-241/243	HTA-4-13, HTA-4-5, HTA-4-6
423	Np-237	HTA-4-14, HTA-4-5, HTA-4-6
424	U Isotopes	2-30.6
425	Th-229, 230, 232	TBD
426	Ra-226	PNL-SP-37
430	Total Beta	HTA-4-23, HTA-4-8
431	Sr/Y-90	HTA-4-8
432	Tc-99	HTA-4-12
433	C-14	HTA-4-17
435	I-129	7-40.17, 7-40.26
436	Se-79	7-40.15
437	Sn-126	HTA-4-21
438	Zr-93	TBD
439	Ni-63, 59	PNL-SP-38
440	Sm-151	TBD
441	Tritium	PNL-SP-30, PNL-SP-33
442	Liquid Scintillation - Solution Analysis	HTA-4-4
450	Gamma Scan (Cs-137, Co-60, Nb-94, Cs-134, Am-241, Pa-231, Ra-226, Ru/Rh-106)	HTA-4-9 HTA-4-9
460	Nuclides by MS or by Calculations (Pu-240, Pu-241, U-234, U-236, Cs-135, Ni-59)	2.30.6, HTA-4-40
470	Uranium by Fluorescence	HTA-4-16

PHYSICAL TESTING

<u>Number</u>	<u>Analyte/Method</u>	<u>Procedure</u>
501	Weight	WHC-053-1
502	Volume	WHC-053-1
503	Density	WHC-053-1
504	Wt % Solids	PNL-ALO-504
505	Particle Size	2-50.2, 2-50.3
506	Penetrometer	PNL-ALO-506
507	Viscosity	WHC-053-1
508	TGA/DSC	TBD
509	Thermal Output	TBD
(Procedure numbers 520 - 529 for Slurry Only)		
520	Settling Rate	WHC-053-1
521	Volume % Settled Solids	WHC-053-1
522	Volume % Centrifuged Solids	WHC-053-1

EXAMPLE

SST SAMPLE TEST INSTRUCTION FOR CHEMICAL ANALYSES

DATE PREPARED : _____ PREPARED BY : _____

SAMPLE NUMBER : _____

APPROVED BY : _____ Date _____
Project Manager

CONTROLLING DOCUMENTS :

TEST PLAN _____

PROJECT SOW _____

INTRODUCTION

This Test Instruction (TI) defines the scope of work to be completed on Sample 88-250. Sample 88-250 is a Homogenized Segment of WHC Core #49492. This TI is based on the test plan identified above. Any deviation on the instructions contained in this TI will require prior approval from the Project Manager.

All analyses are to be completed following the identified procedures. Any deviations for the procedure must be documented and this documentation must accompany the analytical data. All analytical data are returned to the Project Management Office.

REQUESTED ANALYSES

<u>Requested Analysis</u>	<u>Procedure #</u>	<u>Task Leader</u>	<u>Data by :</u>
- ICP Metals from Acid Digestion	PNL-SP-7	Hara	_____
- ICP Metals from Fusion	PNL-SP-7	Hara	_____
- Total Uranium (fluorimeter)	HTA-4-16	Kaye	_____
- Anions by IC	7-40.8	Stromatt	_____
- pH on Water Leach	WHC-053-1	Steele	_____

<u>Requested Analysis</u>	<u>Procedure #</u>	<u>Task Leader</u>	
- TOC on Water Leach	7-40.7	Stromatt	_____
- TOC on Solids	7.40.16	Baldwin	_____
- Wt. % Solids	PNL-ALO-504	Steele	_____
- Radionuclides from Fusion (Na ₂ O ₂ fusion only)			
- Total Alpha	HTA-4-22, HTA-4-6	Kaye	_____
- Total Beta	HTA-4-23, HTA-4-8	Kaye	_____
- Gamma Energy Analysis	HTA-4-9	Kaye	_____

SAMPLE PREPARATION INSTRUCTIONS

<u>TECHNIQUE</u>	<u>PROCEDURE #</u>	<u>Priority</u>
Acid Digestion for ICP Metals	PNL-ALO-102	2
Sodium Peroxide Fusion (Zr Crucible)	PNL-ALO-103	1
- Split for ICP Metals and Radiochemistry		
Water Leach for pH, anions, and TIC/TOC	PNL-ALO-104	3

SAMPLE SPLITS REQUIRED FOR :

<u>Analysis</u>	<u>Amount Re'qd</u>	<u>Task Leader</u>
- TOC on Solids	1 gram	Baldwin
- Total Uranium	100 mg	Kaye
- Wt% Solids	4 grams	Steele

EXAMPLE

SST SAMPLE TEST INSTRUCTION FOR PHYSICAL TESTING

DATE PREPARED : _____ PREPARED BY : _____

SAMPLE NUMBER : _____

APPROVED BY : _____ Date _____
Project Manager

CONTROLLING DOCUMENTS :

TEST PLAN _____

PROJECT SOW _____

INTRODUCTION

This Test Instruction (TI) defines the scope of work to be completed on the Prehomogenized Segment # 4 of WHC Core #49492. This TI is based on the test plan identified above. Any deviation on the instructions contained in this TI will require prior approval from the Project Manager.

All analyses are to be completed following the identified procedures. Any deviations for the procedure must be documented and this documentation must accompany the analytical data. All analytical data are returned to the Project Management Office.

REQUESTED ANALYSES

<u>Requested Assessment</u>	<u>Procedure #</u>	<u>Task Leader</u>	<u>Data by :</u>
- Weight	WHC-053-1	Scheele	_____
- Volume	WHC-053-1	Scheele	_____
- Density	WHC-053-1	Scheele	_____
- Particle Size	2-50.2, 2-50-3	Burt	_____
- Penetrometer	PNL-APO-	Scheele	_____

Requested AssessmentProcedure #Task LeaderData by : Page 4 of**- Slurry Only****- Settling Rate****WHC-053-1****Scheele**

**- Vol% Settled
Solids****WHC-053-1****Scheele**

**- Vol% Centrifuged
Solids****WHC-053-1****Scheele**

Page ____ of ____

SST CHAIN OF CUSTODY

SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION
SENDER		DATE
RECEIVER		DATE

SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION
SENDER		DATE
RECEIVER		DATE

SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION
SENDER		DATE
RECEIVER		DATE

SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION
SENDER		DATE
RECEIVER		DATE

SUPPORTING DOCUMENT

1 Page 1 of 101

2 Title Analytical Chemistry Services Laboratories Quality Assurance Plan		3 Number WHC-SD- QAPP-001	4 Rev No. 0
5 Key Words Analytical Chemistry Services Laboratories Quality Assurance Plan		6 Author G. B. Svancara S. S. Moss Name (Type or Print) <i>Stephen Scott Moss</i> Signature 12743 Organization Code	

7 Abstract

The current quality assurance program used within Analytical Chemistry Services is described. Procedures which implement quality assurance actions are listed. Correlations are made between the 18 elements of ANSI/ASTM/NQA-1, the nine functions of ASTM C 1009-83, and the Analytical Chemistry Services Laboratories implementing procedures.

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LIST OF ACRONYMS

222-S AL	222-S Analytical Laboratory Facilities
ALP/ALTRP	Analytical Laboratory Procedures/Analytical Laboratory Training Records Program
AMS	Analytical Measurement System
ASCL	Analytical Chemistry Services Laboratories
ATS	Applied Technology Section
CPD	Chemical Processing Division
CR	Control Report
DMC	Data Measurements and Control Section
DOE	Department of Energy
DSI	Don't Say It --- Write It
ECN	Engineering Change Notice
EDC	Engineering Document Control
EDP	Electronic Data Processing
EDT	Engineering Configuration Management
LA	Analytical Procedures
LCCS	Laboratory Customer Communication System
LICCB	Laboratory Instrument Calibration Control Board
LMCS	Laboratory Measurement Control System
LOP	Laboratory Operating Procedure
LR	Laboratory Reference Material Specification
NCR	Nonconformance Report
NDA	Nondestructive Assay
NIST	National Institute of Standards and Technology (formerly National Bureau of Standards)
OJT	On-the-Job Training
OSCR	Off-Standard Condition Report
PAL	PUREX Analytical Laboratory
PCA	Procedure Change Authorization
PFP EL	PLutonium Finishing Plant Engineering Laboratory
PR	Precision Report
QA	Quality Assurance
QAPI	Quality Assurance Program Index
RIDS	Records Inventory and Deposition Schedule
RSA	Request for Special Analysis
SD	Supporting Documents
UO3	Uranium Oxide Plant
WHC	Westinghouse Hanford Company

ANALYTICAL CHEMISTRY SERVICES LABORATORIES
QUALITY ASSURANCE PLAN

INTRODUCTION

All work performed by Westinghouse Hanford Company (WHC) is to conform to ANSI/ASTM NQA-1. NQA-1 is a Quality Control Program for nuclear facilities. ASTM C 1009-83 is a consensus document published by the American Society for Testing and Materials as a "Standard Guide for Establishing a Quality Assurance Program for Analytical Chemical Laboratories within the Nuclear Industry". C 1009 interprets the 18 elements of NQA-1 for applicability to an analytical chemistry laboratory. The 18 elements of NQA-1 are organized into the nine functions identified in C 1009 as the basic elements of a laboratory quality assurance program.

The purpose of this document is to describe the WHC's Analytical Chemistry Services Laboratories (ACSL) Quality Assurance Program. The organizational outline in ASTM C 1009 is used for this document. The procedures which implement the quality assurance requirements in C 1009 are detailed within the text and appendices to this document.

Appendix J is provided as a Quality Assurance Program Index (QAPI) for the ACSL. In this index, implementing procedures are correlated with the 18 elements of NQA-1.

1.0 ORGANIZATION

1.1. OBJECTIVE

The location of the laboratory within the company organization shall be identified and the internal structure defined. The responsibilities assigned to various functional positions shall be documented, along with the authorities granted to carry out the responsibilities. Interfaces between groups and organizations within and outside of the company shall be identified and described.

1.2. PROGRAM IMPLEMENTATION

1.2.1. Structure

Within WHC the ACSL are located in the Chemical Processing Division (CPD) which is one of the Defense Program Divisions. The Vice President, Defense Program Divisions reports to the President of WHC.

The ACSL represents a collection of five entities who report to the manager of the CPD through several organizational pathways. These entities consist of the 222-S Analytical Laboratory Facilities (222-S AL), the Plutonium Finishing Plant Engineering Laboratory (PFP EL), the PUREX Analytical Laboratory (PAL), Applied Technology (ATS), and Data Measurements and Control (DMC). The organizational structure for WHC is documented in WHC-CM-1-2. The organizational pathways of the ACSL within the CPD are detailed in this manual.

WHC-CM-5-4, Analytical Chemistry Services Laboratories Operating Instructions. Procedures 1-02 through 1-06, contain organization charts for the five sections that comprise ACSL.

1.2.2. Functional Responsibilities

ACSL provides analytical services in support of the WHC chemical processing plants, environmental monitoring programs, waste management activities, and other programmatic objectives. The laboratories provide chemical, nuclear, and physical measurements which are used for process control, product material specification evaluation, nuclear material accountability, analytical and process method development, and effluent monitoring. The ACSL are also responsible for the operation of their facilities, the planning and administration of their operating budgets, and to provide scientific apparatus glass working services. The ACSL conducts self-monitoring of all activities within the laboratories.

1.2.2. Functional Responsibilities (Continued)

and provides a data communication and evaluations system for dissemination of analytical results to customers.

Responsibilities described in this document are assigned in various sections of WHC-CM-5-4 and in Procedure LQ-150-001. Responsibilities defined in WHC-CM-5-4 are assigned in Section CH 1.2 of WHC-CM-1-2, Organization Charts and Charters.

1.2.2.1. By Organization

Analytical laboratory sections, 222-S, PFP, and PUREX, are organized by physical facility and are staffed with section and unit managers and bargaining unit personnel. These groups perform the routine analytical work.

Scientists in the ATS provide technical support for all analytical sections/units. The DMC provides standards, data processing, and internal audits for all laboratory sections.

222-S Analytical Laboratory Facilities Section

The analytical services provided by 222-S AL include analysis of effluent, waste management, Uranium Oxide (UO₃) Plant process, research support, and essential plant material samples. The 222-S Laboratory Building is the location of the principal counting room supporting radiochemical analysis for ACSL.

The Building Operations Unit provides services to the 222-S Facility that are performed by Plant Operations groups in operating plant facilities, (e.g., landlord services.) This unit also provides stockroom support and glassblower services. This unit does not perform any analytical measurements.

Plutonium Finishing Plant Engineering Laboratory Section

The PFP EL provides analytical services in support of the PFP processes. This laboratory group also provides analytical support to the UO₃ and PUREX plants. Personnel make the required nuclear material accountability sample analyses and product specification measurements on plutonium bearing material. Analyses are also made in support of criticality safety controls and shipper/receiver requirements for all plutonium bearing materials shipped or received in the 200 Areas by WHC.

PUREX Analytical Laboratory Section

The PAL provides the process control, effluent monitoring, and criticality control measurements for the PUREX plant. The group also makes the measurements for nuclear material accounting on the feed streams, waste streams, and uranium streams. Accountability measurements are also made on rework and recycle streams.

Applied Technology Section

The ATS provides technical oversight and support to all of the laboratories. The scientists in the Analytical Chemistry and Nuclear Measurements units prepare technical procedures, train laboratory personnel, and monitor method performance. The scientists establish, troubleshoot, and assure proper repair of analytical instrumentation.

Data Measurement and Control Section

The DMC Manager is assigned quality assurance overview responsibility for all the activities within ACSL. He also has approval authority for laboratory-wide Laboratory Operating Procedures.

Personnel assigned to this section perform routine surveillances of adherence to policy and procedure by the other laboratory sections. DMC also provides an interface with regulatory and outside audit agencies to assure compliance to rules and regulations. Coordination of the documentation required to support the ACSL mission is also accomplished by this section.

The Technical Support Unit has the responsibility for all laboratory computer systems and application of automation. They maintain the Laboratory Customer Communications System (LCCS) and Laboratory Measurement Control System (LMCS) which are data communication and evaluation systems for the laboratories. The Standards Preparation Unit provides reagents and standards for calibration and quality control. The unit develops and maintains a stock of blind standards for method control overview programs. The unit also provides calibration services for volumetric glassware and thermometers.

1.2.2.2. By Position

All laboratory personnel are responsible for implementation of the quality assurance practices described in this document and prescribed in the company manuals applicable to their work assignments.

1.2.2.2. By Position (Continued)

Laboratory Managers

Laboratory managers are responsible for the coordinated operation of the laboratories. This includes financial planning and reporting, adjusting the manpower to meet changing work needs, selection of personnel, integration of manpower with other sections, and assuring that the various training requirements are met. Each manager has the responsibility of implementing the quality control activities in his laboratory group.

Unit Managers

Unit managers supervise work done by the technologists to analyze the samples submitted to the laboratory. They are responsible for the safe, accurate and timely completion of the work and training of their personnel. They interface with those submitting the samples to assure that the work performed meets the needs of the customers. The unit managers are responsible for selection of the best analytical method to use in analyzing samples. They assure that the work done meets required measurement performance criteria, i.e., precision and accuracy.

Each managerial position has a specific position description describing his/her duties which is maintained by Human Resources with field copies maintained by various managers.

Scientists

Scientists are responsible for writing purchase specifications and setting-up and maintaining operability of analytical instrumentation. They develop the analytical methods and write the procedures used in analyzing samples. They provide an ~~is~~ overview of method performance and quality control. Scientists work directly with the managers and laboratory customers to provide technical support in the evaluation of data and the selection of the best analytical method to use in analyzing samples. They assist in the training of personnel particularly in areas of high technology.

General descriptions delineating qualifications (training and experience) for scientists are maintained by Human Resources.

Bargaining Unit Personnel

The senior chemical technologists and the chemical technologists are members of the Bargaining Unit and as such perform work in accordance with the current labor contract.

1.2.2.2. By Position (Continued)

Senior chemical technologists perform analytical laboratory analysis and/or assignments of diverse and complex nature, requiring the full knowledge of analytical laboratory techniques and procedures and the ability to operate the analytical laboratory equipment. Senior chemical technologists may direct activities of others and give on-the-job training to less experienced personnel.

Chemical technologists perform various assignments and/or analytical laboratory analyses on a variety of samples by chemical, physical, instrumental, and radiochemical methods using a variety of laboratory instrumentation and equipment and following the laboratory procedures. Chemical technologists may direct others and give on-the job training to less experienced personnel.

Requesters/Sample Suppliers

Suppliers of samples are responsible for taking samples, identifying samples, designating required analyses, and providing adequate sample information to ACSL. The reliability and traceability of samples from generation to submittal to the laboratory are maintained by the supplier. Upon receipt, ACSL is responsible for maintaining reliability and traceability through proper handling and storage practices. Although responsibility for sampling and sampling plans rests with the requestor, assistance in developing plans may come from ACSL.

1.2.3. Levels of Authority

Laboratory Manager

The laboratory manager has approval authority for procedures and documents prepared in accordance with WHC-CM-5-4. The laboratory manager has approval authority for combined data reports generated by the units reporting to him/her.

Unit Manager

The unit manager has full decision making authority and approval authority for the analytical results issued by his/her laboratory unit. In special cases a unit manager may declare an instrument system operational.

1.2.3. Levels of Authority (Continued)

Scientist

The scientist has full decision-making authority on the operational readiness of the instrument systems assigned to him/her.

Authority is granted to other personnel, as necessary, to carry out their assigned responsibilities.

1.2.4. Interfaces

Communication systems used in the various laboratory groups are dependent on the particular sample and customer. A network computer system is used to communicate sample results to some of the customers. Some sample data is classified as secret restricted data and must be handled in restricted ways. These formal reporting systems are described in the documents listed in Appendix A.

The use of telephone, DSI, internal memos, and external letters to communicate laboratory results are used as the conditions warrant. In all cases original basic laboratory records are maintained to support these communications.

Appropriate meetings between laboratory and customer representatives are held. Formal presentations may be made and written minutes issued. Some meetings are only information exchanges and planning sessions of an informal nature.

References:

ASTM C 1009-83, "Standard Guide for Establishing a Quality Assurance Program for Analytical Chemistry Laboratories within the Nuclear Industry," Section 5

WHC-CM-1-2, Organization Charts and Charters.

WHC-CM-5-4, Analytical Chemistry Services Laboratories - Operating Instructions.

2.0 QUALITY ASSURANCE PROGRAM

2.1. REQUIREMENTS

The quality assurance program implemented shall meet the requirements specified in ASTM C 1009. The topics specified in ASTM C 1009 are those from ANSI/ASTM NQA-1 which apply to analytical laboratories working within the nuclear industry.

Appropriate documents, procedures, and directions shall be prepared and approved to establish how the quality assurance requirements are implemented in laboratory operations. Laboratory management shall assure that all their personnel understand the laboratory quality assurance program and are trained in the use of the implementing procedures and directions. Annually, the quality assurance program shall be formally reviewed for adequacy and revised as needed. Assessments of program adequacy shall be documented.

2.2. PROGRAM IMPLEMENTATION

2.2.1. Basis for a Quality Assurance Program

This document defines the ACSL Quality Assurance Program. This quality assurance program meets the requirements of WHC-CM-4-2 and NQA-1 as specified in ASTM C 1009-83. Manual WHC-CM-5-4 and other appropriate documents, procedures, and directions shall be prepared and approved to establish how the quality assurance requirements are implemented in laboratory operations.

Table 2.2.1 shows the related sections of this document and the quality assurance requirements specified in ASTM C 1009 and ANSI/ASTM NQA-1. All nine elements of quality assurance contained in the C 1009 Standard are addressed in this quality assurance program. The nine elements are based on 14 of the 18 requirements in the NQA-1 Standard. Requirements 3 (Design Control), 4 (Procurement Document Control), 7 (Control of Purchased Items and Services), and 11 (Test Control), are not addressed in ASTM C 1009. For ACSL, activities related to the first three of these requirements are carried out primarily by other WHC organizations such as Quality Assurance and Procurement and Materials Management.

Table 2.2.1

RELATIONSHIPS BETWEEN SECTIONS OF THIS DOCUMENT, ASTM C-1009, AND NQA-1

<u>SECTION OF THIS DOCUMENT</u> <u>TOPIC</u>		<u>ASTM</u> <u>C-1009*</u>	<u>NQA-1 ELEMENT</u>
1.	Organization	5	1
2.	Quality Assurance Program	6	2
3.	Training and Qualification	7	2,9
4.	Procedures	8	5,6,9
5.	Laboratory Records	9	6,9,17
6.	Control of Records	10	17
7.	Control of Equipment and Materials	11	8,10,12,13,14,15
8.	Control of Measurement	12	12,14
9.	Deficiencies and Corrective Actions	13	16,18

* Sections 1, 2, 3, & 4 of ASTM C-1009 are introductory and policy statements on quality assurance in the laboratory.

2.2.1. Basis for a Quality Assurance Program (Continued)

These activities are controlled and verified through the WHC Quality Assurance Program which is defined in WHC-CM-4-2. NQA-1 Element 11 (Test Control) is performed by ACSL for WHC to verify that purchased plant materials meet the quality specifications given for their use by the plants. This is done through the use of Laboratory Essential Material Procedures.

2.2.2. Quality Assurance Documentation

This document describes the ACSL Quality Assurance Program, and is organized so that different sections address each of the nine topics in ASTM C 1009. Within each section, the requirements of that portion of the quality assurance program are specified and the implementation of the requirements within ACSL described. Specific procedures used to define and implement the requirements are given in the text and appendices of this document.

2.2.3. Quality Assurance Program Modification

Should a modified quality assurance program be required for another project or special types of samples, its requirements must be added to this document or a separate quality assurance program document must be prepared. A modified quality assurance program may have fewer quality assurance requirements or it may have additional requirements imposed from another quality assurance standard or other requirements documents. If the modified program requires new laboratory procedures or the revision of existing procedures, they will be prepared according to Section 5 of WHC-CM-5-4.

2.2.4. Quality Assurance Administration

Administration of the ACSL Quality Assurance Program is assigned to the DMC Manager. He delegates various aspects as follows:

Personnel assigned quality assurance overview responsibility have experience in the management and technical aspects of the analytical laboratories. These people have full access to all technical records and to all laboratory personnel. In addition, they are supported by the statistics team of the Process Chemistry & Engineering Laboratories Section. Scientists and/or managers within ACSL may be delegated the task of overview. Generally personnel providing quality assurance overview are selected so that they are not directly responsible for implementation of the quality assurance program in the area being reviewed. For cases where technical expertise is required personnel with operational responsibility may be assigned to a quality overview team.

2.2.4. Quality Assurance Administration (Continued)

Scientists in the DMC Section are assigned responsibility for the Laboratory Measurement Control System (LMCS) and for the issuance of special and periodic reports.

Section and unit managers are responsible for implementing the QA program in their areas of responsibility. The DMC Manager is assigned general quality assurance overview responsibility for all analytical measurement systems (AMSs) used in ACSL. Scientists within DMC are assigned specific review responsibilities for AMSs on a permanent basis as well as an as-needed basis. These scientists may also perform surveillances of laboratory practices.

2.2.5. Management Assessments

At least annually, the Manager of DMC will assess the adequacy of the ACSL Quality Assurance Program. The assessment may involve reviewing past internal and external audit reports, interviewing laboratory and quality assurance personnel, and reviewing records and other documents. The assessment will be documented by a report that includes as a minimum a description of how the assessment was conducted, recommendations for improvements, if any, and a statement about the overall adequacy of the program. The manager may do the assessment or have it done by someone outside of the organization.

References:

ASTM C 1009, Section 6

WHC-CM-4-2, Quality Assurance Manual, Section QI 2.2, "Quality Assurance Program Planning."

WHC-CM-5-4

3.0 TRAINING AND QUALIFICATION

3.1. REQUIREMENTS

Management must maintain a documented training system to assure that persons are adequately trained and that their training remains current as changes in work practices occur. Such a program must be based on job requirements relating to skills, knowledge, and levels of competency required for adequate and safe job performance. Quality assurance training should be included. Management is responsible for assuring that analysts are qualified on general operating practices as well as on specific analyses.

Training records must show the past and current training status of each person trained. Qualification records shall be kept which document the basis of an analyst's qualification and show management certification of qualification. Certification includes not only specific training, but also the review and verification of applicable education and experience. Qualification shall be reviewed and updated at least every two years.

3.2. PROGRAM IMPLEMENTATION

3.2.1. Training

Training of personnel within ACSL is accomplished through the following means:

Company-Wide Classes - These classes deal with security and safety topics and are under the control of the WHC groups assigned to monitor and maintain each program. Westinghouse Hanford Company policies specify which classes are required for laboratory personnel.

Laboratory Classes - This training is provided by the laboratory and consists of formal training programs. Training for new chemical technologists consists of formal classroom and hands-on training in laboratory safety and basic analysis techniques. Self-study guides and examinations covering company and laboratory policies and procedures are often used by managers and scientists. Appendix B lists these courses.

3.2.1 Training (Continued)

On-the-Job Training (OJT) - This training in specific laboratory procedures is provided under the direction and observation of knowledgeable employees. Managers direct the effort, but actual training may be delegated to scientists or technologists who have documented qualification in the subject being taught. All OJT instructors must have attended the OJT Instructors Course. All training is accomplished and documented according to Instruction 4-01 in WHC-CM-5-4.

