Sampling and Analysis Plan for Phase 2 Remedial Investigation at the Tonawanda Landfill Operable Unit in the Town of Tonawanda, New York

Volume I: Field Sampling Plan
Volume II: Quality Assurance Project Plan

Revision 0

Buffalo District
Formerly Utilized Sites Remedial Action Program

Prepared by:
American Remediation Solutions and Environmental Corporation (ARSEC)
2609 N. River Road
Port Allen, LA 70767

For:
U.S. Army Corps of Engineers – Buffalo District
Formerly Utilized Sties Remedial Action Program
Contract No. W912P4-07-D-0009, Delivery Order 0003

October 2009 Revision 0

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Volume I
Field Sampling Plan

SAMPLING AND ANALYSIS PLAN

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FSP APPROVALS

By their specific signature, the undersigned certify that this Field Sampling Plan is approved for use during sampling and surveys at the Tonawanda Landfill Site, Tonawanda, NY

APPROVED BY:

[redacted] 10/19/09

ARSEC - Project Manager Date

[redacted]

[redacted] 10/19/09

ARSEC – Radiation Safety Officer (RSO) Date

[redacted]

By their specific signature, the undersigned certify that they reviewed and provided comments on this FSP for use during the performance of health physicist services the Tonawanda Landfill FUSRAP Site, Tonawanda, NY.

[redacted] 10/19/09

ARSEC – ES&H Manager Date

[redacted]

[redacted] 10/19/09

ARSEC – Chief Executive Officer Date

[redacted]

[redacted] 10/19/09

ARSEC – Corporate Quality Manager Date

[redacted]

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ALARA	As Low As Reasonably Achievable
ARARs	Applicable or Relevant and Appropriate Requirements
ARS	American Radiation Services
ARSEC	Joint Venture between ARS and Safety and Ecology Corporation (SEC)
bgs	below ground surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Response, Compensation, and Liability Act
CHP	Certified Health Physicist
cm	centimeter(s)
COC	Contaminant of Concern, or Chain of Custody
CQCSM	Contract Quality Control System Manager
DAC	Derived Air Concentration
DCGL	Derived Concentration Guideline Level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQCR	Daily Quality Control Report
DQO	Data Quality Objectives
DOT	U.S. Department of Transportation
ECWA	Erie County Water Authority
EPA	U.S. Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
ft	foot (feet)
FSP	Field Sampling Plan
FSS	Final Status Survey
g	gram(s)
GPS	Global Positioning System
GWS	Gamma Walkover Survey
HDPE	High-Density Polyethylene
HP	Health Physicist
HSRPP	Health, Safety, and Radiation Protection Plan
HTRW	Hazardous, Toxic, and Radioactive Waste
IDW	Investigation Derived Waste
ILCR	Incremental Lifetime Cancer Risk
ITR	Independent Technical Reviewers
keV	kilo-electron volts
m, m^2	meter(s), square meter(s)
MARSSIM	Multi Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MDCR	Minimum Detectable Count Rate
MED	Manhattan Engineer District
NaI	Sodium Iodide
NCP	National Contingency Plan
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NRC	U.S. Nuclear Regulatory Commission

ORNL	Oak Ridge National Laboratory
OU	Operable Unit
PCB	Polychlorinated Biphenyl
pCi, pCi/g	picoCurie(s), picoCurie(s) per gram
PM	Project Manager
POC	Point of Contact
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QCP	Quality Control Plan
Ra	Radium
RFP	Request For Proposal
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
RPP	Radiation Protection Plan
RSO	Radiation Safety Officer
SAP	Sampling and Analysis Plan
SM	Site Manager
SOP	Standard Operating Procedure
SOW	Statement of Work
SSHO	Site Safety and Health Officer
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TBD	to be determined
TCLP	Toxicity Characteristic Leaching Procedure
Th	Thorium
U	Uranium
µCi/ml	microCuries per milliliter
USACE	U.S. Army Corps of Engineers
USACE–Buffalo	U.S. Army Corps of Engineers, Buffalo District
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
XRF	X-Ray Fluorescence
YSI	Yellow Springs Instrument

1.0 PROJECT BACKGROUND

1.1 Introduction

American Remediation Services and Environmental Corporation (ARSEC) have been contracted by the U.S. Army Corps of Engineers – Buffalo District (USACE-Buffalo) under Contract No. W912P4-07-D-0009, D.O. 0003 to provide Hazardous, Toxic, and Radioactive Waste (HTRW) environmental services for the Tonawanda Landfill Formerly Utilized Sites Remedial Action Program (FUSRAP) Site (hereafter referred to as the "Site") in Tonawanda, NY. Historical field sampling and gamma survey results have indicated the presence of Manhattan Engineer District (MED)-like material in the non-operational landfill. Identified constituents of concern were uranium-238 (U-238), thorium-230 (Th-230) and radium-226 (Ra-226). As a result, the Landfill, comprised of the landfill itself and the adjoining mudflats, was designated as a FUSRAP Vicinity Property to the Linde Site in 1992. This Field Sampling Plan (FSP) outlines the requirements and methodologies for performing gamma walkover radiation surveys and surface/subsurface soil sampling in accordance with the *Scope of Work, RI Addendum, Tonawanda Landfill Operable Unit* (USACE 2009). The survey, sampling and analytical techniques prescribed herein are consistent with the Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM).

1.2 Site Description

The Tonawanda Landfill Vicinity Property is located approximately 1.5 miles north of the Linde (Praxair) FUSRAP Site in the Town of Tonawanda, New York. The site is comprised of two operable units: The Town of Tonawanda Landfill (Landfill) and the Mudflats (Mudflats). This Statement of Work (SOW) addresses the 55 acre Landfill Operable Unit (OU). The Landfill is located at the northern end of East Park Drive and is bounded by residential developments to the north and northwest, a railroad line to the east, and a right of way owned by National Grid to the south. A 48-inch diameter Erie County Water Authority (ECWA) water transmission line traverses through the National Grid right-of-way. ECWA also has another easement for a second parallel 48-inch line through the National Grid right-of-way, for future use. The property is owned by the Town of Tonawanda, NY and is zoned as commercial/industrial. The bordering property to the north is residential. A no-action Record of Decision (ROD) for the Mudflats OU was signed 30 September, 2008.

1.3 Site History and Contaminants

A Proposed Plan for the Tonawanda Site in Tonawanda, New York was originally prepared by the United States Department of Energy (DOE) in September 1993 under its authority to conduct the FUSRAP. The 1993 Proposed Plan for the DOE Tonawanda Site addressed remediation of radioactive contamination at the four (4) locations in the town of Tonawanda that comprised the DOE Tonawanda Site as defined at the time: The Linde (now Praxair) Site; the Ashland 1 Site; the Ashland 2 Site; and the Seaway Site. Due to local concern regarding the DOE's 1993 Proposed Plan, the DOE began to address each site separately.

In 1990, the DOE raised the concern that radiological material from the Linde site might have been disposed in the nearby Town of Tonawanda Landfill and requested a team from the Oak Ridge National Laboratory (ORNL) to conduct a radiological survey of the landfill and adjoining mudflats. Field sampling and gamma survey results by ORNL indicated the presence of MED-like material in the non-operational landfill (DOE 1992, ORNL 1992). Identified constituents of

concern were uranium-238 (U-238), thorium- 230 (Th-230) and radium-226 (Ra-226). As a result, the Landfill, comprised of the landfill itself and the adjoining mudflats, was designated as a FUSRAP Vicinity Property to the Linde Site in 1992.