Development and Enrichment - There are a number of classes and learning opportunities available to management and technical staff to enhance their performance capability. Many of these courses are taught offsite by non-WHC staff including vendors, consultants, technical experts, and university personnel. Attendance at these classes is contingent on management concurrence.

WHC-CM-1-1, Management Policy, Section 4.3, "Employee Training and Development," is a statement of WHC's commitment to training. All training is in support of Department of Energy (DOE) Order 5480.5.

WHC-CM-8-1, Operations Support Services Manual, describes WHC's formal training program. Procedure 9-01, "Administration of Training," describes the organizations that provide the training. Procedure 9-03, "Training Schedule," describes the employee's responsibility for being aware of their training needs and for participating in training as identified and scheduled by their immediate supervisor.

WHC-WD-56110-004, 200 Area Analytical Laboratory Training Program for Technologists, Managers, and Scientists, is a working level document prepared by WHC Technical Training detailing the laboratory training program for technologists, managers, and scientists.

WHC-CM-5-4, Procedure 4-01, "On-The-Job Training and Qualification of Laboratory Personnel," specifies the laboratory training and qualification program and the records used to document qualification.

Formal indoctrination in the ACSL Quality Assurance Program is done by training on Procedure LQ-150-001. The Performance Check List is used to document this training. "Good laboratory practices" and additional quality assurance orientation and training are accomplished through laboratory training classes and management tutoring.

3.2.2. Qualification

Qualification of technical staff is based on education and experience in laboratory operations. Scientists, by reason of their education, training, and experience, may be qualified as analysts for all methods within their areas of responsibility.

Chemical technologists are qualified to perform analyses as they meet the specifications given in WHC-CM-5-4, Instruction 4-01. Training is tailored to the work assignment, education, and experience of the technologist as determined by his/her manager. Qualification is documented on the Performance Check Lists shown in Instruction 4-01.

For those tasks that are "performing an analytical measurement," the technologist must demonstrate proficiency by analysis of a method control standard. The number of standards required and the time period for qualification may vary, but the normal criteria is to achieve analytical recovery on three consecutive standards (1) over a period not to exceed three days and (2) obtain results which are statistically equivalent to the results achieved by those currently trained and performing the work. Provisions are made on the Performance Check Lists for management to show its approval of each analyst's qualification.

For those tasks not in support of an analytical measurement, the technologist's performance is documented by the trainer based on observation of adherence to the criteria detailed on the Performance Check List.

Documentation of requalification on modified/revised procedures is by dated management and technologist signatures (initials) in the Procedure Change Authorization Log Book and/or by documentation on the previous Performance Check List or on a new Performance Check List.

3.2.3. Proficiency Evaluation

The proficiency of laboratory personnel is evaluated at least annually in performance appraisals. As a minimum, each appraisal includes the date of the evaluation and a statement summarizing the status of proficiency.

Loss of proficiency in an area of work is documented by updating the current qualification form. When proficiency is regained, the qualification form is again updated and includes the documentation of any retraining done.

3.2.4. Records

Training records for the company and laboratory classes are maintained on a computer data base by the Computer Based Training Department.

Performance Check Lists for documenting OJT are kept in the employee's work location and go with the employee when he/she transfers. These sheets are kept as long as the employee's qualification is active. A computer based tracking system for employee qualifications is also maintained under the Analytical Laboratory Procedure/Analytical Laboratory Training Records Program Computer Programs (ALP/ALTRP).

Copies of employee's annual performance appraisals are maintained in the employee's field file.

References:

ASTM C 1009, Section 7

WHC-CM-5-4

WHC-CM-1-1, Management Policies.

WHC-CM-8-1, Operations Support Services Manual.

WHC-WD-56110-004, 200 Area Analytical Laboratory Training Program for Technologists, Managers, and Scientists.

4.0 PROCEDURES

4.1. REQUIREMENTS

Procedures and methods shall be prepared, reviewed, and approved for use in performing laboratory operations and analyzing samples. Procedures provide direction for those doing the work in order to provide consistent operation, control analyses, and avoid errors. They also provide information for training analysts, establish the technical basis for the methods, and document the processes used in the analyses. Procedures shall be prepared by following established formats and shall be reviewed for clarity, completeness, and technical accuracy. Before procedures and methods are issued, they shall be approved by designated management. The distribution of procedures and methods shall be controlled to assure that all controlled copies are updated when revisions are made. Copies of procedures and methods shall be located in work areas where they are used. Only the latest revisions shall be used at work places. Changes to procedures and methods shall be reviewed, approved, and documented.

4.2. PROGRAM IMPLEMENTATION

Analytical measurements and routine laboratory support activities (sample receiving, waste handling, etc.) are described by written procedures and directions to assure accuracy, consistency, and safety. ACSL uses three different types of documents to fulfill this purpose.

Laboratory Supporting Documents are used to explain the technical background for laboratory activities. Laboratory Supporting Documents are prepared and controlled as specified in various instructions found in WHC-CM-5-4 and WHC-CM-6-1, Standard Engineering Practices.

Laboratory Directions give concise procedural steps for a laboratory activity. Laboratory Directions are not authorized without a Laboratory Supporting Document to detail the technical basis for their use.

Laboratory Procedures give the steps for performing a laboratory activity but also include some technical and explanatory information.

Laboratory Directions and Procedures are prepared, used, and controlled as specified in various instructions found in WHC-CM-5-4 and WHC-CM-5-5, Operations. General Administration.

4.2.1. Preparation

4.2.1.1. Format and Content

Six types of laboratory procedures and directions are defined and described in WHC-CM-5-4, Instruction 5-01. They are:

- LA - Laboratory Analytical Procedure/Direction
- LC - Laboratory Computer Procedure/Direction
- LE - Essential Material Procedure/Direction
- LO - Laboratory Operating Procedure/Direction
- SO - S-Plant Operating Procedure
- LQ - Laboratory Quality Control Procedure/Direction
- LR - Laboratory Reference Material

The SO procedures are Laboratory Operating Procedures written for the 222-S Laboratory to provide services that are performed by Plant Operations groups in operating plant facilities.

Every procedure/direction is assigned a unique identification code according to the format specified in Instruction 5-02 and Procedure LO-155-002.

Instruction 5-01 gives recommended topics to cover in a laboratory procedure. They are: summary, applications, limitations, unique safety considerations, reagents, equipment, procedural steps, calculations, calibrations, discussion, procedures referenced, and general references.

Instruction 5-06 gives instructions for format to be used for Laboratory Directions. They could include: summary, unique safety considerations, reagents, special equipment, and procedural steps..

Laboratory Supporting Documents (SD) do not have a format specified but do require a particular title page which contains information needed for document release, distribution, and change control. These specifications can be found in WHC-CM-6-1, Procedure EP-1.12. The identification number for a supporting document is obtained from the Supporting Document Release Station. Precise directions for this can be found in Instruction 5-04.

4.2.1.2. Writing

The laboratory procedures, directions, and supporting documents are written by management and technical staff based on technical knowledge, literature sources, and laboratory experience. Vendor manuals and training course texts are cited where necessary.

4.2.1.3. Editorial/Technical Review

For laboratory procedures a preliminary review to ensure that the procedures are technically correct and usable without further clarification is accomplished by either a "peer review" and/or a "user test." This process is documented by either an Operating Documents Preliminary Review Form or a User Test Approval Form. The acceptance review is accomplished by the appropriate members of the Laboratory Procedure Review Committee. These reviews are documented on the Document Acceptance Review Form. The procedure administrator assures that all review comments are addressed. Specific details of these review processes can be found in Instruction 5-03 in WHC-CM-5-4 and Procedures GA-3.8 and GA-3.9 in WHC-CM-5-5.

Laboratory Directions are based on a technical supporting document and do not exist alone. Therefore, the amount of review they need is less than for procedures and is determined by the approval authority. The Document Acceptance Review Form is used to document these reviews. Instruction 5-06 in WHC-CM-5-4 details this information.

Supporting documents are reviewed by various organizations within WHC as determined by the approval authority. These reviews are documented on the Engineering Data Transmittal (EDT) form. Instruction 5-04 in WHC-CM-5-4 and Procedures EP-1.6 and EP-1.7 in WHC-CM-6-1 give more details of this process.

4.2.1.4. Approval

Each document is covered by an approval page signed by reviewers, the approval authority, and laboratory management. The specific signatures needed are detailed in the WHC-CM-5-4 Instructions and WHC-CM-6-1 Procedures listed in the review paragraphs above.

4.2.2. Control

All laboratory procedures, direction, and documents are under the administration and control of Engineering Configuration Management (ECM), through the Engineering Document Control (EDC) Group.

The laboratory procedures and directions are issued according to the Westinghouse Operating Document Control System and are administered by 200 West Area and 200 East Area Document Control. These are two sections within the EDC Group. Active laboratory procedures and directions have no fixed expiration date, but shall be reviewed at least every 24 months for accuracy and adequacy. This review is documented on the "Periodic Review of Operating

4.2.2. Control (Continued)

Operating Documents" form. When a current procedure is not to be used for task performance it is "inactivated" through a written request to ECM from the section manager. When a procedure is no longer required, it is "voided" through the same means. Engineering Document Control removes all inactivated or voided documents from all controlled locations. Detailed information concerning these activities can be found in Instruction 5-01 in WHC-CM-5-4 and Procedure GA-3.1 in WHC-CM-5-5.

Laboratory Supporting Documents are released by EDC but are administered under the Information Resource Management Document Control System. Supporting documents have no expiration date or fixed review interval. The EDC is responsible for the control and accountability of supporting documents as described in Procedure EP-1.12 in WHC-CM-6-1. The Initial Release and Change Control Record is used by EDC to maintain a record of initial release and subsequent revision.

An Engineering Change Notice (ECN) is also used to cancel/void a supporting document or to cancel/void or supersede another ECN. Details of this process are in Procedure EP-2.2 in WHC-CM-6-1.

4.2.2.1. Distribution

Three distribution classes are defined for procedures and directions.

Goldenrod - Fully approved, release-stamped, auditable copies at the work site and in certain other specified work locations.

White Copy - Uncontrolled copies of the goldenrod document used for reference only.

Blue User - A laboratory procedure used by a limited number of people under controlled conditions to test the method. Use of this special type of procedure is detailed in Instruction 5-03 of WHC-CM-5-4.

The goldenrod procedures and directions are release-stamped, duplicated, distributed, and maintained by EDC.

Distribution for supporting documents is specified on the Engineering Data Transmittal Distribution Sheet. Supporting documents are release-stamped by ECM and then duplicated, distributed, and maintained by Information Resource Management Document Control.

4.2.2.2. Application

The applicability of a procedure for analyzing particular sample types is decided by laboratory management based upon recommendations from the technical staff. This information is incorporated into formal computerized sample schedules which are used to control how particular samples are analyzed. For non-routine samples methods are specified by management upon consultation with the customer and appropriate scientist. When sample schedules are changed, laboratory management reviews and approves the change after evaluating the effectiveness of the specified analytical method for the measurement point.

4.2.2.3. Changes

A Procedure Change Authorization (PCA) is used to quickly change laboratory procedures and directions. The alterations to the procedure are listed on the PCA form and approval signatures are obtained. Engineering Document Control issues the PCA. Two types of PCAs exist: 1) temporary, which are not normally incorporated into the procedure and 2) permanent, which must be incorporated into a new revision or modification of the procedure prior to expiration of the PCA.

A procedure is "revised" when there are significant permanent safety, technical, or operational changes. Revisions are prepared, reviewed, approved, and issued per the same requirements as for a new document. (See Section 4.2.1.) Document format and content must be updated to meet current procedure preparation requirements before revisions can be approved and released. Engineering Document Control modifies the periodic review dates as appropriate.

If only minor changes are to be made to a procedure or direction, it is "modified." In a modification, only the changed pages need to be reviewed and updated. The acceptance review is restricted to the incorporated changes and the other pages they impact unless safety issues are involved. The modification needs the approval of only the author, procedure administrator, and approval authority. The procedure is re-issued with the new revision/modification number and EDC stamp.

Engineering Document Control is responsible for issuing all PCAs as well as revisions and modifications to laboratory procedures and directions. Details for these operations can be found in Procedures GA-3.10 and GA-3.11 in WHC-CM-6-1.

Supporting Documents are revised using the ECN form. For Direct Changes, the ECN summarizes the change description and is the authorization for a new revision of the document to be issued.

4.2.2.3. Changes (Continued)

For Supplemental Changes, the ECN delineates the change details and becomes a part of the document. Supplemental ECNs are incorporated into the document in the next revision. Both methods are detailed in Procedure EP-2.2 in WHC-CM-6-1. Approval signatures are obtained from the author and the author's manager. Engineering Document Control release-stamps the ECN/document and Information Resource Management Document Control distributes complete document revisions or document with supplemental ECN incorporated to the same (or officially revised) recipients as the original document.

References:

ASTM C 1009, Section 8

WHC-CM-5-4,

- a. Instruction 5-01, "Laboratory Procedure Instruction."
- b. Instruction 5-02, "Laboratory Procedure Identification Numbers."
- c. Instruction 5-03, "Laboratory Procedures Approval System."
- d. Instruction 5-04, "Laboratory Supporting Document Procedure."
- e. Instruction 5-06, "Laboratory Directions Instruction."

WHC-CM-5-5, Operations - General Administration.

- a. Procedure GA-3.1, "Operating Document Control System."
- b. Procedure GA-3.8, "Essential Material Specifications and Procedures."
- c. Procedure GA-3.9, "Preparing, Reviewing, and Approving Operating Documents."
- d. Procedure GA-3.10, "Changing Operating Documents."
- e. Procedure GA-3.11, "Procedure Change Authorizations and Interim Procedure Changes."

WHC-CM-6-1, Standard Engineering Practices.

- a. Procedure EP-1.1, "Engineering Document Identification."
- b. Procedure EP-1.6, "Engineering Data Transmittal (EDT)."
- c. Procedure EP-1.7, "Engineering Document Approval and Release Requirements."
- d. Procedure EP-1.12, "Supporting Documents."
- e. Procedure EP-2.2, "Engineering Document Change Control."

LO-155-002, "Numbering of Laboratory Procedures."

5.0 LABORATORY RECORDS

5.1. REQUIREMENTS

The laboratory record system shall provide for complete documentation of the work done in the laboratories, from receipt of samples to reporting of analytical results. The following five functions shall be included in the system: 1) receive sample information from the requester, 2) provide sample identification, 3) transmit information and data through the laboratory, 4) provide a record of data and information generated during analysis of samples, and 5) report results of analyses. The system may be a manual system using forms and other documents, a computerized system, or a combination of both. Whatever is used, the system shall be described and instructions for its use shall be available for laboratory personnel.

Manual entries on all records shall be made in ink. All analytical (measurement) data entries shall be signed and dated by the analyst doing the work. Data entries into a computer system shall be identifiable as to who made the entries and the dates of entries. A computer system shall have provisions for making corrections.

The basic information that the record system shall contain relating to each sample is the following: sample submitter, date received in the laboratory, analyses required, type of material, laboratory sample identification (laboratory serial number), date analyses completed (date results reported), and date sample returned or discarded. The record system shall document the following basic information generated during analyses: measurement (sample) data, calibration and control standards reported, who did the work, and when it was completed. Distribution and retention time of each type of record in the system shall be established and documented. Analytical results shall be reviewed (evaluated) and approved before being reported.

5.2. PROGRAM IMPLEMENTATION

ACSL uses a manual/paper record system to document laboratory work, supplemented by computer systems for tracking and reporting results. Entries on paper records are made in ink. Incorrect entries are initialed and a line drawn through the incorrect entry in such a way that the entry is still readable. All analytical (measurement) data entries are dated and marked with the payroll number or initials of the analyst doing the work. Data entries in the computer systems are identifiable as to who made the entries and the dates of entries. The computer systems have provisions

5.2 PROGRAM IMPLEMENTATION (Continued)

for making corrections. The computer system for sample record keeping is called the LCCS. The computer system used for standards record keeping is called the LMCS. Provisions are made in the manual/paper records system for fulfilling the functions of a laboratory record system as described above. The manual/paper record system is the primary record keeping system, although the computer systems fulfill many of the functions of a laboratory record system.

5.2.1. Analysis Request

5.2.1.1. Manual

Most laboratory customers publish a document containing a sample schedule which gives the samples which will require analysis, their origin, frequency, analyses needed, and the turnaround time required for the analyses. When a laboratory customer (e.g. Plant Operations) takes a sample or series of samples, the sample schedule is used to determine what analyses are to be performed. Analytical cards are then manually or computer generated on various forms to initiate the analysis process. For those sample schedules which are programmed into the LCCS computer as a set of sample analysis request menus, the computer is used to generate the analytical cards.

At the PFP Laboratory and in some units at the 222-S Laboratory, the samples submitted are not covered by formal sample schedules. In these cases, the "Request for Special Analysis" (RSA) form is generally submitted with the sample(s) to delineate the analyses requested by the submitter. This form includes instructions for its completion and requests such information as the sample matrix, analyses desired, minimum detection level, measurement uncertainty, sample disposal instructions, and distribution of final results. This is a multi-copy form and copies are retained by both the requester and the laboratory. At the PFP Laboratory, PFP Plant customers use the "Plutonium Finishing Sample Analysis Request" form to specify which analyses are requested for a particular sample. When possible the computer is used to generate all the analytical cards; however, in some cases manual cards or forms are used. Pertinent information (such as assigned sample serial number) relating the analytical cards and the RSA form are written on the RSA. For mass and emission spectrometric analyses

5.2.1.1. Manual (Continued)

at the PFP Laboratory multi-copy forms are used either alone or in connection with an LCCS analytical card to collect the sample information. Analysis Request forms are shown in Figure 5.2.1. and Analytical Cards are shown in Figure 5.2.3.

In some cases, particularly when large numbers of samples are involved, requested sample analyses are transmitted to the laboratories by internal letter. When possible the LCCS program is used to generate the analytical card; otherwise, cards are generated manually.

For nondestructive assay (NDA) analyses done at both PFP and PUREX, analysis requests are verbal; work is coordinated and performed by plant operations personnel.

Sample schedules are retained until superceded, or for a year after the plant has shut down. Sample analysis request forms and internal sample request letters are kept for a period of one year.

5.2.1.2. LCCS

Programmed into the LCCS is a set of sample analysis request menus, which are based on the current sample schedules. When a laboratory customer (Plant Operations) takes a sample or series of samples the sample point is entered into the computer and the series of analyses required is identified. The computer then prints out in the laboratory an analytical card for each analysis on that sample. For essential plant material samples, the analyses needed for particular materials are specified in Laboratory Essential Material Specification Sheets which are then programmed into analysis request menus on LCCS. For samples not covered by a sample schedule or when analyses not specified in the sample schedule are requested, a RSA or "Plutonium Finishing Special Analysis Request" form is filled out by the requestor and submitted to the laboratory with the sample(s). From the information on these forms, laboratory personnel can use a determination menu on LCCS to generate the analytical cards.

5.2.1.3. LMCS

An Electronic Data Processing (EDP) Code has been established for each AMS in the laboratory to track the results of standard analyses. Each EDP Code is assigned a minimum frequency that standards are to be run. The minimum frequency may be a certain number of standards analyzed per fixed time or on a sample batch basis. Analytical cards for standards are either generated on

ANALYTICAL LABORATORIES - 3145 LABORATORY

SEARCH NO.	DESCRIPTION
SEARCH TYPE	LAB NO.
CONTAINER	ANALYST
ANALYSIS DATE	DATE
APPROVAL	DEFINITION
NO.	NO.
DATE	DATE
TIME	TIME

ANALYTICAL LABORATORIES - 3145 LABORATORY

PLUTONIUM FURNISHING ANALYTICAL LABORATORY

SEARCH NO.	DESCRIPTION	LAB NO.	ANALYST	DATE	TIME
SEARCH TYPE	LAB NO.	ANALYST	DATE	TIME	
CONTAINER	ANALYST	DATE	TIME		
ANALYSIS DATE	DATE	TIME			
APPROVAL	DEFINITION	DATE	TIME		
NO.	NO.	DATE	TIME		
DATE	DATE	TIME			
TIME	TIME				

PLUTONIUM FURNISHING ANALYTICAL LABORATORY

PLUTONIUM FURNISHING ANALYTICAL LABORATORY - TECHNICAL SERVICES SECTION

SEARCH NO.	DESCRIPTION	LAB NO.	ANALYST	DATE	TIME
SEARCH TYPE	LAB NO.	ANALYST	DATE	TIME	
CONTAINER	ANALYST	DATE	TIME		
ANALYSIS DATE	DATE	TIME			
APPROVAL	DEFINITION	DATE	TIME		
NO.	NO.	DATE	TIME		
DATE	DATE	TIME			
TIME	TIME				

PLUTONIUM FURNISHING ANALYTICAL LABORATORY - TECHNICAL SERVICES SECTION

ANALYTICAL CARDS

SEARCH NO.	DESCRIPTION	LAB NO.	ANALYST	DATE	TIME
SEARCH TYPE	LAB NO.	ANALYST	DATE	TIME	
CONTAINER	ANALYST	DATE	TIME		
ANALYSIS DATE	DATE	TIME			
APPROVAL	DEFINITION	DATE	TIME		
NO.	NO.	DATE	TIME		
DATE	DATE	TIME			
TIME	TIME				

Figure 5.2.3. Analytical Cards

3145 LABORATORY - PROCESS CONTROL LABORATORIES

SEARCH NO.	DESCRIPTION	LAB NO.	ANALYST	DATE	TIME
SEARCH TYPE	LAB NO.	ANALYST	DATE	TIME	
CONTAINER	ANALYST	DATE	TIME		
ANALYSIS DATE	DATE	TIME			
APPROVAL	DEFINITION	DATE	TIME		
NO.	NO.	DATE	TIME		
DATE	DATE	TIME			
TIME	TIME				

5.2.1.3. LMCS (Continued)

LCCS or manually. Completion of standards analyses is manually monitored. Laboratory management is responsible for assuring that the minimum number of standards are analyzed.

5.2.2. Log Book

5.2.2.1. Manual

Various types of log books are used throughout the laboratories. Sample receiving and shipping log books are kept at the 222-S and PUREX laboratories to document the receipt and shipment of samples. Sample log books used at the PFP and PUREX laboratories document sample identification, source, date received, particular analyses requested, and dates analyses are completed. Similar log books at the 222-S Laboratory document sample identification, source, date received, and date all analyses are completed.

All three laboratories have log books established for particular analysis methods where all the samples analyzed by that method are tracked along with pertinent information specific to that analysis method. Log books have also been established for the major analytical instruments to track their use, calibration, performance, (sometimes instrument settings), and repair history.

Shift log books are used to transmit administrative information from one shift to another. Such information usually details sample information, AMS performance and corrective actions required, problems with measurement instruments or systems, special customer instructions, notices of issuance of a PCA, or a revised issue of a procedure and/or safety items.

Log books have a minimum retention time of five years.

5.2.2.2. LCCS

When the computer generated analytical cards are printed in the laboratory, a file is created in the computer data base to track the progress of the sample. Each sample is assigned a unique sample serial number and is identified by the sample source. The date sampled and analyses requested are part of this record. As analyses are completed, the results are entered into the data base. On-line reports indicating the progress of the work are printed in the plant control area as each entry is made into the data base. When the work requested is complete, the sample is identified on a list for disposal after a specific holding time which varies for different laboratory units.

5.2.2.2. LCCS (Continued)

The results on the sample are maintained in the data base for up to 60 days; then the files are archived on magnetic tape for recall or review.

The minimum retention time for the tapes is three years.

5.2.2.3. LMCS

Many of the standards cards are printed by the LCCS system and thus are tracked in the manner described in 5.2.2.2 above. Other standards are manually tracked. The LMCS computer base receives the standards only after the analysis is completed. Measurement check/control actions for an AMS are required when Off-Standard Condition Report (OSCR), Precision Report (PR), or Control Report (CR) forms are generated by the computer.

The analysis results of standards are maintained in the active computer base for one and a half to two years and are then archived to magnetic tape. The completed OSCRs and PRs are maintained by the Manager DMC for an unlimited time period. Control Reports do not have to be retained.

5.2.3. Analytical Cards

5.2.3.1. Manual

Upon receipt of a sample, a set of analytical cards are filled out; one for each analysis requested (except in certain cases where a single form can be used for several analyses). These cards contain as a minimum: the sample serial number, identification, material type or sample source, analysis to be performed, method to be used, sample size, or dilution to be used.

The technologist writes the instrument readings and other raw data on the card as the analysis of the sample is completed. The calculation of the final results are written on the card, along with the payroll number or initials of the technologist(s) who performed the work. In certain cases the manager and/or the scientist will also initial the card signifying their review and approval of the work.

5.2.3.2. LCCS

The card generated by the LCCS when the sample is submitted acts as the in-laboratory data base and information source. The card identifies the sample number, the material type, analytical method to be used, normal sample or dilution size, the attribute to

5.2.3.2. LCCS (Continued)

be measured, and a number of management evaluators (cost code, estimated turn around time, etc.). This card is used to record raw instrument data and calculations to support the final results. The card is dated and marked with the payroll number or initials of the employee performing the work and the employee checking or performing the calculations.

5.2.3.3. LMCS

Standards cards are generated by either the LCCS system or the manual method. The Standards' analytical cards are used in the same way as sample analytical cards to record raw instrument data and calculations.

The normal retention time for the analytical cards is one year; however, analytical cards for environmental "record" samples and those for product specification analyses are retained for an unlimited time period.

5.2.4. Data Record

A future link of the laboratory computer systems will automatically correlate sample results with those of the standard run with them. Presently, this match-up is done manually upon request.

5.2.4.1. Manual

The analytical card is the basic data record. ACSL uses the analytical cards shown in Figure 5.2.3. Some of these are single copy cards, and some are multipart carbon-less forms. Log books, data worksheets, and instrument printouts are used to supplement the data on the analytical cards.

The Standards Preparation Unit maintains documentation on the makeup of all standards produced.

The instrumentation of the NDA laboratory is fully automated. The items to be measured are logged in on forms to trace their progress. The instrument computer printouts are used for reporting purposes. An extensive set of log book records are maintained to support the calibration of the instruments and their performance. Most of the routine work is performed by operations personnel, not laboratory technologists. The scientists and technologists provide an overview, documentation, and reporting function.

5.2.4.1. Manual (Continued)

Laboratory cards are kept for a minimum time period of one year. The documents detailing Standards' makeup have an unlimited retention time. The NDA log books are kept for an unlimited time as they are used as references for instrument settings.

5.2.4.2. LCCS

The computer system provides a near-real-time record of the work performed on a sample. As analyses are completed in the laboratory, the results of the analyses are entered into the computer, which then prints them out at the operations terminal for the operations and engineering staff. Summary reports are printed out for performance evaluations upon request.

The data tape is maintained for three years minimum.

5.2.4.3. LMCS

Warning Notices, CRs, PRs, and OSCRs are issued as data is entered into the system and statistical evaluations are performed. Status reports are generated at the end of each month for each EDP Code for evaluation of the number of standards entered during that month. Special status reports are also issued which give the number of PRs or OSCRs generated and completion date.

Some of these reports are informational in nature and need not be retained. However, the PR and OSCR document corrective action and must be retained. The completed reports are maintained by the DMC Manager for an unlimited time period. The computer data tape is also retained indefinitely.

5.2.5. Analytical Report

5.2.5.1. Manual

Analytical results are transmitted to laboratory customers in one of the following ways: (1) The computer prints the results out at the customers computer terminal shortly after laboratory personnel enter the results into the LCCS computer. (2) When all analyses have been completed on a sample, the computer is used to generate a report containing all the requested analytical results. (3) Report forms developed for specific customers are utilized.

5.2.5. Analytical Report (Continued)

These reports have various formats; however, all are signed by laboratory management. Some reports are sent with a letter of transmittal. And (4) memos/letters containing the analytical results are issued and sent to the customer.

Retention time for the memos/letters is usually one year; however, results on "record" environmental samples are retained indefinitely. Plutonium product specification reports are retained for an unlimited time period by the PFP EL Manager. Uranium product specification reports are forwarded to the customer. In all cases, the analytical cards that support the result reports are maintained by the laboratory as per DOE document retention guidelines.

5.2.5.2. LCCS

The analytical results are entered into the computer system as the laboratory work is completed. These results are sent by the computer to the sample submitting organization. At various time schedules, summary reports are printed out to meet customer needs.

Some of the laboratory units use a computer sample status report to transmit the results when all of the analyses for that sample have been completed. These reports are signed by the manager signifying approval of the data.

5.2.5.3. LMCS

Various demand and diagnostic reports are available for reviewing data in the LMCS files. Personnel from the DMC Section will print these reports upon request. (Other laboratory personnel may have these report printing privileges also.)

References:

ASTM C 1009, Section 9

6.0. CONTROL OF RECORDS

6.1. REQUIREMENTS

A records management system shall be established to control records generated by laboratory activities. The records generated and controlled shall be identified. The storage location of records and types of storage facilities shall be documented. To the degree possible, records in storage shall be protected from damage and loss and shall be easily retrievable from storage locations. A retention time shall be established and documented for each type of record.

6.2. PROGRAM IMPLEMENTATION

Several procedures have been written to control the management of records. These are LO-150-121 and LO-150-222.

6.2.1. Identification

- Laboratory records fall into three categories: (1) QA records which must meet the requirements specified in this section, (2) worksheets, which are not QA records, which are used for temporary record storage or transmittal, or for information purposes, and (3) WHC forms which have records management requirements specified in company manuals. Instructions for completion of the WHC forms will not be duplicated here.

Records generated from laboratory activities are identified in different sections of this document, in WHC-CM-5-4, and in various laboratory documents and procedures. Appendix C lists laboratory QA records and the documents which specify their use.

6.2.2. Distribution

Many of the laboratory records are maintained within the laboratory and have no distribution. For those records which have a distribution either original records or copies are maintained in the laboratory where they are generated. Distribution of records is documented in the Customer Sample Schedules, on the RSA Form, or in the documents found in Appendix C. Laboratory qualification records (Performance Check Lists) for an employee are transferred to the new management group each time a person changes jobs.

Laboratory management is responsible for the control and distribution of records.

6.2.3. Storage

Record storage is the responsibility of the laboratory section managers. Corrective action reports are maintained by the DMC Manager. Records of laboratory training classes are maintained and distributed by the Laboratory Training Specialist. The manager of the Standards Preparation Unit is responsible for standards' makeup documents. The manager of the Data Control Unit is responsible for storage of data tapes.

Each laboratory has different record storage locations; however, most use file cabinets and shelves in the managers or scientists offices and in the laboratory. Some records are maintained at the specific work site. Special tape storage cabinets are used for the magnetic data tapes. Standards' makeup documentation is kept in file cabinets in the applicable standards laboratory.

Laboratory record storage locations are chosen to avoid proximity to water, chemicals, and fumes to minimize damage potential. Fire protection is per building codes. The records in each area are afforded security protection suitable to the classification of the data. Access is limited to laboratory personnel and need to know.

6.2.4. Retrieval

Data and records are stored by customer, laboratory sample number, and/or date. Training records are filed in appropriate notebooks or folders for each person. Data on computer tapes must be accessed through the chemist assigned to the laboratory computer or by a knowledgeable computer operator.

6.2.5. Retention Time

Certain laboratory records, such as those for environmental or accountability analyses, are to be maintained indefinitely. The retention times for those laboratory records which can be disposed of are found in each groups "Records Inventory and Disposition Schedule" (RIDS) which is maintained by management.

References:

ASTM C 1009, Section 10

LO-150-121, "222-S Laboratory - Records Control."

LO-150-222, "Handling of Classified Documents - PUREX Analytical Laboratory."

7.0 CONTROL OF EQUIPMENT AND MATERIALS

7.1. REQUIREMENTS

Equipment and materials shall be controlled to the extent necessary to assure that their integrity is maintained while used and stored. Equipment requiring calibration shall be calibrated individually by an analyst or maintained on an established calibration program. There shall be a system for indicating calibration status for each instrument or item of equipment requiring calibration. Out-of-calibration equipment shall not be used to obtain analytical data. The standards used for calibration shall be specified. The basis for calibrating and verifying calibrations of volumetric glassware shall be documented.

The required quality of reagents and water used shall be specified. Reagents and standards shall be labeled with name, concentration, matrix, date prepared, preparer, and special limitations on storage, use, and age. Reagents and standards found to be unlabeled shall not be used. When required for a reagent or standard, an expiration date shall be included on the label, after which the reagent or standard shall not be used, unless recertified. Reagents and standards shall be stored to protect against deterioration. When required, special storage conditions shall be specified.

Samples and standards shall be inspected when received to assure that they are properly labeled and identified and that they meet criteria established for receipt. If a deficiency is found with a sample or standard, it shall not be analyzed until the problem is resolved. Samples and standards shall be uniquely identified and labeled in a manner to prevent loss of identification. Samples and standards shall be handled and stored to preserve their integrity, and any whose integrity is suspect shall not be used but shall be controlled to prevent inadvertent use. Retention times and subsequent disposition shall be established for samples. Disposition actions shall be recorded and dated in the record system.

7.2. PROGRAM IMPLEMENTATION

7.2.1. Equipment

General instructions for use in establishing equipment calibration are given in the procedures listed in Section I of Appendix D. Specific instructions for use in calibrating a particular piece of equipment are documented. A listing of procedures containing this information is found in Appendix D, Section II. Since each piece of equipment is a component of an AMS, its performance is continually monitored through the LMCS system or by the use of control charts. An Intralaboratory Exchange Program has also been established to assure that all instruments that measure the same analyte are consistent within prescribed limits.

Analytical balances are calibrated once per year by WHC Physical and Electrical Standards personnel. Stickers are placed on each balance indicating when it was calibrated and the expiration date of its calibration. WHC instrument personnel check the validity of this calibration on a monthly basis. Where highly accurate weighings are needed for a specific operation, the analyst checks the performance of the balance before (and sometimes during) the operation.

When performing an analysis, or generating a reagent or standard, glassware is chosen such that the tolerance specified in the procedure is met. Volumetric glassware and pipettes purchased from vendors are usually Class A and have the standard tolerances of this class. In some cases, a piece of glassware is purchased which has a Certificate of Accuracy (or Certificate of Calibration). Where tighter tolerances than Class A are needed for a piece of glassware, the item is calibrated. Instructions for calibration and use of volumetric glassware, burets, and pipettes can be found in the procedures listed in Section III of Appendix D. This section also gives the procedures used in calibrating dispensers and automatic pipetters. The tolerances allowed by the calibration are listed in each procedure.

7.2.2. Reagents and Standards

Reagent Water Types I and II as defined in ASTM D 1193-77 shall be used for the preparation of reagents and standards. Type I grade of reagent water shall be used where maximum accuracy and precision is indicated, provided dissolved organic matter will not interfere. Type II grade of reagent water shall be used for all other analytical procedures and for procedures requiring water low in organics. Type I water may be used for organic analysis if a filter for removing organics is a part of the water treatment

7.2.2. Reagents and Standards (Continued)

system. Requirements for the quality of water are identified in the procedure where they differ from those stated above. Water used for all dilutions and chemical analyses follow the same guidelines.

Laboratory Reference Material Specifications (LRs) indicate the purity of starting materials, concentrations, and tolerances of all components in the standards. Special limitations of storage, use and age are also detailed. Analytical Procedures (LAs) give the same information for reagents. Unless otherwise indicated, all chemicals used in standards and reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other chemical grades that are used have been tested to assure that the reagent is of sufficient purity to permit its use without adversely impacting the determination. Document SD-CP-LB-028, Laboratory Reagents, gives detailed information on the grades of chemicals.

Procedures used for water, reagent, and standard makeup, labeling and control are listed in Appendix E, and found within the procedures listed in Section II of Appendix D.

7.2.3. Samples

Samples are received and controlled according to the instructions given in the procedures listed in Appendix E. All samples are inspected when received and are assigned unique identification numbers by the computer for those operations supported by the LCCS. For laboratory work not supported by LCCS, either number sequences provided by the customer or laboratory assigned numbers are used for identification. The majority of samples analyzed are radioactive or contain hazardous chemicals. For this reason, only a few research samples or the items submitted for NDA analysis are returned to sample originators. Samples are disposed of through waste or material recovery systems. Samples are discarded as they appear on Slurp/Return Lists.

References:

ASTM C 1009, Section 11

ASTM D 1193-77(Reapproved 1983), "Standard Specification for Reagent Water."

SD-CP-LB-028, "Laboratory Reagents."

8.0 CONTROL OF MEASUREMENTS

8.1. REQUIREMENTS

A measurement control system shall be established that will assure that reported results will be within required tolerances. Computer programs used for measurement control shall be verified and validated using established practices for assuring the quality of computer programs. A statistician should be consulted in designing the computer program. Instructions should be given also for preparing and using control charts when utilized for method control.

For each analysis, the following must be established and documented:

- (1) calibration and control standards
- (2) frequency of use of calibration and control standards
- (3) instructions for performing calibrations
- (4) any special instructions necessary for obtaining reliable data
- (5) required treatment of data
- (6) instructions for method control
- (7) criteria that indicate when a method is out of control
- (8) requirements to bring the method back into control
- (9) instructions for preparation of the calibration and method control standards.

When available, standards should be traceable to nationally recognized standards. Standards obtained from the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards, are an example.

Instructions should be given as to the number of significant digits to report based on the capability of the measurement method. Instructions should also be given for treatment of outlying observations based on methods recommended by a statistician.

Tolerances for all measurements made during an analysis should be specified in some manner. Considerations should be given to providing error limits for all reported results. The error limit should be defined. Backup information should be available if requested, such as the multiple of the standard deviation, the number of observations, and the identity of all sources of variation incorporated into the standard deviation.

A record system should be established to document all measurement control actions and to record data generated.

8.2. PROGRAM IMPLEMENTATION

8.2.1. Method Control

The LMCS is a computer program designed for near-real-time support of management Quality Control decisions. This program is described in the references found in Section I of Appendix H. Each method and application has different control parameter requirements. The LMCS has a master index that identifies the control parameter for each method and application, the standard to be used, the frequency of standard analyses, and the warning and control limits. In some cases, the frequency of standard analyses is specified in a procedure. These are listed in Section II of Appendix H.

The LMCS program provides two types of control charts: one shows performance versus limits (standard W. A. Shewhart type), and the other is a histogram of standard recoveries.

When a standard analysis exceeds a warning limit, the computer issues a "warning notice" to alert that a problem may be present in the AMS.

When a standard analysis exceeds a control limit, a "control report" is generated which requires analysis of two additional standards.

Precision reports are issued to indicate obvious outliers and long-term trending behavior (i.e. when the confidence interval of the average of the last eight standards is outside the control limits.) An investigative and/or corrective response to a PR is required, but the AMS may continue in normal use.

If any two, of three consecutive standard analyses, exceed a control limit, an OSCR is generated. The method is removed from service until the OSCR has been investigated and corrective action taken. The completed OSCR is the record of the investigation and actions taken to return the AMS to service. When an OSCR is generated, the measurement system may only be used for reporting analytical results when a letter of "Exception to LMCS Qualification" between the laboratory and customer is written.

Statistical methods used in the LMCS program were selected by consultation with the statisticians in the Process Chemistry and Engineering Laboratory.

Instructions for manual control of AMSs are given in the procedure listed in Section III of Appendix H.

8.2.2. Calibration

Standards and methods to be used in calibrating equipment and analytical measurement systems are in procedures and/or supporting documents. The procedure/document specifies the calibration standard, instructions for its makeup and use, and details the required treatment of data, demonstrating with an example. A listing of these is given in Appendix D, Section II.

The Analytical Laboratories Instrument Calibration Record is a master index of all analytical equipment. This index includes such items as: calibration status, review interval, calibration type, calibration procedure, LMCS Electronic Data Processing (EDP) Codes, and type and location of calibration record storage. Section I of Appendix D gives the laboratory documents that explain the instrument calibration system.

An Intralaboratory Exchange Program has been developed that evaluates whether all instruments that measure the same analyte perform within prescribed limits. The document that describes this program is also listed in Section I of Appendix D.

8.2.3. Standards

An analytical procedure may be used for analyzing several types of sample material. The standard used for method control is often formulated to simulate the sample material to be analyzed. This can result in multiple standards for a method. Because of this, the procedure for makeup of the control standard(s) is separate from the analytical procedure. The instructions for standard makeup are found in the LR procedures. Standards are traceable to NIST or other nationally recognized standards when materials are available.

8.2.4. Reporting Significant Numbers

The procedures which give instructions for reporting significant numbers and rounding off numbers are found in Section IV of Appendix H.

8.2.5. Outlying Observations

The LMCS software includes an algorithm to evaluate whether a value is a member of the population or if it is an outlier. If an outlier, it is identified as such on the reports. Correlation with results of past samples is not documented.

8.2.6. Tolerances

The procedure which gives instructions for specifying tolerances is found in Section IV of Appendix H.

8.2.7. Error Limits

The AMS data set is used to calculate a statistical evaluation of analytical performance. The assumption is made that the performance of the AMS on the standard is representative of the performance of the AMS on the samples. The calculated error limits for an AMS are available from the LMCS data base for any time period desired.

The LMCS program gives the standard deviation of a single observation. It also gives the 95% Confidence Interval of the average. Information is also given which could be used to calculate the 95% Confidence Interval of a single observation.

The major sources of variance in an AMS are: facility, equipment, procedure, personnel, reagents, standards, and calibration. The LMCS has the ability to track as individual points of variance the facility, instrument, personnel, standard, and procedure. The calibration is monitored through the Laboratory Instrument Calibration Control Board (LICCB). Currently, no specific program tracks the reagent as an individual variable. The performance of the reagent is incorporated as an unspecified variable in the LMCS data.

8.2.8. Records

Data generated from analysis of standards is maintained in the laboratory on analysis cards and in the LMCS computer data base. The LMCS AMS Specification Sheet documents the parameters of the AMS and is also used to document any changes in the parameters. The OSCR and the PR are used to document all measurement control actions. All of these records are quality assurance records and are maintained by the DMC Manager.

Reference:

ASTM C 1009, Section 12

9.0 DEFICIENCIES AND CORRECTIVE ACTIONS

9.1. REQUIREMENTS

A system shall be established to detect and correct failures, defects, errors, deviations from specified requirements, and other conditions considered adverse to quality. Identification and correction of deficiencies must be timely so that there will be no significant consequences to the operation of the laboratory. A system of well defined practices to identify, evaluate, resolve/dispose (correct), and record actions taken to correct deficiencies shall be established and documented through the quality assurance program.

9.2. PROGRAM IMPLEMENTATION

ACSL supports a variety of customers with various sample types. Various systems are in place for detecting, correcting, and documenting corrective actions for laboratory operations and measurement systems. Where specific criteria are provided by the customer the laboratory highlights deficiencies and assists in problem correction.

9.2.1. Identification

Some sample points have specifications delineated for analytical results. If a product sample from the PFP EL does not meet a specification, a nonconformance report (NCR) is issued as specified in WHC-CM-4-2, Section QR 15.1, "Nonconforming Item Reporting." NCRs are issued for Essential Materials which do not meet specifications per WHC-CM-5-5, Procedure GA-3.8., "Essential Material Specifications and Procedures."

For some samples, at the request of the customer, an "Out of Tolerance" Report is issued when sample results lie outside expected ranges. The "Out of Tolerance" Report is not a deficiency or corrective action report but is used for information purposes only. For sample points on the LCCS, this program includes routines to flag sample results outside of expected ranges. Up to ten levels of ranges with specific messages can be utilized on LCCS.

9.2.1. Identification (Continued)

Warning Notices, PRs, CRs, and OSCRs are generated as appropriate by the LMCS as described in Section 8.2.1. These reports identify (possible) problems with AMS as determined by statistical analysis of the standard results. The OSCR is a corrective action report which indicates that an AMS is not performing within control limit specifications. The Warning Notice is an information only report; the PR and CR do not necessarily require corrective action.

Normal surveillance carried out by the managers and scientists may result in the detection of conditions that vary from the desired. These are investigated and documented through the company reporting system using "Event Fact Sheets," "Critiques," and/or "Unusual Occurrence Reports."

ACSL has an active internal auditing program which is carried out by personnel who are knowledgeable in the laboratory's operation but are not directly responsible for the work and operations being audited. The ACSL is also subject to external audits and surveillances by WHC Quality Engineering, and Quality Control, as well as applicable DOE and other government agency groups.

9.2.2. Evaluation

Evaluations are made to determine the cause of deficiencies and to identify actions required for correction of the deficiencies and to minimize recurrence of the deficiency. All investigations are completed and documented in a timely manner.

Standard auditing practices are used for both internal and external audits.

9.2.3. Resolution/Disposition

The forms which are used to document deficiencies and corrective actions are listed in Appendix H along with the documents that specify the responsibilities and time schedules for resolution of deficiencies.

An occasional unique problem may have the investigation and resolution reported in letter or scientific publication form.

Resolutions that require procedural changes are recorded through PCAs and/or reissuance of procedures.

9.2.3. Resolution/Disposition (Continued)

The forms used to document identification, evaluation, and disposition of deficiencies are either routed for signature by all concerned parties or are routed to a distribution of appropriate laboratory personnel. Emphasis is placed on resolutions designed to minimize the possibility of recurrences.

For an internal audit, the laboratory manager assigns the responsibilities for action and schedule for resolution/final disposition. The auditor tracks the items to completion. Personnel in DMC coordinate with laboratory management the resolution of external audit items and track their completion.

9.2.4. Records

The OSCR is used for documenting corrective actions taken for AMS. All changes to procedures are recorded in PCAs and/or new procedures. These records and those for internal audits are maintained by the DMC Group.

All out-of-specification or out-of-range measurements are recorded on NCRs, Out-of-Tolerance Reports, or flagged on the LCCS. These different reporting routes are a function of the sample source and impact of the condition. Copies of these reports are maintained in the laboratory.

External audit responses are tracked by the Quality Safety Trending System.

References:

ASTM C 1009, Section 13

WHC-CM-4-2

WHC-CM-5-5

APPENDIX A

LABORATORY REPORTING SYSTEMS

RHO-CD-1181	Laboratory/Customer Communication System Functional Requirements.
LO-150-222	Handling of Classified Documents at PAL
LO-150-223	Laboratory Interface with Operations for Corrected and Rerun Analyses
LO-150-224	Reporting Analytical Results on the Laboratory Customer Communications System (LCCS) at PUREX

APPENDIX B

LABORATORY TRAINING CLASSES

MANAGERS

Laboratory Manager Normal Operating Conditions Training

Depending on Job Location

PFP Process for Laboratory Managers

PUREX Process for Laboratory Managers

Emergency Procedures and Abnormal Plant Conditions

PFP

PUREX

222-S

Standards Lab at PFP

SCIENTISTS

Scientist Normal Operating Conditions Training

CHEMICAL TECHNOLOGISTS

Laboratory Technologist Training

Depending on Job Location

Emergency Procedures and Abnormal Plant Conditions

PFP

PUREX

222-S

Standards Lab at PFP

SELECTED PERSONNEL DEPENDING ON JOB FUNCTION AND LOCATION

Waste Isolation Pilot Plant - Waste Acceptance Criteria

PFP

PUREX

APPENDIX C

LABORATORY RECORDS/FORMS AND THEIR REFERENCE DOCUMENTS

I. Q.A. RECORDS

101 Surveillance/Transfer Log	SO-100-007
102 Tank Transfer Record	SO-100-003 SO-100-004
103 Surveillance/Transfer Log	SO-100-005
202-A Lab Administrative Procedure Check List	LO-150-241
202-A Lab Analytical Procedure Check List	LO-150-241
202-A Lab Operating Procedure Check List	LO-150-241
207-SL Record Sheet	SO-080-001
219-S Surveillance/Transfer Log	SO-100-001 SO-100-003
222-S Counting Room Data Sheets	LA-508-112
222-S Counting Room Sample Cards	LO-150-112
222-S Laboratory Customer Sample Schedule	LO-090-101
55-Gal Drum Packaging Checklist - TRU	SO-170-014
55-Gallon Drum Log Book	SO-170-010
55-Gallon Drum Packaging Checklist	SO-170-005 SO-170-010
A.L. to PRF Valve Verification Sheet	LO-100-333
Accountability Card	LO-100-333
ACSL Operating Instruction Format	WHC-CM-5-4 Proc. 3-01
ACSL Procedure Form	WHC-CM-5-4 Proc. 5-01

LABORATORY RECORDS/FORMS AND THEIR REFERENCE DOCUMENTS (Continued)

ACSL User Test Approval Form	WHC-CM-5-4	Proc. 5-01
Air Sample Chain of Custody Form	LO-090-101	
Air Sample Log Book	LA-508-301	
Anal. Lab. Instrument Calibration Record	LO-140-002	
Anal. Lab. Instrument User Calibration Input Form	LO-140-002	
Analytical Laboratories Performance Check List 3488A	WHC-CM-5-4	Proc. 4-01
Analytical Laboratories Performance Check List 3488B	WHC-CM-5-4	Proc. 4-01
Analytical Laboratory Sample Log Unit _____	LO-090-101	
Analytical Request Slips	LO-100-333	
Analytical Sample Cards - LCCS	LO-150-043	
Calibration Log Book	WHC-CM-5-4	Proc. 9-07
Calibration of Motor-Driven Buret	LQ-510-212	
CERCLA/Ecology Hazardous Substance Release Report	SO-001-001	
Change Notice Form	WHC-CM-5-4	Proc. 3-01
Chemical Discharge History	SO-001-001	
Chemical Sewer Discharge History Data Sheet	SO-100-001	
Chemical Waste Container Identification Number Form	SO-100-006	
Chemical Waste Container Inventory Sheet	SO-100-006	
Competency Record	SD-CP-QAPP-001	Sect. 3
Counting Room Instrument _____ Log Book	LO-150-115	
Counting Room Instrument _____ Sample Log	LO-150-112	
D-5 Log Book	LO-080-221	
Dispenser Calibration Work Sheet	LQ-510-211	
Effl. & Env. Sample Chain-of-Custody Record Sheet	LO-150-113	

LABORATORY RECORDS/FORMS AND THEIR REFERENCE DOCUMENTS (Continued)