On October 13, 1997, the Energy and Water Development Appropriations Act (1998) was signed into law as Public Law 105-62. Pursuant to this law, FUSRAP was transferred from the DOE to the United States Army Corps of Engineers (USACE). As a result of this transfer, the responsibility for this project was transferred to the USACE. The Energy and Water Development Appropriations Act for Fiscal Year 2000, Public Law 106-60, provides authority to USACE to conduct restoration on FUSRAP sites subject to the Comprehensive Response, Compensation, and Liability Act (CERCLA), 42 United States Code 9601 et seq., as amended. At that point, USACE began addressing the four locations of the Tonawanda Site and associated vicinity properties as individual projects under CERCLA.

One of these individual projects was the Tonawanda Landfill Vicinity Property, a site including both a landfill OU and a mudflats OU. USACE study of the site began in 2001 with a whole-site field investigation that culminated in a 2005 Remedial Investigation Report (RIR). Because the Baseline Risk Assessment (BRA) portion of the RIR concluded that the incremental lifetime cancer risk (ILCR) to human receptors was within the criteria established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), a 'No Further Action' Proposed Plan for both operable units was issued to the public in 2007. Specific results of the RI are summarized in Table 1-1.

Table 1-1. Summary of USACE Remedial Investigation Results: Tonawanda Landfill Vicinity Property – Tonawanda, New York

Matrix	# Samples at Landfill OU	Range: Results: Landfill OU	# Samples Mudflats OU	Range: Results: Mudflats OU
Soil	280 samples 114 locations	Th-230: 0.65 – 32.5 pCi/g U-238: 2.0 - 227 pCi/g Ra-226: 0.83 – 20.1 pCi/g	224 samples 96 locations	Th-230: 1.79 – 31.5 pCi/g U-238: 1.37 – 27.9 pCi/g Ra-226:0.65 – 22.6 pCi/g
Surface Water	4 samples	Total U: 5.16 – 459 pCi/L Ra-228 + Ra-226: 4.95 – 37.38 pCi/L	None on OU	N/A
Sediment	4 locations, 9 samples	Th-230: 1.02 – 3.90 pCi/g U-238: 0.77 – 25.30 pCi/g Ra-226: 0.87 – 5.80 pCi/g	None on OU	N/A
Groundwater	7 shallow wells, 3 deeper wells for filtered and unfiltered analysis	Well L3: Total U: Unfiltered: 175.0 pCi/L Filtered: 133.0 pCi/L	4 wells for filtered and unfiltered analysis	Th-230: no exceedances U-238: no exceedances Ra-226: no exceedances

1.4 Results of Previous Investigations

1.4.1 DOE Investigations (1990-1995): Radioactive material surveys for the presence of MED-related materials at the Landfill and Mudflats were conducted by the DOE in 1990 as part of the Linde FUSRAP Site investigation. The intent of the survey was to assess whether any MED-related materials had been transported and disposed of off-site in the general area surrounding the Linde facility. The preliminary survey was completed using a mobile gamma scanning van. An anomaly in the survey detected in the Mudflats during the mobile scanning activities was

verified using handheld gamma screening devices. Subsequent soil samples collected from the area around the anomaly indicated elevated levels of U-238 and Ra-226, which are two isotopes consistent with material expected to be in ore processing byproducts generated at the Linde Site (ORNL 1990).

A limited radiological survey was conducted by DOE in September 1991 (ORNL 1992). The survey focused on both the Landfill and Mudflats and consisted of gamma walkover scans, measurement of radiation levels, and the collection and analysis of systematic and biased soil samples. The results of the survey detected soils in the Landfill and Mudflats with elevated concentrations of Ra, Th, and U. Laboratory results received indicated some soil samples exhibited characteristics similar to the MED product formerly produced at the Linde facility and others were consistent with the by-products of the refinery process conducted at the same Linde facility. The Landfill and Mudflats were subsequently designated together as a single Vicinity Property of the Linde FUSRAP Site.

DOE conducted additional soil sampling activities at the Landfill and Mudflats in 1994 to determine the vertical extent of the radiological contamination at the site. Analytical results obtained for subsurface soil, sediment, surface water and groundwater samples indicated that the radiological contamination was mainly limited to the upper 1.5 feet of soil, but was found in lesser concentrations at 24.5 feet below ground surface (bgs). A summary of results is shown in Table 1-2.

Table 1-2. Results of DOE Investigations

Matrix	# Samples at Landfill OU	Results	# Samples Mudflats OU	Results
Soil	148 samples 92 locations	Th-230: 1.59-4300 pCi/g U-238: 2.34-1800 pCi/g Ra-226: 2.27-2000pCi/g Lead (2 samples): 740 mg/kg; 1,200 mg/kg	43 sample 21 locations	Th-230: 1.60-660 pCi/g U-238: 1.31-78 pCi/g Ra-226:2.22-120 pCi/g Lead (1 sample): 300 mg/kg
Surface Water	1 sample	Th-230: 0.2 pCi/L Th-232: 0.06 pCi/L U-238: 48.2 pCi/L Ra-226: 521 pCi/L	None on OU	N/A
Sediment	1 sample	Th-228: 2.7 pCi/G Th-230: 121.8 pCi/g Th-232:2 pCi/g U-234: 382.3 pCi/g U-235: 19.5 pCi/g U-238: 393.5 pCi/g Ra-226: 65.7 pCi/g	None on OU	N/A
Groundwater	2 samples	Th-230: 2.4, 693 pCi/L Th-232: 1.1, 6.7 pCi/L U-238: 20.2, 4328 pCi/L	3 samples	Th-228: 1.1, 0.77, 1.2 pCi/L Th-230: 7.9, 3.4 pCi/L Th-232: 1.1, 0.98, 1.5 pCi/L U-238: 6.4, 20.8, 4.1 pCi/L Ra-226: 4.2, 2.4, 4.3 pCi/L

1.4.2 USACE Investigations (1999-2007): Upon receiving responsibility for the Tonawanda Landfill Vicinity Property in 1997, USACE began a review of data previously taken for the site. Based on the data, a Radiological Human Health Assessment was performed for both the Landfill and Mudflats OUs in February 1999. Closure scenarios for the Landfill addressed during the assessment included capping the contaminated soil in place and excavation and removal of

the impacted soil. Closure alternatives evaluated for the Mudflats area included no action, covering the impacted area with clean soil, and excavation and removal of impacted soil.

Following discussions with the state regulator and other stakeholders, USACE decided there was not enough data available to make a definitive conclusion on whether action was required at the Tonawanda Landfill Vicinity Property. Therefore, USACE proceeded forward with an RI of the Tonawanda Landfill Vicinity Property. The RI was structured to include both the Landfill OU and the Mudflats OU as separate but related parcels. The objectives of the RI were as follows:

- Verify that MED-related material is present in soil, groundwater, surface water and sediment
- Confirm concentration of contaminants in areas found to be elevated by DOE
- Determine whether chemical or non-MED material is comingled with MED-related materials
- Assess long term risks posed by leaving MED-related material in place, including fate and transport profile as a function of time.

Extensive field sampling of surface and subsurface soil, groundwater, surface water and sediment was conducted in 2001. Details of sample acquisition numbers and findings are presented in the *Remedial Investigation Report, Tonawanda Landfill Vicinity Property, Tonawanda, New York* (USACE, April 2005) and summarized in Table 1-3 below.