Essential Materials Manual Sampling Procedures	LO-150-114
Essential Materials Manual Technical Information	LO-150-114
Essential Material Report of Analysis	LO-150-114
Essential Materials Report	LO-150-114
Exception to LMCS Qualification of an AMS	LO-150-002
Filter Change Record Sheet	SO-170-001
SO-170-003	SO-170-009
SO-170-010	SO-170-016
Hazardous Chemical Waste Log Book	SO-100-006
Hazardous Material Drum Inventory Log Sheet	SO-170-008
Inspection Checklist for 55-Gallon Drums	SO-170-004
SO-170-014	
Inspection Sheet for Non-Transuranic Waste Containers	LO-100-223
Inspection Sheet for TRU Waste Drums or Lard Cans	LO-100-224
_____ Instrument Log Book	WHC-CM-5-4 Proc. 9-07
Instrument Technician Qualification	LO-150-011
Instrument Technician Qualif. for 202-A X-ray Lab	LO-150-201
Interface Sheet	LO-150-223
Inventory Verification of Unsecured Facilities	LO-180-205
LO-180-305	
Laboratory Directions	WHC-CM-5-4 Proc. 5-06
Laboratory Procedures-All types	WHC-CM-5-4 Proc. 5-03
Laboratory Supporting Documents	WHC-CM-5-4 Proc. 5-04
Lab Waste Trnsfr 219-S to Tank Farms	SO-100-004
LCCS Determination/Method Update Form	SD-CP-QAPP-001 Sect. 5

LABORATORY RECORDS/FORMS AND THEIR REFERENCE DOCUMENTS (Continued)

LCCS Sample Point Information Update Form	SD-CP-QAPP-001 Sect. 5
LMCS AMS Specification Sheet	LO-150-028
LMCS Listing	SD-CP-ADP-003
Lock and Tag Data Sheet	LO-162-102
Lock and Tag Index	LO-162-102
Lock and Tag Log Book	LO-162-102
Mass Spectrometer Log Book Instrument _____	LA-946-301
Mass Spectrometer Sample Preparation Log Book	LA-946-301
Monthly Inventory Flowsheet	LO-180-001
New LMCS Standard Request Form	SD-CP-QAPP-001 Sect. 7
NDA Assay Calculation Sheet	LA-948-348 LA-948-349
Nuclear Material Transaction Record Book	LO-180-001
Off-Standard Condition Report	LO-150-001 LO-150-002
LQ-150-001	SD-CP-ADP-007
Out-of-Tolerance Analytical Result Report	WHC-CM-5-4 Proc. 3-03
PC Item Summary Sheet	LA-948-349
PFP Portable NDA Notebook	LA-948-348 LA-948-349
PFP Sample Analysis Cards	LO-090-304
Plutonium Isotopic Sample Exchange Data	LO-150-325
Plutonium Finishing Sample Analysis Request	LO-090-304 LO-100-333
Plutonium Metal Sample Exchange Report	LO-150-325
Possible Analytical Measurement System Error Report	LO-150-123

LABORATORY RECORDS/FORMS AND THEIR REFERENCE DOCUMENTS (Continued)

Precision Report	LQ-150-001
	LQ-150-002
LQ-150-001	
Preprinted Standards Laboratory Label	LQ-120-001
Procedure Signature Log Book	WHC-CM-5-4 Proc. 4-01
Procedure Signature Sheet	LQ-150-144
LQ-150-244	
Pu IDMS Log Book	LA-946-202
Radioactive Mixed Waste Data Sheet	LQ-100-223
Request For Special Analysis Form	LQ-090-101
	LQ-090-304
Sample Analysis Request Slip	LQ-090-304
_____ Sample Log Book	LQ-090-101
	LQ-090-201
	LQ-090-304
_____ Sample Schedule	LQ-090-304
_____ Shift Log Book	LQ-150-002
	LQ-150-115
Shipping Container Log Book	LQ-090-002
Stock Solutions Record Form	LQ-180-001
Thermometer Calibration Check Data	LQ-519-101
Thermometer Calibration Check Tag	LQ-519-101
Waste Recovery Log Book	LQ-100-333
Weekly Waste Container Inspection Sheet	SO-100-006
X-Ray Operator Qualifications for 202-A X-ray Lab	LQ-150-201
X-Ray Operator Qualifications	LQ-150-011
X-Ray Worker Qualifications	LQ-150-011
X-Ray Worker Qualifications for 202-A X-ray Lab	LQ-150-201

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APPENDIX D

EQUIPMENT CALIBRATION AND CONTROL

I. EQUIPMENT CALIBRATION

LO-140-002 Instrument Calibration Record System
WHC-CM-5-4 Inst. 9-07 Laboratory Instrument Calibration Control
WHC-CM-5-4 Inst. 9-08 Intralaboratory Exchange Program

II. EQUIPMENT CONTROL

LA-211-101 Fisher Cat Titrator for Acid/Base/pH Det.
LA-211-101 Operation of Fisher CAT Titrator for Acid/Base/pH Det.
LA-211-241 Determination of Na⁺ by Selective Electrode
LA-212-101 Set-up and Std. of pH Meter and Glass Electrode
LA-212-201 Operation of Corning Models 125 and 130 pH Meters
LA-212-203 Operation of the Corning Model 140 pH Meter
LA-212-204 Orion Research Model 901 Ionalyzer for pH and mv Meas.
LA-218-102 Opr. of Packard 460CD Liquid Scintillation Counter
LA-218-103 Opr. of Packard 460D Liquid Scintillation Counter
LA-221-101 Det. of CaCO₃ in Disaggregated Sediment Samples
LA-325-102 Mercury Analysis by Hydride Generation Atomic Absorption
LA-331-301 Aluminum by Potentiometric Titr. with F Orion 960 System
LA-344-101 Det. of C in Soln. or Solids by Combustion & Coulometry
LA-344-103 Packing Coulometer TOC Combustion Tubes
LA-344-104 TOC Combustion Tube Change
LA-344-111 Det of Inorganic/Organic C Model 700 I Corp. Toc Analyzer

II. EQUIPMENT CONTROL (Continued)

- LA-344-111 Inorganic and Organic C using Model 700 I Corp. TOC
- LA-344-302 Det. of C in SNM Using a LECO Carbon Determinator
- LA-344-303 Low Level C by LECO WR12 Analyzer
- LA-355-131 Arsenic Anal. by Hydride Generation Atomic Absorption
- LA-364-302 Total Sulfur by LECO IR-132 Sulfur Determinator
- LA-364-303 Total Sulfur by LECO IR-32 Sulfur Determinator
- LA-365-131 Selenium Analysis by Hydride Generation Atomic Absorption
- LA-371-135 Det. of F in Encapsulation Plant Waste Samples
- LA-371-235 Determination of F by Selective Ion Electrode
- LA-371-311 Free F- on Acid Smpl. by Method of Additions/Orion 960 Sys.
- LA-371-312 Total F- on Acid Smpl by Method of Additions/Orion 960 Sys.
- LA-371-332 Determination of F by Selective Ion Electrode
- LA-374-301 Det. of Cl in PuOxide by Pyrohydrolysis Sep/Spec Method
- LA-375-301 Spectrophotometric Det. of Cl in UO3 Process Streams
- LA-375-303 Spectrophotometric Det. of Cl in Plutonium Soln.
- LA-501-201 Operating Procedure for Metrohm 645 Titrator
- LA-501-202 Operating Procedure for Metrohm 535 Titrator
- LA-501-205 Operation of the Metrohm 635/636 Automatic Titrator
- LA-501-207 Operating Procedure for Metrohm 682 Titroprocessor
- LA-505-101 Cary 219 Spectrophotometer Operation
- LA-505-103 B & L Spectronic 21 Spectrophotometer Operation
- LA-505-104 Spectronic 1001 Operation
- LA-505-121 Opr. Proc. for High Activity AA-6 Atomic Absorption Spec.
- LA-505-126 Perkin-Elmer 2380 Atomic Absorption Spec. Opr.

II. EQUIPMENT CONTROL (Continued)

- LA-505-141 S/S of the ICP Spectrometer and Its Scrubber Unit
- LA-505-143 Inductively Coupled Plasma Analytical Procedure
- LA-505-201 Beckman 5240 Spectrophotometer Operation
- LA-505-203 Operation of the Spectronic 21 Spectrophotometer
- LA-505-210 Perkin-Elmer Lambda 9 Spectrophotometer Opr.
- LA-505-241 Sample Analysis with the Polychromator of the ICP
- LA-505-242 R/N Startup/Shutdown of the ICP Emission Spectrometer
- LA-505-244 Calibration of the ICP Emission Spectrometer
- LA-505-245 Computer Operations for the Inductively Coupled Plasma
- LA-505-246 Sample Trap Operations for the ICP
- LA-505-251 Samp. Anal. with Scan. Monochromator of the ICP
- LA-505-306 Use of the Filament Bake-out Station
- LA-505-362 Spectrochemical Analysis of Plutonium
- LA-505-363 Mercury Profile of Quantometer
- LA-505-366 Cleaning of Platinum Crucibles
- LA-505-367 Film Developing Method
- LA-505-369 Quantometer Computer Operations
- LA-505-370 Spectrochemical Analysis of Uranium Trioxide
- LA-505-371 Spectrochemical Analysis of Solutions (Extr.)
- LA-505-372 Spectrochemical Anal. of R.E. in Plutonium Dioxide
- LA-506-302 Total Alpha Cntng and Data Anal. for PFP Mass Spec. Lab.
- LA-506-303 Source Removal and Installation of IC-2
- LA-506-304 Source Disassembly, Cleaning, and Assembly for IC-2
- LA-506-305 Cleaning of Mass Spectrometer Hats and Filament Parts

II. EQUIPMENT CONTROL (Continued)

- LA-506-307 Assembly of Filaments and Mounting in Hats
- LA-507-126 Prep. of Pressed Pellets for Quantitative X-ray Fluor.
- LA-507-131 Qualitative Elemental Analysis Using the Rigaku S/Max.
- LA-507-141 Operation of the LINK XR300 for Quantit. X-ray Fluor. Anal.
- LA-507-150 Startup and Shutdown of the PDP 11/23 Computer in 4-L
- LA-507-151 Operation of the D/Max Diffractometer
- LA-507-152 Automated D/Max Data Handling
- LA-507-201 IOP's for the Tracor Model 4020 Energy Dispersive X-ray
- LA-508-051 Alpha Energy Analysis using the Canberra Jupiter Systems
- LA-508-052 Gamma Energy Analysis on the Canberra Jupiter System
- LA-508-053 Boot the PDP 11/24 on Jupiter System at PUREX and Z-Plant
- LA-508-054 Archiving Spectra on the Jupiter System
- LA-508-056 Manual Operation of the Series 85 Multichannel Analyzer
- LA-508-103 Operation of the Dual Guarded Alpha-Beta Detector (6AB)
- LA-508-104 Total Alpha Counting by Alpha Proportional Counters
- LA-508-105 Opr. of Gamma Products A/B Counting Systems in 222-S
- LA-508-106 Opr. of Micronova for Air and Liq. Effluent Samp. Cnt.
- LA-508-107 AEA of PUREX Main Stack Air Filters
- LA-508-110 Opr. of Tenelec LB-5500 Alpha/Beta Counting System
- LA-508-111 Opr. of Tenelec LB-1000 A/B Detectors (9,10,11, and 12)
- LA-508-114 Opr. of Gamma Products A/B Count. Sys. Using PC Control
- LA-508-121 Opr. of Beckman LS 5801 Liquid Scintillation Counter
- LA-508-152 Operation of the TN 4500 for Gamma Energy Analysis
- LA-508-153 Booting the PDP 11/34 on the Jupiter System at 222-S

II. EQUIPMENT CONTROL (Continued)

- LA-508-201 Total Alpha Counting by Alpha Proportional Counters
- LA-508-203 Alpha/Beta Counting Using Canberra System at PUREX
- LA-508-204 Opr. of Gamma Products A/B Cnt. Sys. in PUREX
- LA-508-205 Non-Rout. Setup/Use of Alpha Prop. Counters at PUREX
- LA-508-206 Opr. of Gamma Products G550 A/B Cnt. Sys. PC Control
- LA-508-257 PUREX Plutonium Solution Isotopic System
- LA-508-303 Total Alpha Counting and Data Analysis at the PFP
- LA-508-351 Alpha Energy Analysis (AEA) at the PFP
- LA-508-352 Updating Isotopic Corr. File on Jupiter Computer System
- LA-508-353 Operation of the Jupiter Computer System at PFP
- LA-508-354 Anal. of Pu/Am Solutions Using a High-Purity Ge Detector
- LA-510-332 Loss-On-Ignition of Plutonium Dioxide
- LA-510-334 Determination of UO₃ Particle Size
- LA-511-301 Determination of UO₃ Powder Tap Density
- LA-512-103 Conductivity of Water on Electromark Analyzer
- LA-512-104 Cond. of Water Using the Markson 1062 Digital Cond. Meter
- LA-512-105 Interfacial Tension Between Two Solns. & Surface Tension
- LA-514-112 Differential Thermal Analysis of Caustic Samples
- LA-514-121 Softening Point Determination by DSC
- LA-519-111 Determination of Density by Densimeter
- LA-519-112 Spg by Hydrometer for High Melt Samples
- LA-519-131 Granulometric Anal. of Disaggregated Sediment Samples
- LA-519-132 Percent Solids by Centrifuge
- LA-519-170 Prep. of Homogeneous Dry Solids Blend for Grout Form.

II. EQUIPMENT CONTROL (Continued)

- LA-519-171 Grout Mixtures Preparation
- LA-519-173 Density by Mud Balance
- LA-519-174 Determination of Viscosity Using the Fann Viscometer
- LA-519-175 Grout Gel Strength, Fann Viscometer
- LA-519-177 Setting Time of Grouts - ACME Penetrometer
- LA-519-178 Setting Time of Grouts - Vicot Needle
- LA-519-179 Compressive Strength of Cement-Based Grouts
- LA-519-211 Density and SpG Measurements by Digital Density Meter
- LA-519-212 Density and SpG by Digital Density Meter in the D-5 Cave
- LA-519-213 Density and SpG for Pu Soln. by Digital Density Meter
- LA-519-312 Density by Digital Density Meter
- LA-519-321 Determination of Viscosity
- LA-519-335 Determination of Solids Volume by Centrifuge
- LA-519-342 Surface Area by a Modified BET Method
- LA-523-122 EDTA/HEDTA by HPLC
- LA-525-303 Percent Organic in Centrifuge Sludge by IR Spec.
- LA-525-304 Percent Organic in Centrifuge Sludge by NIR Spec.
- LA-525-310 Shimadzu Model IR-460 IR Spec. Part I Quant. Analysis
- LA-525-311 Shimadzu Model IR-460 IR Spec. Part II Calibration
- LA-525-312 Shimadzu Model IR-460 IR Spec. Part III Param. Init.
- LA-533-101 Anion Analysis on DIONEX Model 10
- LA-533-102 Anion Analysis on DIONEX Model 2020I - System 2
- LA-533-103 Anion Analysis on DIONEX Model 2020I
- LA-533-105 Anion Analysis on DIONEX Model 4000I

II. EQUIPMENT CONTROL (Continued)

- LA-542-101 Electrodeposition of Actinides
- LA-542-102 Electropolishing of AEA Discs
- LA-551-303 Det. of Hyrdoxylamine Nitrate by Orion 960 Autotitrator
- LA-555-201 Spectrophotometric Determination of Hydrazine
- LA-561-111 Percent Water by Thermogravimetric Analysis
- LA-622-101 Carbonate in Solutions and Solids by Coulometry
- LA-634-102 Ammonia by Kjeldahl
- LA-634-202 Ammonia by Kjeldahl
- LA-651-103 Nitrate in High Salt and Complexant Solns by SIE
- LA-651-202 Determination of Nitrate by Specific Ion Electrode
- LA-651-302 Nitrate Determination by Specific Ion Electrode
- LA-661-304 Det. of OH on AMU Samples by Orion 960 Autotitrator
- LA-838-101 Storage and Retrieval of AEA Spectra - 222-S
- LA-905-301 Spectrophotometric Det. of Thorium with Arsenazo III
- LA-905-302 Spec. Det. of Thorium in PuDioxide TIOA/Ion Exch/Arsenazo
- LA-905-305 Spec. Det. of Thorium in Pu Metal TIOA/Ion Exch/Arsenazo
- LA-905-306 Spec. Det. of Thorium in PuNitrate TIOA/Ion Exch/Arsenazo
- LA-920-101 Det. of Uranium in UO3 by Thermogravimetric Analysis
- LA-921-001 Pot. Endpoint Determination of Uranium Using Davies-Gray
- LA-921-201 Auto Titration Determination of Uranium Using Davies-Gray
- LA-921-301 Det. of U Using Davies-Gray Potentiometric Endpoint
- LA-925-106 Determination of Uranium by Laser Fluorometry
- LA-925-107 Uranium by Laser Induced Kinetic Phosphorescence Analyzer
- LA-925-206 Det. of Uranium by Scintrex UA-3 Laser Fluorometer

II. EQUIPMENT CONTROL (Continued)

LA-925-208 Det. of U in TBP/NPH by Sol. Extr./Laser Fluorometry
LA-925-307 Det. of Uranium by Scintrex UA-3 Laser Fluorimeter
LA-926-301 Uranium Analysis by Isotopic Dilution Mass Spec.
LA-926-302 Uranium Isotopic Analysis by Mass Spectrometry
LA-928-301 235U Measurement Using a High Purity Detector
LA-935-203 Spectrophotometric Det. of Np using Dichromate Oxidation
LA-942-301 Amperometric Plutonium Assay
LA-945-203 Spectrophotometric Determination of Pu (Total)
LA-945-204 Spectrophotometric Det. of Pu (IV)&(VI) Valence States
LA-945-210 Spectrophotometric Det. of Pu (Total) by Weight
LA-945-301 Spectrophotometric Determination of Pu(III)
LA-945-303 Spectrophotometric Determination of Pu (VI)
LA-946-301 Plutonium Isotopic Analysis by Mass Spectrometry
LA-946-303 Plutonium Analysis by Isotopic Dilution Mass Spec.
LA-948-051 Pu Soln. Isotopic System Sample Prep., Cntng, Analysis
LA-948-233 NDA of N-Cell by Gamma Counting
LA-948-242 Pu Using Segmented Gamma Scan Assay at PUREX
LA-948-329 Pu Isotopic System Operating Proc. with ND-65 Analyzers
LA-948-332 Pu Using Segmented Gamma Scan Assay - Small Table
LA-948-333 NaI Package Counter Operating Procedure
LA-948-334 NaI Package Counter Periodic Chk & Energy Calibration
LA-948-340 NaI Sludge Counter in 236-Z
LA-948-341 NaI Sludge Counter Calibration Support Measurements
LA-948-342 Pu Using Segmented Gamma Scan Assay - Large Table

II. EQUIPMENT CALIBRATION (Continued)

- LA-948-343 Log On/Set Up Small Table Segmented Gamma Scan Assay Sys.
- LA-948-344 Log On/Set Up Large Table Segmented Gamma Scan Assay Sys.
- LA-948-345 Pu Using Segmented Gamma Scan Assay System in PFP
- LA-948-346 Set-up for Small Table Segmented Gamma Scan Assay in PFP
- LA-948-348 Opr. of Portable NDA Gamma Cntng Sys. ND-6 MCA & NaI Det.
- LA-948-349 Opr. of Port NDA Gamma Cntng Sys S-10 or S-10/MCA & NaI Det
- LA-948-361 Neutron Well Coincidence Counter Measurement Operation
- LA-948-363 Opr. Proc. for High Level Neutron Coincidence Cntr at Z
- LA-948-382 Item & Q. A. Measurement Proc. for Mound Calorimeter Sys.
- LC-400-004 Control of Sensitive Computer Systems and Applications
- LC-400-005 Laboratory Computer Control
- LC-502-001 Startup and Shutdown of Data General Desktop Computers
- LC-508-053 Booting the PDP 11/24 on the Jupiter System
- LC-601-201 Backing up the UDD on the PUREX A. L. System (PALS)
- LC-601-202 Backing up the LCCS on the PUREX A. L. System (PALS)
- LC-602-006 Data General Tape Drive M-6026 Load/Unload
- LC-602-101 CS/DLS Orderly Shutdown
- LC-602-102 CSDL System Startup After Normal Shutdown
- LC-602-103 CS/DLS Emergency Shutdown
- LC-602-104 CSDL System Restart After Abnormal Shutdown
- LC-602-106 Data General Tape Drive M-6026 Load/Unload
- LC-602-201 Orderly Shutdown of PUREX A. L. System (PALS)
- LC-602-202 PALS Startup After Normal Shutdown
- LC-602-203 PALS Restart After Abnormal Shutdown

II. EQUIPMENT CONTROL (Continued)

- LO-090-002 Insp. of DOT 6 M Type B Shipping Cont. and Annual Inv.
- LO-110-111 Removal/Repair of 1E &/or 1F Manipulators
- LO-120-301 Prep. of Ceramic Crucibles for Use wi Low Carbon Sample
- LO-140-004 Routine Operation of Mettler AE Balances
- LO-150-115 Instrument Standards Counting Frequency 222-S C. R.
- LO-161-002 Sample Centrifugation
- LO-161-101 1-F Cubicle Operation, 222-S Bldg.
- LO-161-103 Model E Heavy Duty (HD) Master Slave Manipulator
- LO-161-104 Cubicle Airlock Carriage Removal 222-S Analytical Lab
- LO-161-111 Operation of Electric Hoist No 4891-Room 1C
- LO-161-112 Genie Lift Operation
- LO-161-113 Hydraulic Crane
- LO-161-116 Drilling Holes in Stoppers
- LO-161-117 Operation of Hako Minuteman MX-1000 Vacuuming System
- LO-161-118 Operation of Wiley Laboratory Mill
- LO-161-121 Operation of Hotpack Furnace Model 770700
- LO-161-122 Opr. Proc. for High Activity AA-6 Absorption Spec.
- LO-161-135 Operation of HP 3390-A Reporting Integrator
- LO-161-141 1E-1 Cubicle Operation 222-S Building
- LO-161-143 Operation of the 1E Overhead Hoist
- LO-161-203 Model F Master Slave for D-5 Cave Rugged Duty Manipulator
- LO-161-211 Operation of the Dumbwaiter
- LO-161-212 Sargent Power Borer
- LO-161-221 Opr. Proc. for Barnstead Nanopure II Demineralizer

II. EQUIPMENT CONTROL (Continued)

LQ-161-303 Shutdown and Startup of Counting Room Equipment at PFP
LQ-162-101 Glove Changing for 222-S Lab AA Scrubber System
LQ-162-102 Lock & Tag Control 222-S Facility
LQ-162-201 Control and Use of Locks and Tags
LQ-211-102 Daily Operation of the Mettler DL40 Memotitrator
LQ-505-199 Operation of the LAMBDA I UV-VIS Spectrophotometer
LQ-508-003 Calibration of the Jupiter Gamma Energy Analysis Systems
LQ-508-005 Calibration of Beta Detectors for Sr-90 and Y-90
LQ-508-205 Non-Routine Setup and Use of Alpha Prop. at PUREX
LQ-510-102 Density by Picnometer
LQ-519-113 DMA 50W/601 Digital Density Meter Operation
LR-211-104 PUREX Nitric Acid Standard
LR-542-101 Electrodeposition of Radionuclides on S.S. Discs
SD-CP-LB-001 Instr for Per. Pu Iso. Anal. Using LEPA & PUAN
SD-CP-LB-015 Alpha/Beta Counting at the ACSL
SD-CP-LB-020 Orion 960 Autochemistry System
SD-CP-LB-021 Infrared Spectroscopy

III. CALIBRATION AND CONTROL OF VOLUMETRIC EQUIPMENT

LA-501-203 Use of Dispensing Burets
LA-501-204 Operating Procedure for Metrohm 655 Digital Buret
LA-501-206 Operating Procedure for Metrohm 665 Digital Buret
LO-080-111 Kernsberg Remote Pipetter
LO-161-222 Operating Procedure for Autozeroing Glass Burets

III. CALIBRATION AND CONTROL OF VOLUMETRIC EQUIPMENT (Continued)

- LQ-161-223 Use of Eppendorf Pipets in the PUREX Lab
- LQ-510-112 Calibration of Volumetric Glassware
- LQ-510-122 Calibrating Pipettors
- LQ-510-211 Calibration of Volumetric Dispensers
- LQ-510-212 Calibration of Motor-Driven Burets

APPENDIX E

REAGENT AND STANDARD CONTROL

LC-608-004 Label Program

LQ-080-311 Opening Pipe Containers for Amperometric Plutonium Assay

LQ-090-004 Packaging Radioactive Mat'l for On-Site Ship/Receiving

LQ-090-005 Shipping Nonradioactive Chemicals and Reagents

LQ-090-011 Opening Glass Ampoules

LQ-090-111 Ampulization of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} \cdot x\text{HNO}_3$

LQ-090-112 Ampulization of Non-Radioactive Solutions

LQ-090-305 Move Nuclear Materials to/from Rooms 221C,D, and E, 234-5 Z

LQ-090-315 Ampulization of Radioactive Solutions

LQ-100-233 Disposal of PUREX Chemical Reagents

LQ-120-001 Labeling of Standards and Reagents

LQ-120-101 Labeling, Disposal, and Adm. Control of Chemicals 222-S

LQ-120-104 Preparation of Single or Mixed Element Solutions

LQ-120-203 Preparation of Dilute Acids

LQ-211-101 Potentiometric Standardization of Acids and Bases

LQ-211-103 Memotitration of HNO_3 Using Oxalate/Fluoride Complex

LQ-211-113 Free Acid or Acid Def. Anal. by Oxalate/F Complex by Titr.