Table 1-3. Results of USACE Investigations

Matrix	# Samples at Landfill OU	Results	# Samples Mudflats OU	Results
Soil	28 samples 114 locations	Th-230:0.65 - 32.5 pCi/g U-238: 2.0-227 pCi/g Ra-226: 0.83-20.1 pCi/g	224 samples 96 locations	Th-230: 1.79-31.5 pCi/g U-238: 1.37-27.9 pCi/g Ra-226: 0.65 -22.6 pCi/g
Surface Water	4 samples	Total U: 5.16-459 pCi/L Ra-228 + Ra-226: 4.95-37.38 pCi/L	None on OU	N/A
Sediment	9 samples 4 locations	Th-230: 1.02-3.90 pCi/g U-238: 0.77--25.30 pCi/g Ra-226: 0.87-5.80 pCi/g	None on OU	N/A
Groundwater	7 shallow wells, 3 deep wells (filtered/unfiltered analysis)	Well L3: total U: unfiltered: 175.0 pCi/L Filtered: 133.0 pCi/L	4 wells (filtered/unfiltered analysis)	Th-230: no exceedances U-238: no exceedances Ra-226: no exceedances

Despite the proximity of USACE's samples to the locations that yielded DOE's historical elevated results, USACE was unable to find any elevated concentrations within the same order of magnitude. Based on the RI and the results of the BRA, the USACE concluded that soils containing uranium, radium and thorium could safely remain in place in their current condition. Therefore a No-Action alternative was recommended to the public in an April 25, 2007 presentation of the Proposed Plan for both the Landfill and Mudflats OUs.

Based on public comments received on the Proposed Plan and the fact that USACE did not find levels of contamination of the same order of magnitude as DOE, USACE has since decided to conduct additional sampling in the Landfill OU. USACE has proceeded forward with a No-Action ROD for the Mudflats OU, which was signed on September 30, 2008.

2.0 ORGANIZATION AND RESPONSIBILITIES

2.1 Project Manager

ARSEC's Project Manager (PM) for this effort is Steve Shirley. He is responsible for evaluating the suitability and adequacy of the technical services provided for the project and for developing the technical approaches and level of effort required to address each task. He is also responsible for the day-to-day conduct of work, including integration of input from supporting disciplines, USACE, and subcontractors. He will work closely with the Site Manager (SM) and Contractor Quality Control Systems Manager (CQCSM) during implementation of the field program. Specific responsibilities include:

- Initiating project planning and directing project activities;
- Ensuring that qualified technical personnel are assigned to various tasks, including subcontractors;
- Identifying and fulfilling equipment and other resource requirements;
- Monitoring project activities to ensure compliance with established scopes, schedules, and budgets;
- Ensuring overall technical quality and consistency of all project activities and deliverables; and
- Serving as the primary ARSEC POC with USACE.

2.2 Corporate CQC Manager

As the Corporate CQC Manager for ARSEC, Darrell Srdoc is responsible for the quality of the ARSEC work. Mr. Srdoc will be responsible for assuring the project team implements the policies and procedures required under the USACE contract and assuring that corrective action is taken if performance does not meet internal or USACE quality requirements. He will work closely with the ARSEC PM, CQCSM, and Independent Technical Reviewers (ITRs) to ensure established protocols and procedures are implemented, the work performed in accordance with the USACE's SOW, and the project work plans.

The Corporate QM is responsible for directing planning, implementing and tracking quality control (QC) activities and maintaining internal communication on QC matters. He will work with the PM, CQCSM, and ITRs to ensure that established QC procedures are implemented. He, or a designee, may conduct periodic Site and project audits as part of this process. The duties also include QC task staffing and ensuring that QC data evaluation, data verification, and reporting procedures are followed. The ultimate goal of these activities is to perform work and produce data that satisfy the project objectives as defined in the project *Quality Control Plan* [QCP, (ARSEC, 2009] and this Field Sampling Plan (FSP) portion of the Sampling and Analysis Plan (SAP).

2.3 Project Health Physicist

Andrew Lombardo, CHP is ARSEC's Radiation Safety Officer (RSO) and Project Health Physicist (HP). In that capacity, he is responsible for oversight and review of all ARSEC radiological activities and data. Mr. Lombardo is responsible for reviewing radiological data deliverables from analytical laboratories, interfacing with the laboratory client services coordinators, and coordinating the resolution of laboratory problems. The Corporate RSO/HP has the authority to direct such activities, stop work (and restart based on consultation with the

PM), and to take appropriate actions, as required, to address radiological emergency situations. He will work directly with the SM, Site Safety and Health Officer (SSHO), and Site RSO to ensure the ARSEC Radiation Protection Plan (RPP) and SAP are properly implemented and followed.

2.4 Site Manager/Safety and Health Officer

ARSEC will utilize Mr. Randy McCrone, CSP as the Site Manager and the Site Safety and Health Officer (SM/SSHO). As the Site Manager, he will report directly to the Project Manager and is responsible for the overall direction and management of field tasks. His duties include oversight of field staff and subcontractors, ensuring procedures for field work are executed in the proper manner, activities are properly documented, the prescribed SOW is completed, and communication protocols are followed. He is also responsible for managing sampling activities in accordance with the project work plans. The SM monitors work progress and schedule, advises ARSEC's PM of variances, and assists in the preparation of work progress schedules, project reports, drawings, and required compliance submittals.

Mr. McCrone will also have reporting responsibility to ARSEC's Corporate Health and Safety Manager and Corporate RSO/HP. As SSHO, he is responsible for ensuring site personnel are appropriately trained in the provisions of the HSRPP. The SSHO has the authority to issue stop-work orders for site activities he believes to be unsafe. When so stopped, site work will not resume until ARSEC's Corporate Health and Safety Manager, Corporate RSO/HP, and PM approve the restart.

2.5 Site Radiation Safety Officer

ARSEC's Site RSO will be Mark Krohn, CHP. The Site RSO is responsible for ensuring that radiation health and safety procedures designed to protect site personnel and the public are maintained throughout the project. The Site RSO coordinates establishing radiologically controlled areas, monitoring radiation exposure levels, and inspecting all material/equipment entering or leaving the Exclusion Zone for compliance with the HSRPP and other applicable requirements. The roles and responsibilities of the RSO are further defined in the project HSRPP.

The Site RSO will also be responsible for overseeing the maintenance and QC check of the on-site radiological instruments and will provide instrument data records to the CQCSM for storage in on-site files.

2.6 Contractor Quality Control Systems Manager

ARSEC's CQCSM, Jim Turner, is responsible for day-to-day compliance with the CQCP and SAP, including records filing and archiving, and the provision of operational support to on-site personnel. Mr. Turner meets the qualifications for CQCSM as identified in the USACE's SOW. He has over 20 years of technical and project management experience.

The CQCSM provides and maintains an effective QC system for all construction and sampling to ensure conformance with authorized policies, procedures, contract specifications, approved work plan and sound practices. The CQCSM also prepares the Daily Quality Control Report (DQCR) and QC checklists, and provides such to the COR or designee. The CQCSM will be on site during the majority of the field activities.

2.7 Field Geologist

ARSEC's Field Geologist, Penny Baxter, P.G. will oversee all soil sampling activities. She will ensure all soils encountered during drilling and test pits activities are documented using applicable ASTM standards for classification, consistency, moisture content, and color. She is responsible for developing and maintaining soil boring logs and will visually observe and describe all materials encountered with respect to depth and location.