LQ-219-101 Det. of HNO_3 by Calculation from Density in Uranyl Nitrate

LQ-281-001 Standardization of $\text{Fe}(\text{II})$ Solutions with 0.1 N Ceric Sulfate

LQ-355-199 Spec. Det. of P using Molybdovanadophosphoric Acid Method

LQ-508-006 Instr. for Doc. of the Calibration of Radiation Sources

LQ-508-301 Preparation of Large Area Gamma Sources

REAGENT AND STANDARD CONTROL (Continued)

LQ-519-101 Calibration Check of Glass Thermometers

LQ-549-101 Preparation of Iron and Aluminum Solutions

LQ-551-101 Prep. and Stand. of Potassium Permanganate Solutions

LQ-551-206 Stand. of Potassium Permanganate by Arsenic (III) Oxide

LQ-582-101 Stand. of Ceric Sulfate by Pot. Titr. with Arsenic Trioxide

LQ-645-199 Spec. Determination of Nitrite in Stock Solutions

LQ-920-101 Gravimetric Assay of Uranium in Uranyl Nitrate Solution

LQ-921-001 Blind Standards Control for Davies-Gray Uranium Procedures

LQ-933-301 Production of Neptunium-239 from Americium-243

LQ-943-101 Preparation and Purification of Pu-236

LQ-946-001 Prep. of SRM 996 for Use in Pu Isotopic Dilution Mass Spec.

LQ-948-001 Plutonium Retention Standard

LQ-949-001 Plutonium Characterization

LR-XXX-XXX Laboratory Reference Material Specifications

APPENDIX F

CONTROL OF SAMPLES

LA-505-122 Sample Prep./Anal. High Activity AA-6 Atomic Abs. Spec.
LA-505-123 Process Quality Control Atomic Absorption Spectrophotometer
LA-505-124 Appl. of Method of Standard Additions to Atomic Absorption
LA-505-143 Inductively Coupled Plasma Analytical Procedure
LA-505-364 Prep. Pu Nitrate Samples for Spec. Trace Impurity Analysis
LA-507-121 Sample Preparation for X-ray Fluorescence
LA-508-107 AEA of PUREX Main Stack Air Filters
LA-508-112 222-S C.R. Calculations for Air, Water, and Smear Samples
LA-508-257 PUREX Plutonium Solution Isotopic System - Sample C/A
LA-508-301 Analysis of Air Samples
LA-508-302 Count Air Samples at 234-5 Process Control Laboratory
LA-508-341 GEA Sample Preparation for UO3 Powder
LA-519-112 SpG by Hydrometer for High Melt Samples
LA-519-131 Granulometric Analysis of Disaggregated Sediment Samples
LA-519-151 Visual Check and Over-the-Top Reading
LA-519-251 PUREX Visual Test
LA-519-253 Performing CP Verification Readings on Gilmont Carriers
LA-533-104 Preliminary Sample Preparation Before DIONEX Anion Analysis
LA-533-110 Chloride Removal for Anion Analysis by DIONEX
LA-540-301 Grav. Prep. of Liquid Mounts for Total Alpha and/or AEA
LA-543-101 Filtering of B Plant Samples in the 1 F Cubicle
LA-544-101 Nitric Acid-Hydrochloric Acid Leach of Soil

CONTROL OF SAMPLES (Continued)

LA-544-102 Nitric Acid-Hydrochloric Acid Leach of Vegetation

LA-544-111 Volume Reduction of Aqueous Samples

LA-548-101 Prep. of Aq. Mounts for Total Alpha and/or AEA

LA-548-102 Prep. of Organic Mounts for Total Alpha and/or AEA

LA-548-103 Gross Beta by Evaporation - Direct Mount

LA-548-111 Preparation of Mounts for Liquid Scintillation Counting

LA-548-121 Preparation of Sample Mounts for Ge(Li) GEA - Low Level

LA-548-122 Preparation of Samples for Gamma Energy Analysis Dry Mount

LA-548-123 Preparing T-vial Mounts for Gamma Energy Analysis

LA-548-141 Filt. of Aq. Samples & Det. of Gross Activity of the Solids

LA-548-142 Prep. of Quarterly Filter Composites for Gamma Analysis

LA-548-201 Prep. of Aq. Mounts for Total Alpha and/or AEA

LA-548-202 Prep. of Organic Mounts for Total Alpha or AEA

LA-548-203 Total Alpha/Total Beta Mounting Procedure

LA-548-211 Preparation of Alpha Mounts with Solids Treatment

LA-548-221 T Vial Preparation of Samples for Gamma Analysis (GEA)

LA-548-222 Dry Mount Prep. of Samples for Gamma Energy Analysis (GEA)

LA-548-223 Double Shell Mount for Analysis of Plutonium Solutions

LA-548-224 Prep. 125 ml Sample Mounts for Low-Level Gamma Energy Anal

LA-548-302 Sep. and Diss. of Solids for Total Alpha Activity Mounts

LA-548-312 Prep. of Aqueous Mounts for Total Alpha and/or AEA

LA-548-313 Prep. of Organic Mounts for Total Alpha and/or AEA

LA-549-101 Compositing and Prep. of Liq. Effluent Samples for Analyses

LA-549-112 Dissolution of Acropor Type Filters

CONTROL OF SAMPLES (Continued)

LA-549-113 Diss. of Solids After Filtration from Liquid Waste Sample
LA-549-114 Diss. of Solids after Filt. from Liq. Waste Samples
LA-549-115 Strontium Fluoride Dissolution
LA-549-121 TK-05 Solids Dissolution in Cubicle Prep. to Pu Analysis
LA-549-122 Separation and Dissolution of Solids
LA-549-133 Nitric Acid-Hydrogen Peroxide Oxidation of Organic Matter
LA-549-134 Quarterly Air Filter Compositing
LA-549-201 Compositing of PUREX Samples
LA-549-202 Dilution of Cladding Removal Waste Samples
LA-549-315 Dissolution of PuDioxide in Nitric Acid and HF
LA-549-321 Dissolution of UO₃ Powder
LA-549-322 Compositing of Uranium Oxide Powder
LA-905-204 Prep. of Pu Samples by Solvent Extr. for Th Anal. by ICP
LA-925-203 Sep'n of U with TBP/NPH for Det. Using Fluorometric Methods
LA-942-302 Plutonium Assay Special Sample Pretreatment
LA-946-202 Pu/U Sep'n for Isotopic Dilution Mass Spec. by Ion Exch.
LO-080-111 Kernsberg Remote Pipetter
LO-080-112 Sample Pig Handling
LO-080-113 Filtering of Process Samples Containing Solids
LO-080-201 Sample Breakdown of High Alpha Solutions (L, M, & N Cells)
LO-080-212 Semi-Remote Hood
LO-080-213 Filtration of Samples with Syringe
LO-080-214 X-ray Sample Cup Slurping
LO-080-221 D 5 Cave Sample

CONTROL OF SAMPLES (Continued)

LO-080-311 Opening Pipe Containers for Amperometric Plutonium Assay

LO-090-001 Seal Application, Control, Removal, and Source Data Forms

LO-090-004 Packaging Rad. Material for On-Site Shipment and Receiving

LO-090-005 Shipping Nonradioactive Chemicals and Reagents

LO-090-011 Opening Glass Ampoules

LO-090-101 Sample Receiving for Routine Samples - 222-S Laboratory

LO-090-151 Weighing and Packaging of NaF for WESF

LO-090-152 Processing PCB Contaminated Oil Samples at 222-S Lab.

LO-090-201 Sample Receiving 202 A Laboratory

LO-090-202 Sample Receiving and Handling - Counting Room

LO-090-203 Packaging and Receiving Requirements B Plant Truck

LO-090-301 Handle Shipping Containers from Offsite and Onsite

LO-090-303 Package Inner Containers for Shipment

LO-090-304 Receiving/Handling and Disposal of Routine Lab. Samples

LO-090-307 Sample Packaging of Plutonium Dioxide

LO-090-313 Receiving and Shipping of UNH and UO3 Samples

LO-100-221 Disposal of Counting Room Samples

LO-100-231 Sample Disposal

LO-150-043 Analytical Sample Cards - LCCS

LO-150-113 Environmental Laboratory Operating Procedure

LO-150-114 Essential Materials Laboratory Operating Procedure

LO-150-126 Sample Dilution

LO-150-131 Remove Sample from Dumbwaiter & Sample Handling in 222-S CR

LO-150-132 Radioactive Sample Storage, Room 2E, 222-S Laboratory

CONTROL OF SAMPLES (Continued)

LO-150-133 Processing PUREX Main Stack Air Samples
LO-150-135 Sample Disposal Criteria
LO-150-211 PUREX Referee Program
LO-150-231 Sample Storage at PUREX Analytical Laboratory
LO-150-325 Rocky Flats Sample Exchange Programs
LO-160-001 Purification of Pu through Quantitative Ion Exchange
LO-161-101 1-F Cubicle Operation, 222-S Bldg.
LO-161-141 1E-1 Cubicle Operation, 222-S Bldg.
LO-161-301 Use Dry Air Complex in Room 139
LO-161-302 Seal-In/Seal-Out of Material from Glovebox by Plastic Bag
LO-162-122 Alpha, Beta/Gamma Survey of Sample Mounts
LO-162-222 Presurvey of Counting Room Sample Mounts
LO-162-322 Survey of Counting Room Sample
LO-180-001 Inventory of Special and Nuclear Materials
LO-180-202 Anal. of Accountability & Physical Inventory Samp. at P.A.L.
SO-021-001 Operate Leckenby Sample Storage Unit
SO-080-001 Sample and Transfer Effluent to the 216-S-26 Crib
SO-170-012 Label Sample Carriers

APPENDIX G

MEASUREMENT CONTROL PROCEDURES

I. LMCS PROGRAM

Documenting Laboratory Measurement Control System Code Parameter Changes	LO-150-028
Laboratory Measurement Control System	SD-CP-ADP-007
Laboratory Measurement Quality Control	LQ-150-001 WHC-CM-5-4 Inst. 9-01
Laboratory Measurement Quality Control Using the Laboratory Measurement Control System (LMCS)	LO-150-001
Laboratory Measurement Quality Control Without LMCS	LO-150-003
PUREX Laboratory Measurement Quality Control Using Laboratory Measurement Control System (LMCS)	LO-150-212
Responses to Off-Standard Condition Reports and Precision Reports	LO-150-002

II. STANDARD ANALYSIS

Instrument Standards Counting Frequency 222-S Counting Room	LO-150-115
Measurement Quality Control for the ICP	LO-150-212

III. MANUAL MEASUREMENT CONTROL

PUREX Laboratory Measurements Control Without LMCS	LO-150-214
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IV. SIGNIFICANT NUMBERS

Detection Limit and "Less Than" Calculations in Laboratory Procedures	LO-150-021
Mathematic Aspects of Checking and Reporting Results	LO-150-127
The Use and Meaning of Significant Figures in Laboratory Procedures	LO-150-022

APPENDIX H
CORRECTIVE ACTION FORMS

<u>NAME</u>	<u>DOCUMENT</u>
Audit Report	WHC-CM-4-2 QR 18.0 QI 18.2
Corrective Action Request	WHC-CM-4-2 QI 16.2
Event Fact Sheet Critique Unusual Occurrence Report	WHC-CM-1-3 MRP 5.14
Inspection/Surveillance Report	WHC-CM-4-2 QI 10.4
Nonconformance Report	WHC-CM-4-2 QI 15.1 QI 15.2
Procedure Change Authorization (Re) Issuance of Procedure	WHC-CM-5-4 Proc. 5-01 Proc. 5-03
Off-Standard Condition Report	LO-150-001 LO-150-002 LQ-150-001

APPENDIX J

QUALITY ASSURANCE PROGRAM INDEX
ANALYTICAL CHEMISTRY SERVICES LABORATORIES

1. ORGANIZATION

IMPLEMENTING PROCEDURES

WHC-CM-5-4

LABORATORY PROCEDURES

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2. QUALITY ASSURANCE PROGRAM

IMPLEMENTING PROCEDURES

WHC-CM-5-4

LABORATORY PROCEDURES

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LC-600-101	LC-600-201
LO-150-001	LO-150-002
LO-150-003	LO-150-021
LO-150-022	LO-150-127
LO-150-211	LO-150-212
LO-150-214	LO-150-241
LO-150-325	LO-161-223
LQ-150-001	LQ-508-004

3. DESIGN CONTROL

This is not a function of ACSL. This is accomplished by another organization within WHC for ACSL.

See WHC-CM-6-1, Standard Engineering Practices, EP 1.0, "Engineering Process."

4. PROCUREMENT DOCUMENT CONTROL

This is not a function of ACSL. This is accomplished by another organization within WHC for ACSL.

See WHC-IP-0258, "Procurement Users Guide."

5. INSTRUCTIONS, PROCEDURES AND DRAWINGS

IMPLEMENTING PROCEDURES

WHC-CM-5-4

LABORATORY PROCEDURES

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LC-400-001	LC-400-002
LC-400-003	LO-150-242
LO-155-002	LQ-508-006

6. DOCUMENT CONTROL

IMPLEMENTING PROCEDURES

LABORATORY PROCEDURES

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LO-150-144

LO-150-244

7. CONTROL OF PURCHASED ITEMS AND SERVICES

This is not a function of ACSL. This is accomplished by another organization within WHC for ACSL.

See WHC-IP-0258, "Procurement Users Guide."

8. IDENTIFICATION AND CONTROL OF ITEMS

IMPLEMENTING PROCEDURES

WHC-CM-5-4

LABORATORY PROCEDURES

LA-519-151	LA-519-251
LA-519-253	LC-400-005
LC-608-004	LO-090-101
LO-090-201	LO-090-202
LO-090-304	LO-100-221
LO-100-231	LO-100-233
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LO-150-221	LO-150-321

9. CONTROL OF PROCESSES

IMPLEMENTING PROCEDURES

WHC-CM-5-4

3-03

LABORATORY PROCEDURES

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LA-211-013	LA-211-101
LA-211-105	LA-211-106
LA-211-108	LA-211-113
LA-211-131	LA-211-204
LA-211-205	LA-211-209
LA-211-210	LA-211-212
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LA-211-216	LA-211-231
LA-211-241	LA-211-301
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LA-211-396	LA-211-398
LA-212-102	LA-212-201
LA-212-202	LA-212-203
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LA-221-101	LA-223-101
LA-245-201	LA-281-201
LA-285-101	LA-285-201
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LA-321-201	LA-325-102
LA-325-201	LA-331-301
LA-335-201	LA-344-101
LA-344-103	LA-344-104
LA-344-111	LA-344-302
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LA-378-103	LA-438-101
LA-438-102	LA-438-111
LA-501-111	LA-501-201
LA-501-202	LA-501-203

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LA-501-207	LA-503-154
LA-503-155	LA-503-156
LA-503-201	LA-503-221
LA-503-222	LA-503-301
LA-505-103	LA-505-104
LA-505-121	LA-505-122
LA-505-124	LA-505-126
LA-505-141	LA-505-143
LA-505-201	LA-505-203
LA-505-210	LA-505-241
LA-505-242	LA-505-245
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LA-505-366	LA-505-367
LA-505-369	LA-505-370
LA-505-371	LA-505-372
LA-505-373	LA-506-302
LA-506-303	LA-506-304
LA-506-305	LA-506-306
LA-506-307	LA-507-121
LA-507-126	LA-507-131
LA-507-141	LA-507-150
LA-507-151	LA-507-152
LA-507-201	LA-508-002
LA-508-051	LA-508-052
LA-508-054	LA-508-056
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LA-508-104	LA-508-105
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LA-512-301	LA-514-112
LA-514-121	LA-519-111
LA-519-131	LA-519-132
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LA-519-172	LA-519-173

9. CONTROL OF PROCESSES (Continued)

LA-519-174	LA-519-175
LA-519-176	LA-519-177
LA-519-178	LA-519-179
LA-519-211	LA-519-212
LA-519-213	LA-519-231
LA-519-232	LA-519-233
LA-519-252	LA-519-261
LA-519-262	LA-519-271
LA-519-312	LA-519-321
LA-519-333	LA-519-335
LA-519-342	LA-519-351
LA-519-352	LA-519-361
LA-519-362	LA-519-363
LA-519-365	LA-521-201
LA-521-202	LA-521-203
LA-521-211	LA-521-301
LA-521-302	LA-523-122
LA-525-303	LA-525-304
LA-525-310	LA-531-101
LA-533-101	LA-533-102
LA-533-103	LA-533-104
LA-533-105	LA-533-110
LA-540-301	LA-541-102
LA-542-101	LA-542-102
LA-543-101	LA-544-101
LA-544-102	LA-544-103
LA-544-111	LA-548-101
LA-548-102	LA-548-103
LA-548-111	LA-548-121
LA-548-122	LA-548-123
LA-548-141	LA-548-142
LA-548-201	LA-548-202
LA-548-203	LA-548-211
LA-548-221	LA-548-222
LA-548-223	LA-548-224
LA-548-302	LA-548-312
LA-548-313	LA-549-101
LA-549-112	LA-549-113
LA-549-114	LA-549-115
LA-549-121	LA-549-122
LA-549-133	LA-549-134
LA-549-201	LA-549-202
LA-549-315	LA-549-321
LA-549-322	LA-551-201
LA-551-202	LA-551-203
LA-551-205	LA-551-207
LA-551-208	LA-551-209
LA-551-301	LA-551-302

9. CONTROL OF PROCESSES (Continued)

LA-551-303	LA-551-306
LA-555-201	LA-560-101
LA-560-111	LA-564-101
LA-613-101	LA-613-111
LA-621-201	LA-622-101
LA-634-102	LA-634-202
LA-635-101	LA-645-001
LA-645-201	LA-645-202
LA-645-301	LA-651-202
LA-651-302	LA-661-102
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LA-661-203	LA-661-204
LA-661-205	LA-661-211
LA-661-304	LA-905-101
LA-905-201	LA-905-203
LA-905-204	LA-905-301
LA-905-302	LA-905-305
LA-905-306	LA-920-101
LA-921-001	LA-921-201
LA-921-301	LA-925-106
LA-925-107	LA-925-113
LA-925-203	LA-925-206
LA-925-208	LA-925-211
LA-925-212	LA-925-214
LA-925-216	LA-925-307
LA-926-301	LA-926-302
LA-926-303	LA-927-201
LA-928-301	LA-933-141
LA-933-201	LA-933-202
LA-933-241	LA-933-242
LA-933-243	LA-933-301
LA-933-341	LA-933-361
LA-935-203	LA-942-301
LA-942-302	LA-943-101
LA-943-105	LA-943-123
LA-943-125	LA-943-126
LA-943-201	LA-943-202
LA-943-205	LA-943-211
LA-943-301	LA-943-302
LA-945-203	LA-945-204
LA-945-210	LA-945-301
LA-945-303	LA-946-202
LA-946-301	LA-946-303
LA-948-051	LA-948-233
LA-948-242	LA-948-329
LA-948-332	LA-948-333
LA-948-340	LA-948-341
LA-948-342	LA-948-343

9. CONTROL OF PROCESSES (Continued)

LA-948-344	LA-948-345
LA-948-346	LA-948-348
LA-948-349	LA-948-361
LA-948-363	LA-948-382
LA-953-101	LA-953-102
LA-953-201	LC-502-001
LC-508-053	LC-508-101
LC-602-006	LC-602-101
LC-602-102	LC-602-103
LC-602-104	LC-602-106
LC-602-201	LC-602-202
LC-602-203	LC-608-001
LC-608-002	LC-608-003
LC-608-051	LC-705-110
LC-705-201	LC-708-101
LC-708-102	LC-708-103
LC-949-010	LO-002-102
LO-002-111	LO-002-201
LO-002-202	LO-002-211
LO-002-212	LO-080-111
LO-080-113	LO-080-201
LO-080-212	LO-080-213
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LO-100-324	LO-100-325
LO-100-326	LO-100-333
LO-100-334	LO-100-335
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LO-110-111	LO-110-201
LO-110-202	LO-110-301
LO-120-003	LO-120-103
LO-120-104	LO-120-202
LO-120-203	LO-120-204
LO-120-301	LO-140-004
LO-140-301	LO-150-011
LO-150-105	LO-150-112
LO-150-113	LO-150-114
LO-150-115	LO-150-126
LO-150-133	LO-150-201
LO-150-205	LO-150-224
LO-150-251	LO-150-301
LO-150-302	LO-160-001
LO-161-002	LO-161-101

9. CONTROL OF PROCESSES (Continued)

LO-161-102	LO-161-103
LO-161-104	LO-161-111
LO-161-112	LO-161-113
LO-161-116	LO-161-117
LO-161-118	LO-161-121
LO-161-122	LO-161-141
LO-161-143	LO-161-203
LO-161-211	LO-161-212
LO-161-221	LO-161-222
LO-161-303	LO-162-101
LO-162-111	LO-162-112
LO-162-122	LO-162-123
LO-162-211	LO-162-212
LO-162-222	LO-162-301
LO-162-311	LO-162-322
LO-180-202	LO-180-321
LO-190-101	LO-190-102
LO-190-112	LO-190-114
LO-190-121	LO-190-201
LO-190-202	LO-190-203
LO-190-204	LO-190-321
LQ-211-102	LQ-211-103
LQ-211-113	LQ-219-101
LQ-355-199	LQ-505-199
LQ-508-205	LQ-510-102
LQ-519-113	LQ-549-101
LQ-645-199	LQ-920-101
LQ-933-301	LQ-943-101
LQ-946-001	LQ-948-001
LQ-949-001	
SD-CP-LB-001	
SD-CP-LB-015	
SD-CP-LB-020	
SD-CP-LB-021	

10. INSPECTION

IMPLEMENTING PROCEDURES

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LABORATORY PROCEDURES

LO-150-106

11. TEST CONTROL

IMPLEMENTING PROCEDURES

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LABORATORY PROCEDURES

LE-XXX-XXX

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IMPLEMENTING PROCEDURES

WHC-CM-5-4

LABORATORY PROCEDURES

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LA-505-244	LA-505-363
LA-525-311	LA-525-312
LA-948-334	LQ-211-101
LQ-281-001	LQ-508-003
LQ-508-005	LQ-508-301
LQ-510-112	LQ-510-122
LQ-510-211	LQ-510-212
LQ-510-221	LQ-519-101
LQ-551-101	LQ-551-206
LQ-582-101	LQ-921-001
LR-YYY-XXX	

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LABORATORY PROCEDURES

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LO-002-331	LO-040-101
LO-060-301	LO-060-302
LO-080-112	LO-080-212
LO-080-311	LO-090-001
LO-090-002	LO-090-004
LO-090-005	LO-090-011
LO-090-111	LO-090-112
LO-090-151	LO-090-203
LO-090-251	LO-090-301
LO-090-303	LO-090-305
LO-090-307	LO-090-313
LO-090-315	LO-100-323
LO-100-327	LO-150-131
LO-150-132	LO-150-231
LO-161-301	LO-161-302
LO-180-001	LO-180-002
LO-180-101	LO-180-105
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WHC-CM-5-4

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WHC-CM-5-4

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LO-150-043

LO-150-121

LO-150-222

18. AUDITS

IMPLEMENTING PROCEDURES

LABORATORY PROCEDURES

WHC-CM-5-4

9-01

AUG 24 1989 48

ENGINEERING DATA TRANSMITTAL

1. EDT 119607

2. To: (Receiving Organization)

222-S/RCRA Analytical Laboratories

3. From: (Originating Organization)

Data Measurements and Control

4. Related EDT No:

N/A

7. Purchase Order No:

N/A

Prog/Dept/Div: Chemical Processing

6. Cog/Proj Engr: S. S. Moss

8. Originator Remarks:

N/A

9. Equip/Component No:

N/A

10. System/Bldg/Facility:

222-S/RCRA Anal Lab

12. Major Assm Dwg No:

N/A

11. Receiver Remarks:

N/A

13. Permit/Permit Application No:

N/A

14. Required Response Date:

N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Trans- mittal	(H) Origina- tor Dispo- sition	(I) Rece- iver Dispo- sition
1	WHC-SD-CP-QAPP-002		0	Quality Assurance Project Plan for the Chemical Analysis of Highly Radioactive Mixed Waste Samples in Support of Environmental Activities on the Hanford Site.	54	1	1	1

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 see MRP 5.43 and EP-1.7	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

(G)	(H)	17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)								(G)	(H)
Reason	Disp	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp
		Cog/Proj. Eng S. S. Moss	<i>Stephen Scott Moss</i>	8/17/89		T. A. Lane	<i>T. A. Lane</i>			1	1
		Cog/Proj. Eng. Mgr. L. H. Taylor	<i>L. H. Taylor</i>			J. D. Briggs	<i>J. D. Briggs</i>			1	1
		QA J.T. Knight	<i>J. T. Knight</i>			J. P. Slough	<i>J. P. Slough</i>			1	1
		Safety				C. R. Stroup	<i>Curtis R. Stroup</i>			1	1
1	1	J. H. Kessner	<i>John H. Kessner</i>	8/17/89							

Stephen Scott Moss
S. S. Moss
Signature of EDT
Originator

8-17-89
Date

Curtis R. Stroup
C. R. Stroup
Authorized Representative
for Receiving Organization

8/18/89
Date

L. H. Taylor
L. H. Taylor
Cognizant/Project
Engineer's Manager

8-17-89
Date

21. DOE APPROVAL (if required)
Ltr No. _____
☐ Approved
☐ Approved w/comments
☐ Disapproved w/comment:

SUPPORTING DOCUMENT

1 Page 1 of 40

2 Title Quality Assurance Project Plan for the
Chemical Analysis of Highly Radioactive Samples in Support of Environmental Activities on the

3 Number WHC-SD-CP-QAPP-002

4 Rev No. 0

5 Key Words Hanford Site

High Level Mixed Waste, Environmental
Quality Assurance Project Plan, 222-S/
RCRA Analytical Laboratory

6 Author

S. S. Moss

Name (Type or Print)

Stephen Scott Moss

Signature

12743

Organization Code

7 Abstract

This is the quality assurance project plan for the 222-S/RCRA Analytical Laboratory's activities dealing with the analysis of highly radioactive mixed waste environmental samples. This project plan was written to the requirements of Guidelines and Specifications for Preparing Quality Assurance Project Plans, (EPA-600/4-83-004, QAMS-005/80) and ANSI/ASME NQA-1 (ASTM C1009) where applicable.