2.8 Field Team

The ARSEC Field Team Members are responsible for performing field activities as stipulated in this Plan and the USACE's Scope of Work entitled "RI Addendum, Tonawanda Landfill Operable Unit", June 2009, and shall report directly to the SM:

- Craft Labor [to be determined (TBD)] – An equipment operator will be on site throughout field work to support field activities. An electrician will establish temporary electrical service at the start of field work, and will be local to the Site.
- HP Technicians – Two HP Technicians will perform periodic instrument checks, perform radiological surveys and collect and prepare soil samples laboratory analysis. The technicians will also maintain radiological zones and controls, perform surveys of personnel and equipment and complete instrument and data records with oversight by the Site RSO.
- Sample Technicians – Two ARSEC sample technicians will be utilized to collect all surface and subsurface soil samples during the field work. They will ensure the samples are collected, contained, prepared and shipped in accordance with all applicable requirements.

2.9 Other

Table 2-1 presents the key points of contact for the Tonawanda project, including USACE, ARSEC and Subcontractor information.

Table 2-1. Contact Information for Key Project Personnel

TITLE	NAME	TELEPHONE
U.S. Army Corps of Engineers – Buffalo District		
Project Manager	[redacted]	716-879-4287 (work)
Project Engineer	[redacted]	716-879-4237 (work)
Industrial Hygienist	[redacted]	716-879-4197 (work)
Health Physicists	[redacted]	716-879-4214 (work)
	[redacted]	716-879-4288 (work)
Chemist	[redacted]	716-879-4448 (work)
Contracting Officer's Representative (COR)	[redacted]	716-879-4214 (work)
Contracting Specialist	[redacted]	716-879-4173 (work)
ARSEC		
Corporate Contractor Quality Control Manager	[redacted]	865-690-0501 (work)
Project Manager	[redacted]	513-673-1906 (cell)
Corporate Health and Safety Manager	[redacted]	865-690-0501
Contracts Manager	[redacted]	865-690-0501 (work)
Site Manager	[redacted]	865-742-5388 (cell)
Corporate RSO/Project Health Physicist	[redacted]	724-312-8935 (cell)
Site Radiation Safety Officer	[redacted]	225-505-1091 (cell)
Site Safety & Health Officer	[redacted]	865-742-5388 (cell)
ARSEC Subcontractors		
Surveyor Local Surveyor (TBA)	–	–
Driller Zebra Environmental Corporation	[redacted]	518-369-4881 (cell)

3.0 PROJECT SCOPE AND OBJECTIVES

The following section identifies the overall scope and the specific objectives of the project and the field measurement and sampling activities that will be used to satisfy the data quality objectives. This section also provides a summary of the data quality objectives (DQOs) as established in the Quality Assurance Project Plan (QAPP, ARSEC 2009). The guidance contained herein serves to ensure that the data collected during this effort will be of sufficient quantity and quality to accurately determine the remaining volume of contaminated soil at the Site.

3.1 Overall Scope

ARSEC will mobilize a team to the Site for the purpose of performing the tasks identified in the Request for Proposal (RFP) to attempt to qualify and quantify the remaining contamination at the Tonawanda Landfill site as follows:

- Conduct clearing and grubbing to prepare the site for the field work;
- Conduct a Gamma Walkover Survey to characterize the site for worker health and safety and to assist in locating surface soil contamination.
- Collect surface and subsurface soil samples in six identified Investigative Areas (IAs) from boreholes installed by direct push methodology to determine whether or not the site poses potential risks to human health or the environment;
- Install temporary well points in up to 14 of the subsurface soil boring locations for the collection of samples to determine the potential for groundwater contamination;
- Perform 100% data validation and verification of the analytical data and prepare an electronic deliverable for the USACE;
- Manage all investigation-derived waste generated during the field work in accordance with the requirements listed in the Task Order RFP.
- Prepare a comprehensive Project Report summarizing all work conducted on the project.

3.2 General Data Collection Summary

Information on COCs will be collected from three investigative field components: (1) Gamma Walkover Surveys (GWS); (2) Surface and subsurface soil sampling based on the results of the GWS scans; (3) Surface and subsurface samples collected from pre-selected systematic sampling grids, as well as replication of samples in areas where the DOE previously found high levels of radionuclide contamination, along the fence line, and along site drainage features; and (4) Groundwater samples collected from temporary well points installed in selected soil borings. Samples collected will be subject to laboratory analysis in accordance with appropriate analytical techniques (e.g., gamma spectrometry, EPA and SW846 methodologies).

3.2.1 Gamma Walkover Surveys: GWS will be performed in parallel with civil survey work being conducted by the local Professional Surveyor. The purpose of the GWS is to characterize the site for worker health and safety and to assist in the location of surface soil contamination. ARSEC will perform all GWS surveys under this task using equipment provided by the ARSEC Instrumentation Facilities located in Knoxville, Tennessee and Port Allen, Louisiana.

In addition to walkover surveys performed in the planned vegetation decomposition area, single direction GWS shall be conducted over 100% of Investigative Areas 1 through 6. The surveys shall be performed using MARSSIM methodology. The purpose of the surveys is to characterize

the site for worker health and safety and to assist in location of surface soil contamination. Figure 1 in Appendix B presents the proposed survey areas.

ARSEC will determine the GWS threshold based on elevation or background and site data. After the completion of the GWS and assimilation of the GWS data, ARSEC will provide a letter report identifying potential areas that warrant the collection of additional GWS data and/or samples to support the RI Addendum re-sampling effort. As delineated in the RFP, ARSEC will not proceed with the proposed sampling until USACE concurrence is received on the letter report conclusions and recommendations.

3.2.2 Surface/Subsurface Soil: Sampling protocols will be based on whether the investigative area has high, medium or low probability of finding radiological contamination. Proposed systematic boring locations are shown on Figure 1 in Appendix B. Boring locations will also include those coordinates where the DOE previously found radionuclide concentrations. For areas with either high or medium probabilities of radiological contamination, such as areas IA 1-5, borings will be drilled to native soil through the vadose zone to the saturated zone. In these borings, each sample collected will include a one foot segment of the 2" boring (except for the cores surface, which will include approximately the top 6-inches of the boring) at the following locations:

1. The core surface, i.e. the top 6 inches of the boring (0.0–0.5 feet bgs)
2. A soil sample just inside the saturated zone
3. A sample just at the top of the native soil
4. A sample where the radiation detection instrument registered the highest reading
5. A sample where the X-Ray Fluorescence (XRF) instrument registered the highest reading

For areas with low probability of contamination, the borings will be drilled to twelve feet (12') below ground surface (bgs). Greater depths will only be obtained if a positive result is obtained in the bottom interval of the soil core during core scanning; the reading that constitutes a positive result shall be determined based on evaluation of background and site data. In that case, the final depth of a sample will be determined by communicating with the COR. The direct push Geoprobe unit that will be used at the site can penetrate to depths greater than 40 feet bgs. For borings terminating at 12' bgs, each sample acquired for analysis at the off-site laboratory will include a one foot segment of the 2" boring (except for the cores surface, which will include approximately the top 6 inches of the boring) at the following locations:

- The core surface [i.e., the top 6 inches of the boring (0.0 – 0.5 feet bgs)]
- A soil sample just inside the saturated zone
- A sample where the NaI instrument registered the highest reading
- A sample where the XRF instrument registered the highest reading.

If fill is encountered in the low contamination potential investigative areas, up to four additional borings per investigative area will be installed extending down to native soil, per direction of the COR. Sampling and analysis in these borings will follow the protocols used for high or medium areas of potential of contamination. In the event that extensive contamination is found along the core in any low probability area, ARSEC shall communicate with the COR to determine final depth. Additional sample collection will be directed by the COR.

3.2.3 Groundwater: ARSEC will install up to 14 temporary well points in the approximate locations shown Figure 1, Appendix B. The well points will be constructed in previously-drilled soil borings. Final locations will be selected based on preliminary screening of soils data. Additional consideration on the final locations of well points will be based on guidance in EM 1110-1-4000, 6-3a, on observed conditions, considering historical groundwater data gaps in the landfill area and adjacent natural (less to undisturbed) areas. The well points will be constructed of 1.25-inch to 2.0-inch PVC with #5 sand (or best equivalent) with a 5-to-10-foot section of 0.010-inch slotted screen. Each well point shall be finished to grade with hydrated bentonite chips with a locking cap on the riser. Well point depth will vary depending on location, but are averaged to be approximately 20-feet bgs.

Sampling of the well points will be after purging is completed; no later than 10 days following installation. Each well point will be sampled as specified in Table 6-2 to determine whether residual MED-like material has impacted site groundwater.

3.3 Data Quality Objectives

Project Data Quality Objectives (DQOs) for field sampling activities have been established based on available site investigation data and potential ARARs pertaining to the Landfill OU. The DQOs have been established to ensure compliance with applicable Federal, State and local regulations for handling and assessing radiological contaminants present at the site, and to evaluate potential remedial activities associated with the handling and/or removal of radiologically impacted material. The project goals/DQOs are:

- Determine the extent and concentration of MED-related material currently in the Landfill OU.
- Estimate potential risks to human health and the environment associated with exposures to MED related contamination which may exist at the site.
- Confirm or update DOE's findings of elevated concentrations of radiological constituents of concern.
- Determine the likelihood and pathways of contaminant migration.
- Evaluate the potential for migration of MED material into residents' back yards and/or presence of material in yards due to historic disposal operations and haulways.
- Bound the depth of MED contamination
- Confirm depth to groundwater, groundwater flow rates and direction of groundwater flow
- Re-evaluate both persistent and intermittent surface water drainages, both historical and present, considering the recent re-contouring of the landfill.
- Obtain data to support technically defensible contaminated soil volume determination.
- Evaluate the characteristics of soil and groundwater for waste disposal

4.0 FIELD ACTIVITIES

A number of field activities will be conducted as part of this characterization effort. The principal activities include:

- Clearing and Grubbing
- Gamma Walkover Surveys
- Surface and Subsurface Soil Sample Collection
- Temporary Well Installation
- Groundwater Sample Collection

Investigative Areas

The field work will be focused within six Investigative Areas exhibiting residual contamination identified from historical investigations by DOE. Collected information and data will be used to determine whether or not the site poses potential risks to human health and the environment. The six areas were selected by USACE through an evaluation of previous field investigation results and site history. They include:

- **IA-1** – A 42,150 SF area that is centered on one of the two locations where screening levels were exceeded during past sampling events. Because of this historical data, IA-1 is considered a "high potential" area for finding radiological contamination.
- **IA-2** – A 31,370 SF area that is centered on the second of the two locations where screening levels were exceeded during past sampling events. This area is also considered a "high potential" for finding radiological contamination.
- **IA-3** – A 397,060 SF area that includes the 1940-1960s waste disposal area and the Town of Tonawanda "buffer zone" of waste that must be moved to cap the landfill. This area is considered a "moderate potential" for finding radiological contamination.
- **IA-4** – A 298,020 SF area that is located on the eastern portion of the 1940-1960s waste disposal area. This area is considered a "moderate potential" for finding radiological contamination.
- **IA-5** – A 229,860 SF area that is located on the western portion of the 1940-1960s waste disposal area. This area is considered a "moderate potential" for finding radiological contamination.
- **IA-6** – A 551,500 SF area that covers the remainder of the Landfill OU and is outside of the 1940-1960s waste disposal area. This area is considered a "low potential" for finding radiological contamination.

IAs 1, 2, 4, 5, 6, and the majority of IA-3 are within the property boundary of the Tonawanda Landfill OU, for which the USACE possess an existing Right of Entry. A portion of IA-3 follows the site surface drainage and is located on National Grid property.

The remainder of this section describes each of these activities in more detail. A current Project Schedule is included as Appendix A to this SAP.

4.1 Site Clearing

In order to prepare the site for the GWS and other work, ARSEC will perform clearing and grubbing consistently over planned Study Areas IA-1 through IA-6 to ensure that 100% coverage of the area by gamma walkover surveys (GWSs) are possible and that all areas are accessible to drill rigs as required.

ARSEC personnel will clear the lower tree limbs and remove foliage and trees < 6-inches in diameter at breast/shoulder height to ground level; will displace bushes or undergrowth that will obscure the efforts of our Professional Surveyor. Where extensive clearing is required, ARSEC will cut trees that are < 6-inches in diameter, larger bushes/brush, and other vegetation flush, within 2-4 inches, with the ground, except for areas where the COR authorizes the growth to stand. Trees that are to be left standing will be cleared of dead branches 1.5-inches in diameter or greater at a height to allow easy access of personnel and survey equipment. All tree limbs, vegetation, and other cleared materials will be shredded onsite using a wood chipper or similar equipment. All chipped and non-chipped material will be staged in USACE and Town of Tonawanda authorized areas for decomposition, noting that the decomposition area shall only be selected if it has a low probability for either chemical and/or radiological contamination, verified by a GWS to verify no elevated surface contamination. ARSEC will coordinate with the Town of Tonawanda prior to initiating the wood chipping process, as it may be possible to use the Town of Tonawanda's wood chipper.

Once the clearing and grubbing is complete, the local State of New York Professional Surveyor will conduct a civil survey to establish the baseline elevations for the site and to locate and mark the locations of USACE delineated sampling locations. The Surveyor will conduct all subsequent surveys, including but not limited to locating and marking of biased sampling locations, locating and marking of Well Point locations, and the confirmation/re-survey of actual installed boring and Well Point locations. This information will be included in the final report.

4.2 Gamma Walkover Surveys (GWS)

The ARSEC heath physics (HP) technicians will begin the Gamma Walkover Survey (GWS) in parallel with civil survey work being conducted by the Professional Surveyor.

To satisfy the requirements of the Task Order RFP, ARSEC will conduct Minimum Detectable Concentration (MDC) bench tests for various field instruments to determine the most appropriate unit for performing the GWS. As such, ARSEC shall check the scan MDC for instruments including but not necessarily limited to a 2-inch x 2-inch sodium iodide (NaI) scintillation detector, a 3-inch x 3-inch sodium iodide (NaI) scintillation detector, and a FIDLER. The HPs will follow the guidance established in MARSSIM/NUREG-1507 to carefully determine the scan MDC and the minimum detectable count rate (MDCR) for the selected instrument to be used during the course of the field investigation activities with respect to the following radionuclides:

- Radium-226,
- Thorium-230,
- Thorium-232 Decay Series, and
- Natural Uranium (U-235, U-238 and U-234).