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11 Impact Level

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QUALITY ASSURANCE PROJECT PLAN

FOR THE CHEMICAL ANALYSIS OF HIGHLY RADIOACTIVE MIXED WASTE SAMPLES
IN SUPPORT OF ENVIRONMENTAL ACTIVITIES ON THE HANFORD SITE

Approvals:

Curtis R Stroup 8/18/89
C. R. Stroup Manager,
222-S/RCRA Analytical Laboratories Date

L. H. Taylor 8/18/89
L. H. Taylor Manager,
Data Measurements and Control Section Date

T. A. Lane 8/18/89
T. A. Lane Manager,
Applied Technology Section Date

J. D. Briggs 8/23/89
J. D. Briggs Manager,
222-S Analytical Laboratory Operations Date

J. H. Kessner 8/18/89
J. H. Kessner Staff Manager,
Office of Sample Management Date

J. P. Slougher 8/23/89
J. P. Slougher Manager,
Process Chemistry & Engineering Laboratories Date

J. T. Knight 8-23-89
J. T. Knight Quality Engineer,
Chemical Plants Quality Engineering Date

D. H. Jones 8/23/89
D. H. Jones Manager,
Environmental Quality Assurance Date

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1.0 PROJECT DESCRIPTION

This document defines the Westinghouse Hanford Company (WHC) 222-S/RCRA Laboratory Quality Assurance Project Plan (QAPjP) for the analysis of highly radioactive mixed waste samples. This QAPjP applies only to activities performed under the Hanford Federal Facility Agreement and Consent Order (the Tri-Party Agreement) for the WHC Environmental Division. The QAPjP has been prepared according to the Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA-600/4-83-004, QAMS-005/80) and ANSI/ASME NQA-1 (ASTM C1009) where applicable.

Westinghouse Hanford Company 222-S/RCRA Laboratory provides analytical support to a wide variety of programs on the Hanford Site. This QAPjP addresses the Quality Assurance and Quality Control (QA/QC) requirements for chemical analysis of highly radioactive solid and liquid wastes and environmental samples. Where applicable, references are made to the Analytical Chemistry Services Laboratories Quality Assurance Program Plan (QAPP) (SD-CP-QAPP-001).

Highly radioactive samples are to be collected from numerous locations and situations at Hanford as part of characterization activities at active and inactive waste sites. The type of samples received vary and range from contaminated water and soil material to radioactive mixed waste materials that occur in various physical forms including solids, liquids, sludges, and salt-cake. Characterization of these wastes are, in many cases, driven by the need to identify waste constituents and concentrations in order to meet the requirements of applicable environmental regulations. For regulatory characterization, the applicable regulation will often determine the specific data quality objectives for the project.

Radioactive, hazardous, and mixed wastes have been produced at Hanford since the early 1940's as the result of Hanford's defense activities. Sampling and analysis of these material are required to properly characterize the wastes to comply with the requirements of the applicable environmental regulations. Samples are to be collected by Tank Farm Operations and transported to the 222-S/RCRA Laboratory for sample preparation and analysis. As samples are collected, they are to be identified immediately with a unique sample number and controlled under chain-of-custody. Samples nearing their regulatory maximum holding times shall be identified as they reach the 222-S/RCRA Laboratory. A database management system to be used to incorporate sampling, analytical, and statistical data on all samples from each sampling mission is currently included in the Laboratory Customer Communications System (LCCS) and the Laboratory Measurement Control System (LMCS).

The initial concern in working with these types of samples is the safety of personnel involved with sampling, transporting, preparing, and analyzing the samples. Procedures must address limiting radiological exposures in addition to controlling potential exposure to the associated chemical hazards. In some cases, accepted practices for sample handling must be modified to permit safe handling of the samples. Likewise, standard U.S. Environmental Protection Agency (EPA) methods of analysis must be modified in many

cases. For each modified standard operating procedure (SOP), there shall be a detailed description of its variation from the standard EPA method. Where standard practices are modified, this plan identifies potential effects on the quality of analysis and suggests recommendations for correct interpretation of the results of chemical analyses.

The flow of field data and samples from collection through reporting and archiving is displayed in Figure 1.

FIGURE 1. Flowchart for Highly Radioactive Mixed Waste Samples and Data

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Organization and responsibility of laboratory groups involved in this project are defined in SD-CP-QAPP-001, Section 1.0, "Organization." Both sectional and individual responsibilities are outlined.

Specific laboratory organizations involved in this project include

- o Process Chemistry and Engineering Laboratory is responsible for initial hot cell processing and sub-sampling,
- o 222-S/RCRA Analytical Laboratory Operations is responsible for the receipt of samples from the field, and the performance the actual chemical analysis of samples,
- o Applied Technology which provides data validation and method development and analytical technical support,
- o Data Measurements and Control which provides standards preparation, and internal quality assurance oversight,
- o Laboratory Upgrades and Engineering Sections which provides non-analytical technical support,
- o Office of Sample Management which provides sample and data management support.

External to the 222-S/RCRA Laboratory is the Waste Management and Site Support Quality Assurance which through its Environmental Quality Assurance Section (EQA) is responsible for overall QA for environmental projects.

Calibration of primary analytical instruments are tracked by an establish team referred to as the Laboratory Instrument Calibration Control Board (LICCB). Based upon the judgment of the technical personnel intermediate calibrations are performed.

Primary responsibility for project performance lies with the Manager of the 222-S/RCRA Analytical Laboratory Operations Section, who oversee unit managers for the Special Analysis and Research Support Units. The Manager of the Applied Technology Section oversee the unit managers of the Analytical Chemistry and Nuclear Measurement Units, who oversee the responsible scientists. The responsible scientists provide technical support to the 222-S/RCRA Laboratory.

The organizational structures for this QAPjP are shown in Figures 2, 3, and 4.

FIGURE 2. Organizational relationship of the 222-S/RCRA Analytical and Process Chemistry and Engineering Laboratories

FIGURE 3. Organization of the 222-S/RCRA Analytical Laboratory

FIGURE 4. Organization of the Process Chemistry and Engineering Laboratories covered under this Quality Assurance Project Plan

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Laboratory QA objectives must be defined for each specific set of project analyses. Quality assurance objectives may be based on overall project goals, proven laboratory performance, and/or indirect requirements (i.e., regulatory mandates). Based on existing 222-S/RCRA Laboratory procedures and practices and those accepted in the industry, general QA objectives listed in Table 1 are recommended. Each customer or project covered under this QAPjP shall be required to provide specific QA objectives if those stated in this QAPjP are inadequate or not required. Minimum required method detection limits based on analyses made on performance standards in water are shown in Table 2. If the current laboratory techniques and methods for analysis can not meet the specific QA objectives of a particular project, new procedures or modifications will be developed and proven in practice. The QA objectives for any project are subject to revision as experience in analysis of specific samples presents performance data.

3.1 ACCURACY

Accuracy of chemical analyses are evaluated using Percent Recovery for evaluation of spikes or known additions to sample matrices; and Percent Relative Error for evaluation of analysis of standards or other reagents of known concentration. It is anticipated that at least two types of known standards will be used during analysis. These are check standards (either blind or known), and matrix spike standards (also referred to as known additions). The purposes and specific QA criteria for each of these types of standards vary. Blind check standards generally consist of aliquots of analytes in appropriate solvent matrix of a concentration unknown to the analyst. Blind check standards form the basis for QA review of accuracy of analyses. Known check standards consist of aliquots of specific analytes added by the technologist (again contained in appropriate solvent matrices) which are used to verify that the analytical method is in control at the bench. Matrix spike standards are used to assess the potential positive and negative interferences caused by the sample material itself. Matrix spikes consist of aliquots of known analyte concentration added to an aliquot of the sample matrix prior to analysis. The results of matrix spike analyses are used to validate the analysis.

Percent Recovery is calculated by the following equation:

$$P = 100 \frac{\text{Observed} - \text{Background}}{\text{Spike}}$$

Where:

P = Percent Recovery.

Observed = Measured analyte concentration in the spiked sample.

Background = Measured analyte concentration in the unspiked sample.

Spike = Concentration of analyte in the spike.

TABLE 1. QUALITY ASSURANCE OBJECTIVES FOR THE ANALYSIS OF HIGH-LEVEL MIXED WASTE SAMPLE

Parameter	EPA Method	Duplicate/Spikes	Blank	Verify Calibration	Other
ICP Metals	6010	spike frequency 20%	ever 10 samples	every 10 samples	
Arsenic	7060 & 7061	spike every 20 samples/standard every 10 samples	per batch	every 15 samples	calibrate curve every hour
Selenium	7740 & 7741	spike every 20 samples/standard every 10 samples	per batch	every 15 samples	calibrate curve every hour
Mercury	7471	spike every 10 samples	per batch	every 15 samples	calibrate curve
Chromium VI	7196	spike every 10 samples	per batch	every 15 samples	
Nitrate	300	spike every 10 samples	per batch	every 15 samples	
Sulfate	300	spike every 10 samples	per batch	every 15 samples	
Chloride	300	spike every 10 samples	per batch	every 15 samples	calibrate curve
Cyanide	9010	spike every 10 samples	per batch	every 15 samples	calibrate curve
TOX	9020	spike every 10 samples	per batch	every 15 samples	
Volatile Organics	8240	spike/duplicate per batch & every 20 samples	per batch	every 12 hours	tuning every 12 hours
Semivolatile Organics	8270	spike/duplicate per batch & every 20 samples	per batch	every 12 hours	tuning every 12 hours
Chlorinated Herbicides	8150	spike/duplicate per batch & every 20 samples	per batch	daily	
Radionuclides	9310 9315	duplicate sample every 10 samples	per batch	periodically	
Precision	All RD +/- 25%				
Accuracy	All spikes (P) +/- 25%, all standards (RE) +/- 25%				
Completeness	All analysis 90%				

TABLE 2. NOMINAL METHOD DETECTION LIMITS (mg/l or mg/kg) FOR PERFORMANCE STANDARDS IN WATER

Parameter	EPA Method	EPA Groundwater SW-846 Limits	EPA Method Quantification Limit SW-846	EP Toxicity MAC-173-090 (δ) 1/10	Mixture Graph WAC-173-103-9906 1/10	Safe Drinking Water Act 40 CFR 141 1/10
Arsenic	7060 7061	0.01	0.001 0.002	0.5	1	0.005
Selenium	7740/7741	0.005	0.002	0.1	1	0.001
Mercury	7741	0.0002	0.0002	0.02	1	0.0002
Chromium	7196	0.01	-----	0.5	1	0.005
Residual metals-ICP	(6010)	0.01 (As) 0.2 (Ba) 0.002 (Cd) 0.01 (Ag) 0.005 (Pb)	0.053 (As) 0.002 (Ba) 0.004 (Cd) 0.003 (Ag) 0.042 (Pb)	0.5 (As) 1.0 (Ba) 0.1 (Cd) 0.5 (Ag) 0.5 (Pb)	1 1 1 1 1	0.1 (Cu) 0.03 (Fe) 0.005 (Mn) 0.5 (Zn)
Nitrate	300	0.3	0.3	-----	1	1.0
Sulfate	300	1	1.0	-----	1	25
Sulfide	9030	1	1.0	-----	1	25
Chloride	300	1	1.0	-----	1	25
Cyanide	9010	0.01	0.01	-----	1	0.2
Fluoride	300	-----	1.0	-----	1	0.2
TOX/EOX	9020	0.005	0.005	-----	1	0.2
Volatile Organics	8240	0.1 - 0.05	0.01	-----	1	0.2
Semi-volatile Organics	8270	0.01 - 0.05	-----	-----	1	0.2
PCB/Pesticides	8080	-----	0.006 ug/l 0.004 ug/l 0.176 ug/l 0.24 ug/l	0.002 0.04 1.0 0.05	1 1 1 1	0.00002 0.0004 0.01 0.0005
Chlorinated Herbicides	8150	-----	0.0012 (2,4-D) 0.00017 (2,4,5-TP)	1.0 0.1	1 1	0.01 0.001

Average percent recovery ($\bar{P}$) and the standard deviation estimate for percent recovery (S_P) will be plotted on a Shewhart-type control chart and will be available to the technologist at the bench. Performance-based values for P and S_P shall be developed after the first 20 data points are collected and will be updated periodically depending on sample frequency, but not less than monthly thereafter. Until an adequate number of P values are obtained, and a performance-based control chart can be developed, the interim control limits for P are 75% and 125%. After actual values are obtained, a control chart will be developed that places warning limits at the average percent recovery $\pm 2S_P$; and control limits at the average percent recovery $\pm 3S_P$. If control limits based on measured values fall outside the interim values of 75% and 125%, the method shall be assessed to identify specific factors that limit recovery.

Percent Relative Error of a series of measured data values is expressed by the following equation:

$$RE = 100 \frac{|X - \bar{X}|}{X_t}$$

Where:

RE = Percent Relative Error.

X = Measured analyte concentration.

$\bar{X}$ = Arithmetic mean (or average) of the series of measured analyte concentrations.

X_t = The true value of the analyte concentration.

Average Percent Relative Error and the standard deviation of the Percent Relative Error (S_{PRE}) will be calculated and plotted on a Shewhart-type control chart. After 20 data points are accumulated, performance-based statistics shall be calculated and a Shewhart-type control chart developed with warning limits at Average Percent Relative Error $\pm 2S_{PRE}$, and control limits at Average Percent Relative Error $\pm 3S_{PRE}$. The control chart will be updated based on sampling frequency, but at least monthly. Until adequate performance-based statistics are available, interim control limits of 75% and 125% of true value are to be used. If performance-based statistics indicate control limits fall outside the interim values of 75% and 125%, the method shall be assessed to identify the source of error.

In applying a Shewhart-type control chart to analyses, any of the following conditions indicates an out-of-control situation:

1. Any data point beyond the control limits.
2. Any two out of three beyond the warning limits.
3. Seven successive points on the same side of average value of the central line of the chart.

When an out-of-control situation, Type 1 or 2, is identified, a corrective action will be initiated by the automatic, LMCS, filing of an Off Standard Condition Report. For a Type 3 situation or other long-term trending behavior, a Precision Report is issued. The source of the problem must be identified and resolved before any more analyses are performed. After the problem is solved and documented, all analyses since the last in-control point will be repeated or discarded.

In order to maintain control of accuracy, all analytical runs are begun begin with a check standard after initial calibration and include continuing calibration standards at a frequency of one per analytical batch or not less than the frequency shown in Table 1. In addition, a check standard shall be run after returning any instrument to service after being placed on standby or turned off. If a particular method is identified as being subject to accuracy problems, the frequency of continuing calibration standards should be increased to reduce the need to re-run unknowns.

3.2 PRECISION

Precision in analyses are assessed through analysis of duplicate aliquots of samples. When dealing with solid wastes and soils or other geologic materials, the precision attainable in the laboratory is a function of the relative homogeneity of the sample material. As the sample material becomes more homogeneous, the ability to select similar aliquots of sample increases, and the relative precision of the duplicate analyses improves (i.e., the range of analytical values decreases). Any factors that could affect the precision of duplicate analyses should be noted in the laboratory report. These factors may include obvious stratification of material, degree of sorting of particle sizes, the presence of multi-phase materials, color variations in the sample material, and any other factor that indicates the degree of heterogeneity of the sample.

Precision are evaluated using Percent Relative Difference. Percent Relative Difference is computed by the following equation:

$$RD = 100 \frac{S}{\bar{X}}$$

Where:

RD = Percent Relative Difference.

S = The standard deviation estimate of the duplicate data set.

$\bar{X}$ = The arithmetic mean (average) of the duplicate data set.

After an adequate number of duplicate data sets are accumulated (minimum of 20 sets), a table of RD values for the range of concentrations encountered will be developed. Until performance-based RD values are obtained, interim objectives of 25% RD are applied. If measured RD values exceed the interim 25% RD, the data shall be reviewed for the presence of sample characteristics which could result in lower precision. If large RD values cannot be related to obvious sample characteristics, the method shall be evaluated to determine if the difference results from sample preparation and handling. As experience is gained, expected RD limits will be established for each sample type analyzed. However, considering the typical characteristics of solid wastes, sludges, and soil materials, it is not anticipated that the performance-based RD values will be less than the interim 25%.

3.3 REPRESENTATIVENESS

Concerted efforts shall be made to assure that sub-samples collected from bulk samples are representative of the sample. Where thorough mixing of samples is not possible, or other characteristics of the sample (i.e., particle sorting, viscosity, multiple phases, etc.) hinder thorough mixing, these conditions shall be documented during sample preparation and the results shall be reviewed with consideration of the possible non-representative conditions.

3.4 COMPLETENESS

The initial QA objective for completeness of chemical analyses in the laboratory is 90%. This means that the goal is to produce usable analytical data for a minimum of 90% of the analyses requested on all samples submitted to the laboratory. This objective will be reviewed after actual performance data are available for each sample type analyzed. The Laboratory's actual performance shall be evaluated against the 90% objective. If the Laboratory's performance drops below this limit, corrective action shall be initiated. This action shall identify and correct those activities within the laboratory that have caused the drop in performance. Based on actual laboratory performance in analysis of samples, individual completeness objectives for individual analytical methods may be developed.

Loss of analytical data will initiate a corrective action to identify the cause of the loss and prevent recurrence.

3.5 SIGNIFICANT NUMBERS

Significant numbers for reporting results of analysis shall be developed for each analytical procedure. Significant numbers shall be limited by the least precise and/or accurate step of an analytical procedure or method. After significant numbers are defined for a method, standard rules for rounding numbers shall be applied to reported data. In no case shall whole numbers or decimal fractions in excess of predetermined significant numbers be reported.

3.6 REQUIRED METHOD DETECTION LIMITS

Method detection limits (MDLs) shall be determined for each analytical method. Since some non-standard techniques are required to safely handle the highly-radioactive samples to be analyzed under this plan, it is necessary to establish minimum criteria needed to meet the needs of each project. Due to method variations (i.e., additional dilution, change in sample aliquot size, etc.), it is anticipated that the MDLs specified in SW-846 and in other documents (i.e., CLP Statement of Work) may not be achievable in many cases. Since most of the samples analyzed under this plan are being characterized to determine their regulatory compliance status, the required MDLs are usually based on the statutory requirements for characterization of the materials. The MDLs needed to determine adequate characterization with respect to applicable environmental regulations (state and federal) are shown in Table 2. The choice of MDLs for any specific project may depend on the need to satisfy specific environmental regulations which are listed above each column. These MDLs are determined to be 10% of the regulatory action level (where such levels are stipulated). This scheme allows regulatory compliance decisions to be made based on analytical results measured in the range of tens times the method detection limit, where both accuracy and precision should be at acceptable levels.

The method detection limit for radionuclide analysis is highly dependant of the size of the original sample used to prepare the sample mount. A large volume of water evaporated to prepare a single mount would produce an excellent detection limit in terms of detectable radionuclide per liter. The presence of multiple radionuclides in a sample makes it difficult to quantify the amount of any particular one. Because the MDLs for radionuclide analysis are so highly sample dependant, they are to be evaluated for each project or customer's samples. As early in the project as possible, MDLs based on analyses of actual samples, shall be reported to the customer or data user. Due to the highly radioactive nature of the samples to be covered under this QAPP, it is expected that MDLs, as a percentage of the sample quantity, will not be a problem.

If actual analytical performance data indicates that the requested MDLs are not routinely achievable on the sample matrices analyzed, then the customer shall be notified and instruction to continue analysis at the higher MDL requested.

3.7 HOLDING TIMES AND TURNAROUND TIMES

Holding times for sample analyses will conform to those stated in SW-846 as applicable. However, it will not always be possible to meet the holding times for highly radioactive wastes, due to extensive sub-sample collection required to be performed remotely in hot cells. At this time significant degradation of samples is not anticipated during the hot cell procedures, with the exception of potential loss of volatile compounds. It is anticipated that the analysis presenting the greatest difficulty in meeting holding times will be chromium (VI) with a maximum holding time of 24 hours. In the case of the highly radioactive waste samples, usually tank waste, the lack of microorganic activity, the age, and concentration of chemicals in the waste, it is expected that the level of chromium (VI) will be stable in the samples for periods considerably longer than 24 hours. Exposure of the sample to air prior to analysis may have an effect on chromium (VI), but the effect, if it indeed occurs, would be to slightly increase the concentration of chromium (VI) in the sample so that any observed bias would be conservative.

The goal of the laboratory operation is to perform analyses within the holding times specified and to assess individually each sample where holding times were exceeded. If holding times are exceeded, data may be reported if otherwise valid, but results shall be flagged in the report.

The objective of laboratory operations is to provide a report of the analytical results to the customer in timely fashion. Turnaround times for reports shall be determined as performance-based information becomes available.

3.8 COMPARABILITY

In order for analytical results to be comparable to other similar results, the methods utilized are based on those methods specified by EPA in SW-846 (Test Methods for Evaluating Solid Waste -- Physical/Chemical Methods) and EPA-600/4-79-020 (Methods for Chemical Analysis of Water and Wastes), and the State of Washington in WDOE 83-13 (Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulation).

Whenever possible, within the constraints of limiting radiation exposure, these methods conform to those specified in terms of reagents used, extraction or solvent ratios, and instruments utilized. It is anticipated that the use of smaller aliquots of sample will be one of the most common amendments to the methods. Where significant deviations from the stated methods are made, the deviation shall be documented and the modified method proven by repeat analyses to perform comparably.

4.0 SAMPLING AND SAMPLE PREPARATION PROCEDURES

4.1 GENERAL COMMENTS

The laboratory shall address sampling procedures to assure that the laboratory receives samples that meet the requirements of analysis. The laboratory will interface with the customer to assist in sampling plan development with respect to sample handling, containers, and preservation. Laboratory personnel must be aware of the objectives of the field mission to match analytical requirements to project needs. Sample handling procedures within the laboratory need to be specified and SOPs developed as required to address sample receipt and log-in, sample preservation and storage requirements, and associated documentation. The emphasis is on the collection of the most representative samples as possible and the needed QA/QC to accomplish that task. The laboratory shall be available as a resource to assist the customer in his overall planning.

4.2 SAMPLE COLLECTION AND PRESERVATION IN THE FIELD

It is noted that valid chemical analytical results are entirely dependent on collection, and receipt in the laboratory, of valid samples. Therefore it is important to address sample collection and handling procedures that may have an impact on the quality of laboratory analyses. Typical non-radioactive field samples are preserved and stored in coolers at 4°C. Field preservation of samples must be stressed when samples are collected from potentially biologically active systems (i.e., soil, surface and ground waters). This method is not practical for samples covered under this QAPjP as it is incompatible with the safe handling of highly-radioactive materials.

Most highly radioactive samples shall be collected using remote-controlled equipment. The sample, contained in the sampling device, is then placed in bulky lead-shielded containers for transport to the laboratory. The need to maintain low radiation exposure levels to field personnel precludes the ability to perform field measurements and to add preservatives in the field. The shielding required for samples makes cool storage of samples in the field very difficult. On the other hand, the need for field preservation and cool storage of highly radioactive samples is less critical than other cases. One of the primary reasons for cool storage and field preservation of samples is prevention or limitation of biological oxidation and reduction in sealed containers. Most materials to be controlled under this QAPjP are chemical mixtures of very high salt content, typically high pH, and such high radioactivity, that it is not expected that any living organisms will be present in the sample material.

A potential quality-related topic related to sampling and field preservation is potential loss of volatile organic compounds from samples. While this potential is recognized, over-riding safety considerations require that the samples be handled remotely and initial preparation be performed with manipulators in a shielded cell. In the case of the highly radioactive samples, some loss of volatile material may occur during sample collection and transport due to the semi-sealed design of the core samplers. This design also limits the amount of air that comes into contact with the sample and, therefore, should reduce potential spontaneous oxidation of reduced compounds. The bottle sampler is closed during transport. However, some loss of volatile material from the sample may occur during sampling and handling. The actual significance of this potential volatile loss shall be addressed in the final report of results and shall consider the type and quantity of volatile compounds known or suspected to be present in the samples.

Another potential quality-related topic includes cross-contamination of samples collected using the same sampling device. In addition there is the potential for contamination of samples with construction residues left on the containers and/or the cleaning solutions used on them. The use of remote sampling equipment and the materials associated with them may introduce adverse quality effects.

Specific field sampling factors that may affect the quality or interpretation of laboratory results are shown in Table 3. In order for the laboratory to fully quantify analytical results, specific information on these field activities must be provided.

TABLE 3. SAMPLE COLLECTION FACTORS AFFECTING ANALYTICAL QUALITY

<u>Factor</u>	<u>Procedures to Minimize Data Quality Impacts or Data Required for Assessment of Quality Impacts</u>
1. Cross-Contamination of the Sampling Devices and Containers	Detailed information on cleaning procedures. Equipment blanks will be routinely analyzed to confirm the absence of residues. Or by the use of single-use sampling devices and containers
2. Residues of Cleaning Solutions	Detailed information on constituents of cleaning solutions. Minimize the use of cleaning solutions that contain analytes of interest. Equipment blanks will be routinely analyzed to confirm the absence of decontamination residues.
3. Residues of Lubricants or other material that may contact samples	Detailed information on constituents of lubricants and other materials that may come into contact with samples on a routine basis. Representative samples of these materials will be analyzed by the laboratory so that contamination can be readily recognized.
4. Loss of Sample Identity	Assure that chain-of-custody procedures are in place in field. Use pre-made labels or tags for identifying samples and transport casks.

4.3 SAMPLE RECOVERY AND HOT CELL PROCEDURES

Due to the radioactive nature of the samples covered by this plan, initial sample preparation will be conducted in a shielded hot cell using remote manipulators. As with field sample collection procedures, tasks performed during hot cell operations may affect the quality of subsequent chemical analyses.

The procedures followed while handling highly radioactive samples in the hot cell will determine to a large degree, the accuracy, precision, representativeness, completeness, and comparability of chemical analyses of the received samples. The ability of personnel performing hot cell procedures to work quickly and efficiently will aid in overall maintenance of sample integrity, thus improving accuracy of analyses. Detailed and accurate descriptions of the physical characteristics of the samples during this phase of operations will affect interpretation of analytical precision through duplicate analyses. Representativeness of samples, particularly composite samples, will be determined by actions of hot cell operators. Destruction or loss of samples during initial sample recovery and handling will adversely affect the overall completeness objective of the project. Consistent operations across the hot cell activities will improve comparability of chemical analyses for the project. When required, preservatives shall be added to the sample extracts or intermediates as part of the hot cell procedures.

Perhaps the most significant potential effect on analytical quality related to hot cell operations is the loss of volatile compounds. The greatest potential for volatile loss will occur during the removal of the samples from the sampling devices and during initial sample preparation. At this time, there does not appear to be a better and/or equally safe way to process these samples. Therefore, some loss of volatile materials may occur and must be recognized in the final interpretation of analytical results in project reporting.

The QA objectives stated in Section 3.0 apply to hot cell operations, as appropriate. Specific factors of sample recovery and initial sample preparation in the hot cell that may affect quality of analyses are shown in Table 4.

TABLE 4. HOT CELL OPERATION FACTORS AFFECTING ANALYTICAL QUALITY

<u>Factor</u>	<u>Procedures to Minimize Data Quality Impacts or Data Required for Assessment of Quality Impacts</u>
1. Cross-Contamination During Recovery	Verify that the recovery equipment is adequately decontaminated and analyze equipment blanks to confirm the effectiveness of the cleaning procedure.
2. Sample Cross-Contamination by Spatulas, Dishes and other Handling Tools	The usage of disposable, single-use tools, otherwise adequate cleaning with equipment blanks to confirm the decontamination.
3. Loss of Volatile Compounds from Sample During Hot Cell Activities	At this time the development of safe, accepted and accurate methods to detect volatile compounds in the recovered samples has not yet been completed.
4. Loss of Sample Identity	Verify that complete chain-of-custody and adequate sample identification is implemented from receipt of samples, through sample break-down and analysis. Use pre-labeled container
5. Loss of sample during Hot Cell Activities	Use of manipulators requires considerable experience and dexterity. Operators must demonstrate adequate skill before working on actual samples. Personnel must be capable of making accurate observations, measurements, and descriptions of samples, using manipulators and observing through the lead-glass windows of hot cells.

5.0 SAMPLE CUSTODY, PRESERVATION AND STORAGE

5.1 SAMPLE CUSTODY

The samples collected from the different projects covered under this QAPjP will be very valuable in terms of labor and equipment investment, time invested in their collection, and the importance of the analytical data to be collected from them. Therefore, it is essential that every precaution be made to confirm that valid samples are analyzed. It may be difficult to collect additional samples in a timely fashion in the event that samples are lost or destroyed.

Sample custody shall be verified from sample collection in the field through receipt of the samples by 222-S/RCRA Laboratory using chain-of-custody forms which record the identity of persons in custody of the samples, sample identity, and time and date of transfer of custody. To verify custody, samples shall be within sight of the persons assigned custody unless the samples are contained in a locked or secure facility. In addition, tamper-indicating custody seals are applied to sample transfer casks in the field. The personnel receiving sample casks shall verify that seals are intact.

The laboratory sample custodian shall take custody of all samples immediately upon arrival. The laboratory sample custodian shall verify sample identity and proper labeling of containers, complete the required chain-of-custody form and record receipt of the samples in the laboratory master log book.

The sample custodian shall place the samples in proper secure storage. After completing the sample log-in procedures, the custodian initiates the internal chain-of-custody procedure and notifies the responsible analyst that samples have been received and are ready for processing and/or analysis. After proper sign off, the sample custodian shall relinquishes samples to the analyst. Upon completion of analysis, any remaining sample portions is returned to the sample custodian for storage. All personnel shall verify that sample identification is transferred and maintained on all extracts and intermediate sample preparations.

The sample custodian shall review the holding time status of samples daily and notify the responsible Manager if samples have not been taken for analysis within 24 hours of critical holding times.

5.2 SAMPLE PRESERVATION AND STORAGE

Samples are stored in appropriate containers (as specified in SW-846) and kept in a secure storage unit. The storage unit will be equipped with adequate radiation shielding to reduce personnel exposure.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

Before any analysis can be performed the analyst has the responsibility to verify that all equipment is properly calibrated. They shall determine that both routine calibrations and computer-controlled instrument calibrations (generated by LMCS) have been properly performed. Instrument manuals contain frequency and methods for calibration. The LICCB tracks instrument calibrations. Periodically calibrated instruments must be labeled/tagged as to their calibration due date.

Guidelines on routine calibration procedures are provided in SD-CP-QAPP-001. This details guidelines for calibration, standards, reporting, significant numbers, identification of outliers, tolerances, error limits and records. Specific calibration procedures for each SOP are included in each SOP located in Appendix A. Table 5 summarizes the required frequency and method of calibration for each analytical technique. Additionally, small equipment is calibrated periodically as follows:

<u>TYPE</u>	<u>FREQUENCY</u>
Balances	Yearly
Auto pipets	Quarterly
Dispensers/Dilutors	Quarterly

Standards are purchased from approved vendors or are prepared from stock solutions. Information on age, response, and dilution history is documented. All calibration or performance standards are traceable to the National Institute of Standard Technology (NIST) or other recognized consensus standards. If no recognized standard exists, the responsible scientist shall document the rationale for the development of a required standard. The purity of water and reagents for standards and working solutions are described in each SOP. Standards from commercial sources are replaced no later than the expiration date supplied by the manufacture. Stock and working solutions are dated and replaced at least as often as according to the following table:

Replacement Schedule for Standard Solutions

<u>Compounds</u>	<u>Stock Storage (Deg C)</u>	<u>Stock and Intermediate Standards</u>	<u>Working Standards</u>	<u>Working Storage (Deg C)</u>
Pesticides/PCBs	-15	1 year	3 months	4
Semi-volatiles	-15	1 year	3 months	4
Volatiles (liquids)	-15	1 month	5 days	4
Other organics	-15	1 year	3 months	4
Metals	Ambient	1 year	3 months	Ambient
Weak Acid soln.	4	1 year	3 months	4
Other inorganics	Ambient	1 year	3 months	Ambient

TABLE 5. CALIBRATION REQUIREMENTS

<u>Method</u>	<u>Calibration Technique</u>	<u>Check Calibration</u>	<u>Calibration Samples</u>
AA	Calibration curves	Every hour of continuous sample analysis	Minimum of a blank and 3 standards
ICP	Computer generated calibration curves	Each workday	2 point normalization of previous 5 point calibration curve for each group
Colorimetric	Check standards	Every 15 samples	one
GC	Calibration curve	Each working day	For each analyte: one or more standards to verify the working calibration curve
GC/MS	Calibration curve and tuning	Every 12 hours	Tuning and calibration standards to verify the working calibration curve
pH	Check Standards	Each sample batch	2 standards to bracket the sample range, typically pH 4 and pH 10
Counting Instruments	Calibration curve	Each sample batch	Available standards

7.0 ANALYTICAL PROCEDURES

All analyses are performed according to an approved SOP. Each SOP is written, reviewed, and approved according to SD-CP-QAPP-001. Each SOP matches an EPA approved procedure or another recognizable source, such as Washington Department of Ecology (WDOE), where possible. Modifications from a standard method are documented and defended in writing. Modification to a SOP or the development of a new method shall follow guidelines established in SD-CP-QAPP-001.

A listing of SOP's and their reference methods are located in Table 6. A listing of the SOP's expected to be used is included in Appendix A.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION

All calculations and unit conversions are confirmed by recomputation and/or review by a second person. No blank corrections, averaging of duplicates, or other manipulation of data are performed in the laboratory.

Any raw laboratory data which is converted from instrument readings to concentration units by comparison with a standard curve is accompanied by the standard curve analysis and correlation coefficient if used.

Concentrations of standard solutions and instrument readouts are correlated to the desired final report concentration units, so that a minimum of unit conversions is necessary.

Data transcriptions are reviewed and confirmed by the responsible scientist in the laboratory and by the manager prior to release of the final data report.

8.2 DATA VALIDATION

Data validation is a continuous process performed at each step of the analytical method. The analyst, responsible scientist, manager, and QA officer all participate in data validation.

The analytical data validation process starts with verification sample receipt and continues through approval of the final report. The general steps utilized in laboratory data validation for this project, and the responsible staff, are shown in Table 7.

TABLE 6. ANALYTICAL METHODS

Parameter	Sample Preparation SOP #	EPA Reference Method	Analytical Method SOP #	EPA Reference Method
Metals:				
Arsenic		3010/3050	LA-355-131	7060/7061
Cadmium		3010/3050		7131
Chromium		3010/3050		7191
Lead		3010/3050		7421
Mercury				7470/7471
Selenium		3010/3050	LA-365-131	7740/7741
Silver		3050		6010/7760
Thallium		3010/3050		7841
ICP metals(aqueous)		3010/3050		6010
(solids)	LA-505-159	3050	LA-505-157&158	6010
Ammonia				MXW-350.2
Anions:				
Chloride			LA-533-105	300
Cyanide				9010
Fluoride		ESM-449	LA-533-105	EPA-300
Hexavalent Chromium			LA-265-101	7196
Phosphate			LA-533-105	EPA-300
Nitrate/Nitrite			LA-533-105	300
Sulfate				300
Sulfide				9030
Organics:TOX/EOX				9020/WDOE8-13
TOC				9060
Volatile org.				8240
VOST				5040
VOAS		5030/5040		8240
Semivolatile org.(core)		3520/3550		ESM-D13
(tank)		3520/3550		8270
PCB/Pesticides				8080
Chlorinated Herbicides				8150
Head space				3810
Radionuclides:				
Total alpha & beta				3910
Total gamma				ESM-D518/722
Pu-238				ESM-D553
Pu-239 & 240				ESM-D578
AM-241				ESM-D715
Te-99				ESM-D702/706
I-129				MXW710A/BC
Sr-90				ESM-679/687
Th-isotope				ESM-D637/645
U-isotope				ESM-D594
Characteristics:				
Corrosivity (pH)		WDOE 83-13	LA-212-102	9040/9045
Reactivity		SW-846-7.3		9010/9030
Ignitibility		ASTM D93-79		1010/1020
EP Toxicity				1310
Drainable liquid				9085
Water (wt%)				CLP-D84

TABLE 7. LABORATORY DATA VALIDATION STEPS

<u>Validation Procedure</u>	<u>Responsible Individual</u>
1. Confirm sample identity.	Analyst, Scientist
2. Perform instrument calibration prior to analytical run including GC/MS daily tuning.	Analyst
3. Perform analysis of check standard and blank(s) prior to analytical run.	Analyst
4. Confirm method in control prior to analysis of unknowns.	Analyst, Scientist
5. Confirm method in control with periodic check standards during analytical run.	Analyst
6. Confirm method in control after completion of run and perform initial evaluation of duplicate precision. Flag results out of calibration range. Initiate Re-Runs if Necessary.	Scientist
7. Confirm data calculations and conversions.	Scientist
8. Review data entry for transcription errors.	Data Processing Supervisor
9. Review on-going QC and blind QA check standards.	QA officer and Scientist
10. Review and Confirm Accuracy, Precision, Completeness, Holding Times, Detection Limits, Units and Significant Numbers.	Managers, Scientist, QA officer
11. Evaluate data for outliers and if in control employing standard control charts.	QA officer and Scientist

Analytical data shall be considered valid if the following criteria are met:

1. Standard curve correlation is within the specifications of the method SOP;
2. Recovery of initial and continuing calibration check standards is within the established accuracy control limits;
3. Spike recoveries and duplicate spike precision are within the established control limits; and
4. Method detection limits are less than, or equal to, those specified for the project.

Failure to meet criteria 1 or 2 above shall require rejection of the data and reanalysis of the sample(s) in question. Poor spike recovery of matrix spikes, or poor duplicate aliquot precision (Criterion 3 above) may not be considered basis for complete rejection of data. Poor spike recovery or duplicate precision results in the flagging of the data and review of sample description data to determine possible causes for the poor performance. Poor precision in analysis of known check standards, however, may be the basis for data invalidation. The customer is contacted to confirm his desired action. If the MDL for specific analysis does not meet the required MDL (Criterion 4 above) the results shall be flagged and reviewed by the responsible scientist. The scientist shall determine what actions, if any, can be taken to improve the quality of the analysis of that sample. The scientist may then require a reanalysis of the sample. If the MDL can not be met, the customer shall be contacted. For the purposes of this project, analyses performed beyond the stated holding times may not necessarily be declared invalid. Results of analyses beyond holding times are flagged in data reports and are reviewed on an individual basis for potential effects on quality.

8.3 DATA REPORTING

After all laboratory analytical data, along with observation and measurement data from hot cell operations, have been compiled and validated, the report package is prepared for delivery to the customer. The complete data package retained in laboratory files shall consist of the components listed below. Validated analytical results, along with all supporting data or specific items as required by the customer, are supplied to the customer. Data sets submitted for outside validation and review include all supporting data.

A standard system of units needs to be established to be used throughout data reporting. For each project, the Office of Sample Management shall provide for consistent units for data reported from the separate laboratories that may be involved.

The following items (when and where they are applicable to a specific sample) shall constitute the complete data package:

1. A copy of the initial observation and descriptions of the sample made during preparation of the sample in the hot cell (including photographs);
2. Analytical Results, including:
 - Sample identification;
 - Analytical method used;
 - Analyte concentration;
 - Sample weight;
 - Percent water content (for non-aqueous samples);
 - Final volume of extract or diluted sample; and
 - Holding time.
3. Calibration, including:
 - Calibration curve or equation coefficients for the curve;
 - Correlation coefficient of the linear calibration; and
 - Concentration and/or response data for calibration check standards including dates of analysis.
 - GC/MS daily tuning results.
4. Column Check (organic analyses). Results of column chromatography check including the chromatogram.
5. Extraction/Digestion/Clean-up methods utilized, including date of extraction.
6. Surrogate Analysis (GC/MS Analyses) including amount of spike and percent recovery for each surrogate.
7. Matrix Spikes including amount spiked, percent recovery, and relative percent difference for each spiked compound in the analytical batch.
8. Check Standard including concentration and percent recovery.
9. Blanks including identity and concentration of each constituent identified.

10. Chromatograms (for organic analyses) including:
 - Sample identification;
 - Method identification; and
 - Retention time of analyte/s identified.
11. Quantitative Chromatogram Report including:
 - Analyte retention time;
 - Amount of sample injected;
 - Area of appropriate calculation of detection response;
 - Amount of analyte found; and
 - Date and time of injection.
12. Mass Spectrum including spectra of standards (one for each report for each compound detected) and spectra of analytes detected.
13. Metal Interference Check Sample Results
14. Method Detection Limit including date and method of estimation.
15. Results of Standard Additions.
16. Results of Serial Dilutions.
17. Instrument Detection Limits.
18. ICP Correction Factors and Linear Ranges (when applicable).

9.0 INTERNAL QUALITY CHECKS

Primarily due to safety concerns, the sample volume for most of the highly radioactive samples are kept at a minimum. Therefore, it is essential for the analyst to have immediate access to method warning and control limits and be trained in their use and interpretation. The determination of whether or not a method is in control should be made as soon as possible after the start of the analytical run. Continuing to run samples "out-of-control" will result in loss of non-replaceable samples with the consequence of missing the completeness goal. To determine if the method is in control standard, Shewhart-type control charts are to be at each appropriate equipment station. Control limits shall reflect 99% (3SD) probability limits and warning limits shall reflect 95% (2SD) probability limits. If a sample falls outside the control limit the responsible scientist must be informed and the cause for the out-of-control sample determined before continuing analysis of the data set.

Other internal control checks (duplication, blanks and spikes) are required in each SOP. These are summarized in Table 1 and must be followed. Required calibration checks are summarized in Table 5. After the responsible scientist evaluates a data set, the analytical results are to be entered into the LMCS. Once data are entered into the LMCS, further data evaluations are performed. Various warnings and reports are produced if the LMCS judges the data not to be in compliance with established controls. This system is described in SD-CP-QAPP-001. Reports include standard control charts and identification of outliers.

Before the analytical data can be accepted as in control and released, it must be reviewed by the Data Measurement and Control (DMC) Section. It must be determined that all of the following quality control requirements were met:

- o The chain-of-custody was followed and documented.
- o The sampling procedures as detailed in each SOP were followed.
- o The sample was analyzed within the required analytical holding time for each parameter, or flagged.
- o All equipment was properly calibrated and all internal checks were performed correctly and documented as per each SOP.
- o The sample preparation and analysis followed the appropriate SOP.
- o All standards and working solutions were properly prepared or can be traced to NIST or similar recognizable source.
- o The analytical data were reviewed and approved by the responsible scientist.
- o The analytical data were entered into the LMCS and judged for control.
- o The data are reported with the correct significant numbers and the accuracy and precision information is included in the package.

10.0 PERFORMANCE AND SYSTEM AUDITS

Both performance and system audits are performed internally and externally. Annual internal auditing requirements are detailed in SD-CP-QAPP-001, and must be met. Additionally, the laboratory is externally audited by the Chemical Processing Quality Engineering and the Environmental Quality Assurance Groups. The manager of DMC reviews all audits and summarize the findings with recommendations for correction of non-compliant items. Reports are issued to the responsible managers who shall address the corrective action and report back to the DMC Manager with information on action taken. Additional audits are listed below.

1. Performance Audits - Blind performance evaluation of commonly analyzed parameters are submitted quarterly. The DMC Manager and QA officer shall select the parameter, concentration and matrix, and evaluate the response.
2. System Audits - System audits are conducted quarterly. The DMC Manager oversees and evaluates the results with the QA officer. Items to be addressed include: personnel training, maintenance, records documentation, and procedures.

11.0 PREVENTIVE MAINTENANCE

A preventive maintenance program has been established by 222-S/RCRA Laboratory to minimize downtime of major equipment. The following items should be addressed in this preventive maintenance plan:

- A list of equipment, that if failed, could produce significant downtime of major analytical or sampling equipment.
- An inventory list of critical spare parts and delivery times.
- A preventive maintenance schedule developed from manufacturers' recommendations, previous experience and the program schedule, (i.e., preventive maintenance on analytical equipment before field operations). This schedule needs to be frequently updated.
- For each preventive maintenance operation it must be determined who is to perform the work: the manufacturer's service personnel or other personnel. Arrangements for offsite personnel need to be made in advance and included in the schedule.

All preventive maintenance shall be recorded in maintenance logs located at the instrument site for all the major pieces of equipment. Included in these logs should be the following information: date, time, personnel, company and action taken. If maintenance activity is judged to potentially affect the data, the calibration and instrument performance must be checked and recorded in the calibration records.

12.0 ROUTINE PROCEDURES TO ASSESS DATA PRECISION/ACCURACY/COMPLETENESS

12.1 ASSESSMENT OF ACCURACY

Accuracy of analyses are routinely evaluated by the use of initial and continuing calibration check standards and the use of spike additions to samples. As specified in Section 3.1, accuracy of these analyses are evaluated by comparing actual analytical results to Shewhart-type control charts of Percent Recovery and/or Percent Relative Error. Initial accuracy evaluation are performed at the bench before and during analysis of unknowns. Analysis of unknowns will not begin until instrumentation is calibrated and analysis of initial check standards are within control limits. If recovery of continuing calibration standards falls outside control limits during an analytical run, analysis of unknowns shall be halted, corrective action taken, and all data since the last in-control check shall be discarded.

Accuracy control charts are updated weekly if 20 or more analyses are performed per week with current charts supplied to the analysts and all personnel involved in data validation. Control chart update may be less frequent if sample load is less, but in no instance (other than no samples analyzed during the period) shall the update be less frequent than monthly.

Blind standards, reference unknowns, inter-laboratory standards, and outside verification standards are analyzed on a regular basis as part of the laboratory's ongoing overall QA program. Introduction of these samples into the routine analytical stream shall be managed by the QA officer in conjunction with the responsible Scientist. The QA officer is responsible for maintaining control charts for Percent Recovery and Percent Relative Error of QA samples.

12.2 ASSESSMENT OF DATA PRECISION

Precision of analyses are routinely evaluated by the use of duplicate aliquots of sample. Duplicates of both unknown samples and of known check standards are used for precision studies. As specified in Section 3.2, precision of analyses are evaluated on the basis of Percent Relative Difference. It is expected that when performance-based data are available, individual control limits for precision of duplicate unknowns and duplicate check standards shall be applied.

The responsible scientist shall perform preliminary evaluation of precision at the end of each analytical run. Poor precision of duplicate unknowns, as previously stated, is not necessarily cause for data rejection. Poor precision of duplicate check standards is cause for data rejection.

Precision control charts or tables are updated weekly if 20 or more analyses are performed per week with current charts supplied to analyst and all personnel involved in data validation. Control chart update may be less frequent if sample load is light, but in no instance (other than no samples analyzed during the period) shall the update be less frequent than monthly.

12.3 ASSESSMENT OF DATA COMPLETENESS

Analytical data completeness are evaluated during preparation of data reports and data validation. The objective for this project is to produce valid analytical results for 90% of the parameters requested for each sample. Since laboratory operations have more flexibility in handling samples than is possible in field operations on this project, all personnel shall exercise a high level of effort to attain 100% completeness. Responsible scientist shall assess the completeness of each analytical run and initiate re-runs or re-analyses, as necessary. Completeness of data shall be considered at each step in each analytical method. Loss of analytical data or inability to analyze samples shall initiate a deficiency report and procedures to prevent recurrence shall be developed. If specific procedures or methods result in unusually low levels of completeness, then the method shall be evaluated for possible errors and alternate methods shall be evaluated.

13.0 CORRECTIVE ACTION

Events or conditions which produce, or may produce, adverse effects on quality of data are addressed through documented corrective action. All corrective actions are performed in accordance with the requirements and procedures specified in SD-CP-QAPP-001, Section 9.0, "Deficiencies and Corrective Actions."

Laboratory personnel at all levels may be responsible for initiating an event fact sheet, critique, unusual occurrence report, or non-conformance report which require corrective action for resolution of a problem. If the problem does not warrant these levels of investigation, the concerned person are notify their supervisor in writing as to the nature of the problem. In order to promote timeliness and efficiency in the laboratory, corrective actions are made at the lowest management level possible.

- o Unit Managers shall review all reports of problems generated in their respective units. The unit managers are responsible for the resolution of problems and assuring that QA objectives are met.

- o Responsible Scientists shall assist unit managers in the resolution of problems relating to their area of responsibility.
- o Section Managers provide overall coordination of laboratory operations including financial and manpower considerations.
- o Quality Assurance Officer is responsible for verifying that reports of problems are closed out and correction action has been taken. The QA officer is expected to maintain a working relationship with all levels of laboratory operations.

The customer too may initiate an event fact sheet, critique, unusual occurrence report, or non-conformance report in response to a problem. If the problem does not warrant these levels of investigation, the customer shall notify in writing the Office of Sample Management and the Manager, 222-S/RCRA Laboratory as to the nature of the problem.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance management and reporting functions are detailed in SD-CP-QAPP-001, Section 2.2, "Program Implementation." The QA officer shall compile and analyze QA data, schedule and perform audits of laboratory operations, and prepare regular reports. The QA officer shall review QA data and verify that control charts are updated as scheduled and that they are distributed to appropriate personnel.

The QA officer shall prepare a monthly report on project QA status including discussion of the following items:

1. Project schedule status;
2. Current status of accuracy and precision analyses;
3. Results of performance and system audits;
4. Status and resolution of quality-related problems identified during the period;
5. Results of inter-laboratory comparison analyses;
6. Major personnel changes during the period; and
7. Recommendations for changes or amendments to the Quality Assurance Project Plan (with detailed justification for the recommendation).

The monthly QA report is submitted for initial approval by the DMC Section Manager and then distributed to the laboratory manager, section managers, unit managers, and the customer (if requested).