The calculations that delineate the approximate sensitivity of each radiological detector for all of the above listed contaminants of concern (COCs) will be submitted to USACE for review and approval. It should be noted that Th-232 was not a COC at Linde or any of the other Tonawanda FUSREP sites and is not expected to be a COC at Town of Tonawanda Landfill based on previous sampling results. However, it is felt that it is prudent to include MDC and MDCR calculations for Th-232 at this stage of the investigation.

Survey Procedures: The GWS surveys shall be performed using the most appropriate detector selected as described above. The detector will be coupled with a rate meter that has a current

annual calibration results of which will be kept on site during the survey. Daily QC checks associated with use of these instruments shall follow the standard operating procedures as detailed in the Sampling and Analysis Plan (SAP). This includes the GPS equipment as well. The detector/rate meter will be linked to a Trimble Global Positioning System (GPS) and a data logger in a portable configuration. Count rate information will be recorded simultaneously with geospatial coordinates in one-second intervals. Data files shall be downloaded from the data logger to the project computer for backup and distribution at least once per day.

Prior to the start of the GWS activities, surface specific background measurements shall be made by averaging 10 one minute integrated counts, distributed within a 10 meter by 10 meter grid type likely to be encountered on site. Surface types will include soil, asphalt and concrete. Surveys of the three background survey units shall be conducted using MARSSIM Class 1 methodology. Background Reference Areas shall be established with USACE concurrence since different areas of the site may have varying background activity due to previous operational history and/or varying geological properties of soil. Prior to beginning a survey, ARSEC technicians will inspect the targeted survey area (grid) and identify physical obstacles and overhead obstructions. Obstacles and obstructions shall be noted on the field map and the survey shall be designed to optimize collection of GPS data.

The GWS surveys shall be performed at a rate not to exceed 0.5 meters per second. The NaI detector shall be maintained approximately 10 centimeters above the surface being surveyed. When elevated activity is identified, surveyors shall bound the area using markers for a visual reference. In areas where the satellite coverage is limited, the count rate will be collected by the data logger while the surveyor makes a reasonable effort to walk in a straight line at a constant rate.

Each survey unit shall have its own data file with a unique file name. Each transect path shall begin and end in a GPS coverage area, or at a location that can be referenced to a control point or monument. Each data file for that grid shall be annotated on the field map. All GWS data, including data collected by conventional means, shall be entered into a GIS application such as ArcView to generate site maps depicting gamma survey results. The entire study area will receive 100 % GWS coverage in one direction, only. The GPS data shall undergo differential correction from a continuously operating reference station. The data shall be processed for illustration on a base map. On GPS walkover maps, any survey data point with a count rate greater than the surface-specific MDCR shall be color-coded to indicate that the reading is greater than background. As count rate readings increase, colors shall be graduated to reflect the increasing values.

4.3 Surface Soil/Subsurface Soil Sample Collection

To confirm the presence or absence of residual contamination, ARSEC will collect continuous soil samples from approximately 192 boreholes installed in the locations shown on Figure 1 and at those locations, specified by USACE, in the areas where the DOE found high concentrations of radionuclides.

Drilling: ARSEC has selected ZEBRA Environmental Corporation (ZEBRA) of Niagara Falls, New York to conduct the drilling activities. Drilling will be performed by direct push methodology with a fully equipped track-mounted Geoprobe. The Geoprobe will be operated by an experienced drilling operator and technician, directed by a representative from ARSEC.

The direct push Geoprobe unit that will be used at the site is capable of penetrating to depths greater than 40 feet bgs. Should refusal be met due to rocks or other sub-surface obstructions, ARSEC shall coordinate with the COR and seek approval to re-locate the drilling location a few feet away from the original location. ZEBRA has the capability of mobilizing an auger unit to the site within a week should refusal a depth still be met. The ZEBRA auger unit has the capability of penetrating through refusal areas.

The Geoprobe unit will set up on each identified drilling location. Each location will be surveyed in by the onsite Surveyor. It is anticipated that approximately 6,280 linear feet will be drilled during the field effort. Samples will be collected as outlined in Section 4.4 below.

Ground areas along the fence line, ditch, and residential areas where drilling will take place will be wetted to prevent dust generation.

Borehole Locations: Borehole locations and IA vertex coordinates are listed in Table 4-1. Actual borehole locations may vary slightly due to obstructions both below and on the ground's surface. Borehole locations will not be changed without the permission of the COR. Actual "as drilled" borehole locations will be reported in the Final Project Report.

Soil samples will be collected from 132 systematic boreholes as shown in Figure 1, and 60 biased boreholes located at previous DOE sample locations, along the fence line, along site drainage features, and at areas of elevated radioactivity or other points of interest identified in the field and agreed up by ARSEC and USACE.

Table 4-1. Borehole/Sampling Locations and IA Vertex Coordinates
Coordinates in NAD NYS Plane 3103 (ft)

Borehole/Sampling Location	IA Locale	Point X (Easting)	Point Y (Northing)
Gridded	IA-6	1066413.02	1092583.92
Gridded	IA-6	1066250.59	1092583.92
Gridded	IA-6	1066088.15	1092583.92
Gridded	IA-6	1065925.72	1092583.92
Gridded	IA-6	1065763.28	1092583.92
Gridded	IA-6	1065600.85	1092583.92
Gridded	IA-6	1065438.41	1092583.92
Gridded	IA-6	1065275.97	1092583.92
Gridded	IA-6	1065113.54	1092583.92
Gridded	IA-6	1064951.10	1092583.92
Gridded	IA-6	1064788.67	1092583.92
Gridded	IA-6	1064626.23	1092583.92
Gridded	IA-6	1066413.02	1092746.35
Gridded	IA-6	1066250.59	1092746.35
Gridded	IA-6	1066088.15	1092746.35
Gridded	IA-6	1065925.72	1092746.35
Gridded	IA-6	1065763.28	1092746.35
Gridded	IA-6	1065600.85	1092746.35
Gridded	IA-6	1065438.41	1092746.35
Gridded	IA-6	1065275.97	1092746.35
Gridded	IA-6	1065113.54	1092746.35
Gridded	IA-6	1064951.10	1092746.35
Gridded	IA-4	1066312.89	1092858.14
Gridded	IA-4	1066210.59	1092858.14
Gridded	IA-4	1066517.48	1092952.13

Table 4-1. Borehole/Sampling Locations and IA Vertex Coordinates
Coordinates in NAD NYS Plane 3103 (ft)

Borehole/Sampling Location	IA Locale	Point X (Easting)	Point Y (Northing)
Gridded	IA-4	1066415.19	1092952.13
Gridded	IA-4	1066312.89	1092952.13
Gridded	IA-4	1066210.59	1092952.13
Gridded	IA-4	1066517.48	1093054.43
Gridded	IA-4	1066415.19	1093054.43
Gridded	IA-4	1066312.89	1093054.43
Gridded	IA-4	1066210.59	1093054.43
Gridded	IA-4	1066517.48	1093156.72
Gridded	IA-4	1066415.19	1093156.72
Gridded	IA-4	1066312.89	1093156.72
Gridded	IA-4	1066210.59	1093156.72
Gridded	IA-4	1066517.48	1093259.02
Gridded	IA-4	1066415.19	1093259.02
Gridded	IA-4	1066312.89	1093259.02
Gridded	IA-4	1066210.59	1093259.02
Gridded	IA-4	1066517.48	1093361.31
Gridded	IA-4	1066415.19	1093361.31
Gridded	IA-4	1066312.89	1093361.31
Gridded	IA-4	1066517.48	1093463.61
Gridded	IA-3	1063923.95	1092331.10
Gridded	IA-3	1063419.79	1092179.83
Gridded	IA-3	1064112.14	1092433.71
Gridded	IA-3	1063547.45	1092277.03
Gridded	IA-3	1064309.05	1092505.96
Gridded	IA-3	1063774.23	1092397.72
Gridded	IA-3	1064478.05	1092608.88
Gridded	IA-3	1063995.54	1092493.42
Gridded	IA-3	1064703.86	1092721.78
Gridded	IA-3	1063696.22	1092234.31
Gridded	IA-3	1064929.66	1092834.68
Gridded	IA-3	1065033.11	1092831.17
Gridded	IA-3	1065151.65	1092910.72
Gridded	IA-3	1065038.75	1092910.72
Gridded	IA-3	1065264.56	1093023.62
Gridded	IA-3	1065682.19	1093204.02
Gridded	IA-3	1065494.71	1093119.03
Gridded	IA-3	1065837.18	1093276.52
Gridded	IA-3	1066160.28	1093369.83
Gridded	IA-3	1066047.38	1093369.83
Gridded	IA-3	1066428.58	1093502.73
Gridded	IA-3	1066315.68	1093502.73
Gridded	IA-1	1065749.26	1093062.69
Gridded	IA-1	1065705.49	1093062.69
Gridded	IA-1	1065880.57	1093106.46
Gridded	IA-1	1065836.80	1093106.46
Gridded	IA-1	1065793.03	1093106.46
Gridded	IA-1	1065749.26	1093106.46
Gridded	IA-1	1065705.49	1093106.46
Gridded	IA-1	1065968.11	1093150.24
Gridded	IA-1	1065924.34	1093150.24

Table 4-1. Borehole/Sampling Locations and IA Vertex Coordinates
Coordinates in NAD NYS Plane 3103 (ft)

Borehole/Sampling Location	IA Locale	Point X (Easting)	Point Y (Northing)
Gridded	IA-1	1065880.57	1093150.24
Gridded	IA-1	1065836.80	1093150.24
Gridded	IA-1	1065793.03	1093150.24
Gridded	IA-1	1065749.26	1093150.24
Gridded	IA-1	1065705.49	1093150.24
Gridded	IA-1	1065924.34	1093194.01
Gridded	IA-1	1065880.57	1093194.01
Gridded	IA-1	1065836.80	1093194.01
Gridded	IA-1	1065793.03	1093194.01
Gridded	IA-1	1065749.26	1093194.01
Gridded	IA-1	1065924.34	1093237.78
Gridded	IA-1	1065880.57	1093237.78
Gridded	IA-1	1065836.80	1093237.78
Gridded	IA-2	1065219.71	1092861.27
Gridded	IA-2	1065295.23	1092899.03
Gridded	IA-2	1065257.47	1092899.03
Gridded	IA-2	1065219.71	1092899.03
Gridded	IA-2	1065181.95	1092899.03
Gridded	IA-2	1065370.75	1092936.79
Gridded	IA-2	1065332.99	1092936.79
Gridded	IA-2	1065295.23	1092936.79
Gridded	IA-2	1065257.47	1092936.79
Gridded	IA-2	1065219.71	1092936.79
Gridded	IA-2	1065181.95	1092936.79
Gridded	IA-2	1065408.52	1092974.55
Gridded	IA-2	1065370.75	1092974.55
Gridded	IA-2	1065332.99	1092974.55
Gridded	IA-2	1065295.23	1092974.55
Gridded	IA-2	1065257.47	1092974.55
Gridded	IA-2	1065219.71	1092974.55
Gridded	IA-2	1065370.75	1093012.32
Gridded	IA-2	1065332.99	1093012.32
Gridded	IA-2	1065295.23	1093012.32
Gridded	IA-2	1065370.75	1093050.08
Gridded	IA-5	1066091.90	1092867.41
Gridded	IA-5	1065989.69	1092867.41
Gridded	IA-5	1065887.47	1092867.41
Gridded	IA-5	1065785.26	1092867.41
Gridded	IA-5	1065683.04	1092867.41
Gridded	IA-5	1065580.83	1092867.41
Gridded	IA-5	1065478.61	1092867.41
Gridded	IA-5	1065376.40	1092867.41
Gridded	IA-5	1066091.90	1092969.63
Gridded	IA-5	1065989.69	1092969.63
Gridded	IA-5	1065887.47	1092969.63
Gridded	IA-5	1065785.26	1092969.63
Gridded	IA-5	1065683.04	1092969.63
Gridded	IA-5	1065580.83	1092969.63
Gridded	IA-5	1065478.61	1092969.63
Gridded	IA-5	1066091.90	1093071.84

Table 4-1. Borehole/Sampling Locations and IA Vertex Coordinates
Coordinates in NAD NYS Plane 3103 (ft)

Borehole/Sampling Location	IA Locale	Point X (Easting)	Point Y (Northing)
Gridded	IA-5	1065989.69	1093071.84
Gridded	IA-5	1065887.47	1093071.84
Gridded	IA-5	1066091.90	1093174.06
Gridded	IA-5	1065989.69	1093174.06
Gridded	IA-5	1066091.90	1093276.27
Gridded	IA-5	1065580.79	1093051.77
Gridded	IA-2	1065181.39	1092970.84
Vertex A	Rounded to Nearest Foot	1066607.00	1092540.00
Vertex B	Rounded to Nearest Foot	1066607.00	1092830.00
Vertex C	Rounded to Nearest Foot	1066607.00	1093557.00
Vertex D	Rounded to Nearest Foot	1066607.00	1093667.00
Vertex E	Rounded to Nearest Foot	1066120.00	1092830.00
Vertex F	Rounded to Nearest Foot	1066120.00	1093328.00
Vertex G	Rounded to Nearest Foot	1065050.00	1092830.00
Vertex H	Rounded to Nearest Foot	1064465.00	1092540.00
Vertex I	Rounded to Nearest Foot	1063618.00	1092141.00
Vertex J	Rounded to Nearest Foot	1063618.00	1092251.00
Vertex K	Verified via Erie County GIS Parcel Coverage	1063162.00	1092057.00
Vertex L	Verified via Erie County GIS Parcel Coverage	1063524.00	1092322.00
Vertex M	Verified via Erie County GIS Parcel Coverage	1063745.00	1092434.00
Vertex N	Verified via Erie County GIS Parcel Coverage	1063875.00	1092558.00
Vertex O	Rounded to Nearest Foot	1064187.00	1092522.00
Vertex P	Rounded to Nearest Foot	1065148.00	1092957.00
Vertex Q	Rounded to Nearest Foot	1065208.00	1092848.00
Vertex R	Rounded to Nearest Foot	1065434.00	1092955.00
Vertex S	Rounded to Nearest Foot	1065372.00	1093066.00
Vertex T	Rounded to Nearest Foot	1065654.00	1093157.00
Vertex U	Rounded to Nearest Foot	1065718.00	1093030.00
Vertex V	Rounded to Nearest Foot	1065980.00	1093155.00
Vertex W	Rounded to Nearest Foot	1065910.00	1093285.00

Sample Collection: A continuous core of soil will be collected from an approximate depth of 12'-40' below grade for sampling purposes. At each borehole location, either a Macro Core (MC) sampler or a Closed Piston Macro Core (CPMC) drive point sampler will be used to collect the soil core for sampling purposes. The MC samplers are open-tube design and measure approximately 2-inches in diameter by 46-inches long. The samplers are fitted with a removable cutting shoe and clear acetate liner. Samples can be collected from 0' to 4', 4' to 8', 8' to 12' below grade and possibly deeper depending on subsurface conditions. If the potential for "cave-in" is significant in a borehole at lower depths, it may be necessary to use the CPMC assembly that fits into the MC cutting shoe. CPMC drive point samplers can be used to collect soil samples at points where subsurface conditions prevent the use of MC open samplers or where continuous sampling is not necessary. The CPMC samplers can be driven closed to a desired sampling depth.