APPENDIX A - STANDARD OPERATING PROCEDURES

Procedure Number	Procedure Title
LA-212-102	Determination of pH, Direct Measurement
LA-265-101	Spectrophotometric Determination of Hexavalent Chromium
LA-355-101	Spectrophotometric Determination of Phosphorus in High-Salt Waste Samples
LA-355-131	Arsenic Analysis by Hydride Generation Atomic Absorption
LA-365-131	Selenium Analysis by Hydride Generation Atomic Absorption
LA-505-157	Sample Analysis with the Scanning Polychromator of the ICP
LA-505-158	Sample Analysis with the Scanning Monochromator of the ICP
LA-505-159	Acid Digestion of Sediments, Sludges, and Sands
LA-212-101	Set-up and Standardization of pH meter and Glass Electrode
LA-344-101	Determination of Carbon in Solutions or Solids by Combustion and Coulometry
LA-344-111	Determination of Inorganic and Organic Carbon using Model 700.I Corp TOC Analyzer
LA-505-143	Inductively Coupled Plasma Analytical Procedure
LA-508-052	Gamma Energy Analysis on the Canberra Jupiter System
LA-508-103	Operation of the Dual Guarded Alpha-Beta Detector (6AB)
LA-508-104	Total Alpha Counting by Alpha Proportional Counters
LA-508-121	Operation of the Beckman LS 5801 Liquid Scintillation Counter

Procedure Number	Procedure Title
LA-508-152	Operation of the TN 4500 for Gamms Energy Analysis
LA-519-132	Percent Solids by Centrifuge
LA-533-103	Anion Analysis on Dionex model 2020I
LA-533-105	Anion Analysis on Dionex model 4000I
LA-560-101	Percent Water, Bulk Density and Particle Density of Waste Tank Samples
LA-560-111	Determination of Percent Water by Thermogravimetric Analysis
LA-564-101	Percent Water in Tank Farm Samples and Plot Evapo- ratory Samples
LA-622-101	Determination of Carbonate in Solution by Coulometry
LA-634-102	Ammonia by KJELDAHL
LA-645-001	Spectrophotometric Determination of Nitrite
LA-905-101	Spectrophotometric Determination of Thorium with Arsenazo-III
LA-925-106	Determination of Uranium by Laser Fluorometry
LA-946-301	Plutonium Isotopic analysis by Mass Spectrometry

6.0 INDEX BY ANALYTE

This index lists methods by analyte and identifies the laboratory in which the methods are performed. It also refers to the page on which each method is described in Sections 2.0, 3.0, or 4.0. For clarity, the method numbers listed here are the primary method numbers listed at the beginning of each method module. Primary method numbers are those that are most likely to be recognized by the reader (i.e., SW-846, CLP, or ASTM numbers rather than those assigned by an individual laboratory). The method followed in the laboratory, although assigned an in-house number, is similar or identical to the primary method.

Analytes are presented in three sections: organics, inorganics, and radiotopes. The analytes are listed alphabetically within each section. After each analyte, laboratories with the capability of analyzing for that analyte are listed with relevant method numbers and reference pages.

ORGANICS

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Acetone (C_3H_6O)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
Acenaphthene ($C_{12}H_{10}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Acenaphthylene (C₁₂H₈)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Acifluorfan		
HEHF	EPA 515.1	4.20
Alachlor (C₁₄H₂₀ClNO₂)		
HEHF	EPA 505	4.19
Aldrin (C₁₂H₈Cl₆)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846-3510	4.22
	SW-846-3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Alpha-BHC ($C_6H_6Cl_6$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Anthracene ($C_{14}H_{10}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Aroclor-1016 ($C_{12}H_xCl_y$), where average weight% of Cl in the mixture is 16).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Aroclor-1221 ($C_{12}H_xCl_y$), where the average weight % of Cl of the mixture is 21).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Aroclor-1232 ($C_{12}H_xCl_y$), where the average weight% of Cl of the mixture is 32).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Aroclor-1242 ($C_{12}H_xCl_y$), where the average weight% of Cl of the mixture is 42).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Aroclor-1248 ($C_{12}H_xCl_y$), where the average weight% of Cl of the mixture is 48).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Aroclor-1254 ($C_{12}H_xCl_y$), where the average weight% of Cl of the mixture is 54).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Aroclor-1260 ($C_{12}H_xCl_y$), where the average weight% of Cl of the mixture is 60).		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Atrazine ($C_8H_{14}ClN_5$)		
HEHF	EPA 505	4.19
Bentazon ($C_{10}H_{12}N_2O_3S$)		
HEHF	EPA 515.1	4.20
Benzene (C_6H_6)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4, 4.9
	SW-846 8021	4.5
	EHS G-1	4.24

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Benzoic Acid ($C_7H_6O_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
Benzo(a)Anthracene ($C_{18}H_{12}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Benzo(b)Fluoranthene ($C_{20}H_{12}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 3510	4.8
	SW-846 8310	4.12
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Benzo(k)Fluoranthene (C₂₆H₁₂)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Benzo(g,h,i)Perylene (C₂₄H₁₄)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Benzo(a)Pyrene (C₂₆H₁₂)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24

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Benzyl Alcohol (C_7H_8O)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Beta-BHC ($C_6H_6Cl_6$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Bromobenzene (C_6H_5Br)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
Bromochloromethane ($BrCH_2Cl$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5

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Bromodichloromethane (CHCl_2Br)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Bromoform (CHBr_3)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Bromomethane (CH_3Br)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
4-Bromophenyl-phenylether ($C_{12}H_9BrO$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Butanone (C_4H_8O)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
Butylbenzylphthalate ($C_{19}H_{28}O_4$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8060	4.10
	EHS G-1	4.24
n-Butylbenzene ($C_6H_5(CH_2)_3CH_3$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
sec-Butylbenzene ($C_6H_5CH(CH_3)C_2H_5$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
terr-Butylbenzene ($C_6H_5C(CH_3)_3$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Carbon Disulfide (CS_2)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
Carbon Tetrachloride (CCl_4)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Chloramben ($C_7H_5Cl_2NO_2$)		
HEHF	EPA 515.1	4.20

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Chlordane ($C_{18}H_6Cl_8$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Chlorneb		
HEHF	EPA 508	4.19
4-Chloroaniline (C_6H_6NC1)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Chlorobenzilate ($C_{16}H_{14}Cl_2O_3$)		
HEHF	EPA 508	4.19

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Chlorobenzene (C_6H_5Cl)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Chloroethane (C_2H_5Cl)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
bis (-2-Chloroethoxy) Methane ($C_2H_5Cl_0$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

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bis (-2-Chloroethyl) Ether (C_3H_7ClO)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Chloroethylvinylether (C_4H_7ClO)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
Chloroform ($CHCl_3$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
bis (2-Chloroisopropyl) Ether (C_4H_9ClO)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9

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Chloromethane (CH₃Cl)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
4-Chloro-3-Methylphenol (C₇H₇ClO)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Chloronapthalene (C₁₀H₇Cl)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
4-Chlorophenyl-phenylether (C₁₂H₉ClO)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

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2-Chlorophenol (C_6H_5ClO)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Chlorothalonil		
HEHF	EPA 508	4.19
2-Chlorotoluene ($CH_3C_6H_4Cl$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
4-Chlorotoluene ($CH_3C_6H_4Cl$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Chrysene ($C_{18}H_{12}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24

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2,4-D		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20
Dalapon		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20
2,4-DB		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20
DCPA Acid Metabolites (C₁₀H₆Cl₄O₄)		
HEHF	EPA 508	4.19
	EPA 515.1	4.20
4,4'-DDD (C₁₄H₁₀Cl₄)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6330C	4.21

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4,4'-DDE (C₁₄H₈Cl₄)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6330C	4.21
4,4'-DDT (C₁₄H₉Cl₅)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3150	4.22
	SW-846 3154	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

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Delta-BHC ($C_6H_5Cl_6$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3150	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Dibenz(a,h)Anthracene ($C_{22}H_{14}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Dibenzofuran ($C_{12}H_8O$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
1,2-Dibromo-3-Chloropropane		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5

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1,2-Dibromoethane ($\text{BrCH}_2\text{CH}_2\text{Br}$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
Dibromomethane (CH_2Br_2)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
Dibromochloromethane (CHCl_2Br)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Di-n-Butylphthalate ($\text{C}_{16}\text{H}_{22}\text{O}_4$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8060	4.10
	EHS G-1	4.24
Dicamba ($\text{C}_8\text{H}_6\text{Cl}_2\text{O}_3$)		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20

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1,2-Dichlorobenzene ($C_6H_4Cl_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
1,3-Dichlorobenzene ($C_6H_4Cl_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHA G-1	4.24
1,4-Dichlorobenzene ($C_6H_4Cl_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
3,3'-Dichlorobenzidine ($C_{12}H_{10}N_2Cl_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

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Dichlorodifluoromethane (CCl_2F_2)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
cis-1,2-Dichloroethene		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
3,5-Dichlorobenzoic Acid		
HEHF	EPA 515.1	4.20
1,1-Dichloroethane ($\text{C}_2\text{H}_4\text{Cl}_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
1,2-Dichloroethane ($\text{C}_2\text{H}_4\text{Cl}_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24

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1,1-Dichloroethene ($C_2H_2Cl_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Trans-1,2-Dichloroethene ($C_2H_2Cl_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
2,4-Dichlorophenol ($C_6H_4Cl_2O$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Dichloroprop ($C_3H_8Cl_2O_3$)		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
1,2-Dichloropropane ($C_3H_6Cl_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
1,3-Dichloropropane ($Cl(CH_2)_3Cl$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
2,2-Dichloropropane ($CH_3CCl_2CH_3$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
1,1-Dichloropropene ($CH_3CH=CCl_2$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
cis-1,3-Dichloropropene ($C_3H_4Cl_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24

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trans-1,3-Dichloropropene (C₃H₄Cl₂)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Dieldrin (C₁₂H₈Cl₆O)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Diethylphthalate (C₁₂H₁₄O₂)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8060	4.10
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
2,4-Dimethylphenol ($C_8H_{10}O$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Dimethylphthalate ($C_{10}H_{10}O_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8060	4.10
	EHS G-1	4.24
4,6-Dinitro-2-Methylphenol ($C_6H_4N_2O_5$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2,4-Dinitrophenol ($C_6H_4N_2O_5$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

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2,4-Dinitrotoluene ($C_7H_6N_2O_4$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2,6-Dinitrotoluene ($C_7H_6N_2O_4$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Di-n-Octylphthalate ($C_{24}H_{32}O_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8060	4.10
	EHS G-1	4.24
Dinoseb ($C_{10}H_{12}N_2O_5$)		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20

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Endosulfan I ($C_9H_6Cl_6O_3S$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Endosulfan II ($C_9H_6Cl_6O_3S$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

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Endosulfan Sulfate		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Endrin (C₁₂H₈Cl₆O)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Endrin Aldehyde ()		
HEHF	EPA 508	4.19

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Endrin Ketone		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
	SW-846 3650	4.15
Ethylbenzene (C₈H₁₀)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
bis (2-Ethylhexyl) Phthalate (C₂₄H₃₈O₄)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8060	4.10
	EHS G-1	4.24
Etridiazole		
HEHF	EPA 508	4.19

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Fluoranthene (C₁₆H₁₀)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Fluorene (C₁₃H₁₀)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Gamma-BHC (Lindane) (C₆H₆Cl₆)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Gamma Chlordane (C₁₀H₆Cl₈)		
HEHF	EPA 505	4.19
	EPA 508	4.19

Grease

HEHF	AWWA 503B	4.23
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HCH Alpha

HEHF	EPA 508	4.19
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HCH Beta

HEHF	EPA 508	4.19
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HCH Delta

HEHF	EPA 508	4.19
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HCH Gamma

HEHF	EPA 508	4.19
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Heptachlor ($C_{10}H_5Cl_7$)

325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12

HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

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Heptachlor Epoxide ($C_{10}H_5Cl_7O$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Hexachlorobenzene (C_6Cl_6)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EPA 505	4.19
	EPA 508	4.19
	EHS G-1	4.24

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Hexachlorobutadiene (C₄Cl₆)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 5030	4.4
	SW-846 8000	4.4, 4.9
	SW-846 8021	4.5
	EHS G-1	4.24
Hexachlorocyclopentadiene (C₅Cl₆)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EPA 505	4.19
	EHS G-1	4.24
Hexachloroethane (C₂Cl₆)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Hexanone (C₆H₁₂O)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5

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5-Hydroxydicamba		
HEHF	EPA 515.1	4.20
Indeno(1,2,3-cd)Pyrene (C₂₃H₁₄)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24
Isophorone (C₉H₁₄O)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Isopropylbenzene (C₆H₅CH(CH₃)₂)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
4-Isopropyltoluene (CH₃C₆H₄CH(CH₃)₂)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
MCPA		
HEHF	SW-846 8150	4.18

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MCPP		
HEHF	SW-846 8150	4.18
2-Methylnapthalene (C₁₁H₁₀)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Methylphenol (C₇H₈O)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
4-Methylphenol (C₇H₈O)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

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Methoxychlor ($C_{16}H_{15}Cl_3O_2$)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 508	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21
Methylene Chloride (CH_2Cl_2)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
4-Methyl-2-Pentanone ($C_6H_{10}O$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
Morpholine		
HEHF	ASTM D1942-80	4.24

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Napthalene (C₁₀H₈)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 5030	4.4
	SW-846 8000	4.4, 4.9
	SW-846 8021	4.5
	SW-846 8310	4.12
	EHS G-1	4.24
3-Nitroaniline (C₆H₅N₂O₂)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Nitroaniline (C₆H₅N₂O₂)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
4-Nitroaniline ($C_6H_6N_2O_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Nitrobenzene ($C_6H_5NO_2$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
2-Nitrophenol ($C_6H_5NO_3$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
4-Nitrophenol ($C_6H_5NO_3$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EPA 515.1	4.20
	EHS G-1	4.24

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N-Nitrosodiphenylamine ($C_{18}H_{16}N_2O$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
N-Nitroso-Di-n-Propylamine ($C_6H_{14}N_2O$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
cis-Nonachlor		
HEHF	EPA 505	4.19
trans-Nonachlor		
HEHF	EPA 505	4.19
Oil		
HEHF	AWWA 503B	4.23
Organic Halides		
325	SW-846 9020	2.13
cis-Parmethrin		
HEHF	EPA 508	4.19

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trans-Parmethrin		
HEHF	EPA 508	4.19
PCP		
HEHF	EPA 515.1	4.20
Pentachlorophenol (C_6HCl_5O)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
Petroleum Hydrocarbons		
HEHF	EPA 418.1	4.11
Phenanthrene ($C_{14}H_{10}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24

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Phenol (C_6H_6O)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EPA 420.1	4.23
	EHS G-1	4.24
Picloram ($C_6H_3Cl_3N_2O_2$)		
HEHF	EPA 515.1	4.20
Propyl benzene ($C_6H_5CH_2CH_2CH_3$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
Propachlor ($C_{11}H_{14}ClNo$)		
HEHF	EPA 508	4.19
Pyrene ($C_{16}H_{10}$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	SW-846 8310	4.12
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Simazine ($C_7H_1^2ClN_5$)		
HEHF	EPA 505	4.19
Styrene (C_8H_8)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
2,4,5-T		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20
1,1,2,2-Tetrachloroethane ($C_2H_2Cl_4$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
1,1,1,2-Tetrachloroethane ($ClCH_2CCl_3$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24

<u>Analyte</u>	<u>Method Number</u>	<u>Reference Page</u>
Tetrachloroethene (C₂Cl₄)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Toluene (C₇H₈)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Toxaphene (C₁₈H₁₈Cl₈)		
325	CLP SOW 2/88 D5/PEST	2.11
	CLP SOW 2/88 D31/PEST	2.11
	CLP SOW 2/88 D33/PEST	2.12
	SW-846 8080	2.12
HEHF	SW-846 3510	4.22
	SW-846 3540	4.22
	SW-846 3650	4.16
	SW-846 8080	4.17
	EPA 505	4.19
	EPA 600/4-81-045	4.20
	ASTM D3478-85	4.21
	AWWA 6630C	4.21

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2,4,5-Tp (Silvex) ($\text{CH}_3\text{CH}(\text{OC}_6\text{H}_2\text{Cl}_3)\text{CO}_2\text{H}$)		
HEHF	SW-846 8150	4.18
	EPA 515.1	4.20
1,2,3-Trichlorobenzene ($\text{C}_6\text{H}_3\text{Cl}_3$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
1,2,4-Trichlorobenzene ($\text{C}_6\text{H}_3\text{Cl}_3$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846 3150	4.8, 4.22
	SW-846 3660	4.8
	SW-846 5030	4.4
	SW-846 8000	4.4, 4.9
	SW-846 8021	4.5
	EHS G-1	4.24
1,1,1-Trichloroethane ($\text{C}_2\text{H}_3\text{Cl}_3$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24

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1,1,2-Trichloroethane ($C_2H_3Cl_3$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Trichloroethene (C_2HCl_3)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Trichlorofluoromethane ($CFCl_3$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
2,4,5-Trichlorophenol ($C_6H_3OCl_3$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24

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2,4,6-Trichlorophenol ($C_6H_3OCl_3$)		
325	CLP SOW 2/88 D5/SV	2.8
	CLP SOW 2/88 D27/SV	2.8
	CLP SOW 2/88 D31/SV	2.9
HEHF	SW-846-3510	4.8
	SW-846 3660	4.8
	SW-846 8000	4.9
	EHS G-1	4.24
1,2,3-Trichloropropane ($ClCH_2CH(Cl)CH_2Cl$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
Trifluralin ($C_{13}H_{16}F_3N_3O_4$)		
HEHF	EPA 508	4.19
1,2,4-Trimethylbenzene ($C_6H_3(CH_3)_3$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
1,3,5-Trimethylbenzene ($C_6H_3(CH_3)_3$)		
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
Vinyl Acetate ($C_4H_6O_2$)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5

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Vinyl Chloride (C_2H_3Cl)		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5
HEHF	SW-846 5030	4.4
	SW-846 8000	4.4
	SW-846 8021	4.5
	EHS G-1	4.24
o-Xylene ($C_6H_4(CH_3)_2$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
m-Xylene ($C_6H_4(CH_3)_2$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
p-Xylene ($C_6H_4(CH_3)_2$)		
HEHF	SW-846 8021	4.5
	SW-846 5030	4.4
	SW-846 8000	4.4
	EHS G-1	4.24
Total Xylenes (C_8H_{10})		
325	CLP SOW 2/88 D5/VOA	2.4
	CLP SOW 2/88 D10/VOA	2.4
	CLP SOW 2/88 D14/VOA	2.5
	SW-846 3810	2.5

INORGANICS

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Ag		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-346 7760	4.45
	SW-846 7761	4.62
Al		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7020	4.29
As		
325	SW-846 3005	2.15
	SW-846 7060	2.17
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
	SW-846 7061	3.4
HEHF	SW-846 3050	4.28
	SW-846 7060	4.51

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B		
325	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
Ba		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7080	4.31
Be		
325	SW-846 3005	2.15
HEHF	SW-846 3050	4.28
	SW-846 7090	4.32
	SW-846 7091	4.52
Bi		
222-S	SW-846 3050	3.2
	SW-846 6010	3.4
Br⁻		
³ 25	PNL-MA-597-7-40.8	2.25
C		
325	PNL-MA-597-7-40.7	2.26
222-S	LA-504-101	3.3
	LA-344-105	3.9

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Ca		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7140	4.34
	EPA 130.2	4.71
Cd		
325	SW-846 3005	2.15
	SW-846 7131	2.18
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7130	4.33
	SW-846 7131	4.53
Ce		
222-S	SW-846 3050	3.2
	SW-846 6010	3.4
Chemical Oxygen Demand		
HEHF	EPA 410.1 & 2	4.74

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Cl⁻		
³ 25	EPA 300.0	2.24
	PNL-SP-6	2.21
	HWVP-1	2.16
	PNL-MA-597-7-40.8	2.25
222-S	EPA 300.0	3.7
HEHF	EPA 300.0	4.66
CN⁻		
³ 25	SW-846 9010	2.23
222-S	SW-846 9010	3.6
HEHF	SW-846 9010	4.65
Co		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7200	4.36
	SW-846 7201	4.55
CO₃⁻²		
222-S	LA-622-102	3.7
Color		
HEHF	AWWA 204A	4.75
Corosivity		
HEHF	AWWA 203	4.74

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Cr		
325	SW-846 3005	2.15
	SW-846 7191	2.18
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7190	4.35
	SW-846 7191	4.54
	SW-846 7196	4.44
Cr VI		
222-S	SW-846 7196	3.6
HEHF	SW-846 7196	4.63
Cs		
325	PNL-SP-11-RO-1	2.22
Cu		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7210	4.37
Electrolytes		
HEHF	EPA 120.1	4.71

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Eu		
222-S	SW-846 3050	3.2
	SW-846 6010	3.4
F⁻		
³ 25	HWVP-1	2.16
	HWVP-2	2.24
	PNL-MA-597-7-40.8	2.26
	PNL-SP-6	2.21
222-S	EPA 300	3.15, 3.16
HEHF	EPA 340.2	4.66
Fe		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7380	4.38
Flash Point		
HEHF	SW-846 1010	4.67
	SW-846 1020	4.68
H₂O		
222-S	LA-500-101	3.12
	LA-560-111	3.13
	LA-564-101	3.13
Hardness		
HEHF	EPA 130.2	4.71

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Hydrazine		
HEHF	ASTM D1385-78	4.74
Hg		
325	CLP SOW 7/88 Sec III, Pt D	2.15
	SW-846 7470	2.20
	SW-846 7471	2.21
222-S	SW-846 3650	3.2
	SW-846 6010 ICP	3.4
	SW-846 7470	3.5
HEHF	SW-846 7470	4.61
IC Anions		
222-S	LA-504-101	3.3
Inorganic Ions		
325	SW-846 1310	2.25
	PNL-SP-6	2.21
	HWVP-1	2.16
K		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	AWWA 3500 K-D	4.44
La		
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4

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Li		
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
Linear Alkyl Sulfonate (LAS)		
HEHF	AWWA 512B	4.76
Metals		
325	CLP SOW 7/88 Sect III	2.14
	Pt A&B	
222-S	SW-846 3010	3.1
	LA-504-101	3.3
	LA-505-122	3.2
	LA-505-124	3.10
HEHF	SW-846 1310	4.26
	SW-846 3005	4.26
	SW-846 3010	4.25
	SW-846 3040	4.27
	SW-846 3050	4.28
Mg		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7450	4.40
	EPA 130.2	4.71

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Mn		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7460	4.41
Mo		
325	SW-846 3005	2.15
222-S	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	SW-846 7480	4.42
	SW-846 7481	4.57
Na		
325	SW-846 3005	2.15
	PNL-SP-7	2.22
222-S	LA-507-121	3.16
	LA-507-141	3.17
	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
HEHF	SW-846 3050	4.28
	EPA 130.2	4.71
	AWWA 3500-Na-D	4.46
Nd		
222-S	SW-846 3050	3.2
	SW-846 6010	3.4

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NH₃		
222-S	LA-634-102	3.14
HEHF	AWWA 417A & B	4.75
Ni		
325	SW-846 3005 PNL-SP-7	2.15 2.22
222-S	SW-846 3050 SW-846 6010 ICP	3.2 3.4
HEHF	SW-846 3050 SW-846 7520 EPA 249.2	4.28 4.43 4.62
Nonvolatiles		
222-S	LA-549-141	3.3
NO_x		
HEHF	EPA 7C	4.70
NO₂⁻		
³ 25	EPA 300.0 PNL-SP-6 HWVP-1 PNL-MA-597 7-40.8	2.24 2.21 2.16 2.25
222-S	EPA 300.0 LA-645-001	3.7, 3.15, 3.16 3.8
HEHF	EPA 300.0 EPA EQN-1277-028	4.65 4.67

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NO_3^-		
³ 25	EPA 300.0	2.24
	PNL-SP-6	2.21
	HWVP-1	2.16
	PNL-MA-597-7-40.8	2.25
222-S	EPA 300.0	3.7, 3.15, 3.16
HEHF	EPA 300.0	4.66
OH^-		
² 22-S	LA-661-102	3.8
HEHF	EPA 310.1	4.73
O_2		
HEHF	EPA 410.1 & 2	4.73
	AWWA 507	4.76
P		
222-S	EPA 300.0	3.7
	SW-846 3050	3.2
	SW-846 6010 ICP	3.4
	LA-355-101	3.15
HEHF	EPA 365.2	4.64
Particulates		
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222-S	LA-212-103	3.9
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325	SW-846 3005	2.15
	SW-846 7740	2.19
222-S	SW-846 3050	3.2
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325	PNL-SP-7	2.22
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222-S	SW-846 3050	3.2
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325	PNL-SP-7	2.22
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	PNL-SP-7	2.22
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222-S	LA-953-102	3.24
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222-S	LA-348-101	3.27
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325	HTA-4-13	2.37
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325	HTA-4-40	2.49
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325	PNL-SP-30	2.50
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325	RSD-54-DEQ 13	2.33
$^{59,63}\text{Ni}$		
325	PNL-SP-38	2.48
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325	PNL-SP-33	2.44
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^{240,241}Pu		
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325	PNL-MA-597, 7-40.39	2.42
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7.0 INDEX BY METHOD NUMBER

Analytical methods used by Hanford laboratories are listed by method number in this index. If method numbers from more than one method source (for example, SW-846, ASTM, and PNL) are associated with a method described in Section 2.0, 3.0, or 4.0, each of the method numbers is listed. This index of method numbers is divided into separate sections for each method source. The order in which these sources are presented is CLP, SW-846, other EPA, ASTM, AWWA, NIOSH, and "in-house." In-house method numbers are those assigned by an individual laboratory at Hanford. The page numbers given refer to the page(s) in Sections 2.0, 3.0, and 4.0 of this Manual on which the method is described.

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