In order to collect samples with the CPMC drive point sampler, it is first driven to the desired sampling depth, then opened and driven four (4) feet further. The CPMC sampler remains completely closed while it is being driven to depth and is opened by releasing a stop pin from the surface. Releasing the stop pin allows a piston to retract inside the sample tube as the soil core is

displacing it. Each of the samplers used will be fitted with a new acetate liner prior to use. The acetate liner assists in the removal of the soil sample from the tube and helps insure sample integrity.

Soil Scan: Soil cores in their acetate liner shall be removed from the boreholes. The outside of the acetate liner will be verified free of loose radioactive contamination. External surfaces of acetate liners with loose radioactive contamination will be decontaminated by wiping the surface with a damp cloth or paper towel or as otherwise directed by the Site RSO. Soil cores in their acetate line will be placed on a table in a low-background area for scanning and visual inspections. The outside of the acetate liner shall be wiped down to remove any possible moisture and to allow for visual inspections of the core soil. HP technicians will scan the core with a 2 x 2 NaI detector. The COR or other USACE on-site representative will scan a percentage of the cores with a portable XRF spectrometer. The USACE shall determine which cores and the number of cores that will be scanned with the portable XRF spectrometer.

The drilling operations will be continuously surveilled by an ARSEC Professional Geologist, [redacted]. [redacted] will utilize GPS and geographic information system (GIS) equipment to record, document, and report the location of the soil borings required under the base contract. Each soil boring will also be surveyed for location and elevation by a local registered Professional Surveyor (PS). ARSEC will work with the Professional Surveyor to ensure that all data, including the gamma scan data, is documented on a GIS generated figure based on NAD 1983 New York North State Plane Coordinates and NGVD 88 Datum.

Boring logs and logs of core scanning results will be documented into bound log books that will be turned over to USACE at the end of the project. All soil borings will be classified by the PG using USACE Engineer Form 5056-R and 5056A-R. A copy of the completed form will be submitted to the USACE Project Manager upon completion of the boring and included in the final report.

Surface/Subsurface Sampling Protocol: ARSEC will implement a sampling protocol that is based on the probability that the investigation area has a “high”, “moderate”, or “low” potential of encountering radiological contamination. For areas where the probabilities are either “high” or “moderate” (e.g., IA-1 through IA-5), the soil boring shall extend to native soil through the vadose zone to the saturated zone. For these borings, each sample acquired for analysis shall include a 1-foot segment of the 2-inch boring (except for the cores surface, which will include approximately the top 6-inches of the boring) as follows:

- The core’s surface, approximately the top 6-inches of the boring,
- A sample just inside the saturated zone,
- A sample at the top of the native soil,
- A sample where the radiological scan registered the highest reading, and
- A sample where the USACE XRF scan registered the highest reading. For cores where an XRF scan was not performed, the sample location will be chosen after consultation and agreement with the COR and will be biased towards the 1-foot segment on top of any clay layer, areas containing soil discoloration, foreign debris, unusual odors, or other abnormal soil characteristics.

For areas with a “low” potential for encountering radiological contamination, the borings shall extend 12- feet below ground surface (bgs) and only go deeper if a positive result is obtained at

the bottom interval of the soil core during radiological scanning, based on concurrence with the COR. For borings terminated at 12-feet bgs, samples will be collected as follows:

- The core's surface, approximately the top 6-inches of the boring;
- A sample just inside the saturated zone;
- A sample where the radiological scan registered the highest reading; and
- A sample where the XRF scan registered the highest reading. For cores where an XRF scan was not performed, the sample location will be chosen after consultation and agreement with the COR and will be biased towards the 1-foot segment on top of any clay layer, areas containing soil discoloration, foreign debris, unusual odors, or other abnormal soil characteristics.

If fill is encountered in the "low" potential area, then up to four (4) additional borings per investigative area shall be installed and sampled, as directed by the COR, using the sampling protocol for "high" or "moderate" potential areas. If extensive contamination is encountered along the core in any "low" potential area, the ARSEC Site Manager/CHP will confer with the COR to determine how to proceed.

All soil and core samples, including field QA/QC samples, will be analyzed for the radiological parameters specified in Table 6-1. In addition, 10% of all soil and core samples will be analyzed for the non-radiological parameters specified in Table 6-1. Selection of soil and core samples for non-radiological analysis will be biased first towards those samples exhibiting the highest radioactivity levels and secondly towards those samples exhibiting the highest XRF uranium readings.

Sample Quantities: Table 4-2 delineates the anticipated sampling requirements for systematic and biased borings in IA-1 through IA-6 and for the biased borings to be installed at the Corps direction along the fence line and within the ditch.

Table 4-2. Soil Sampling Quantities per Investigative Area and Other Areas[1]

IA	Systematic Borings	Biased Borings	Routine Samples	Field Duplicate Samples	MS/MSD Samples[2]	Total # of Samples
IA-1 (H)	22	14	180 (18)	9 (1)	(1)	198 (19)
IA-2 (H)	22	6	140 (14)	7 (1)	(1)	154 (15)
IA-3 (M)	22	4	130 (13)	7 (1)	(1)	144 (14)
IA-4 (M)	22	4	130 (13)	7 (1)	(1)	144 (14)
IA-5 (M)	22	4	130 (13)	7 (1)	(1)	144 (14)
IA-6 (L)	22	4	104 (11)	5 (1)	(1)	114 (12)
Fenceline (L)	0	12	48 (5)	2 (1)	(1)	52 (6)
Ditch (L)	0	12	48 (5)	2 (1)	(1)	52 (6)
Total	**132**	**60**	**910 (92)**	**46 (8)**	**(8)**	**1,002 (100)**

[1] Numbers outside of parentheses are for radiological samples. Numbers in parentheses are for chemical analysis.
[2] MS/MSD samples are not required for the soil radiochemical analyses being performed for this project for the following reasons:

- Radium-226, Americium-241, and Uranium 235 and 238 are analyzed by gamma spectroscopy for which a matrix spike is not appropriate.
- Isotopic Thorium uses a tracer and therefore does not require MS/MSD (Reference MARLAP 18.4.3 and DOD QSM D 4.1.b.2).

Sampling Methods: Soil samples will be collected by using a stainless steel trowel or sampling spoon and will be homogenized in a stainless steel bowl or container prior to containerization. Visually identifiable non-soil components such as stones, twigs, and foreign objects will be manually separated in the field and excluded from the laboratory samples to avoid biasing results low. A label shall be affixed to each sample container in accordance with Section 5.4.2 of this FSP. All protocols for trip blanks, field blanks, etc., will be implemented as required by SW 846.

Field sampling equipment used during soil sampling will be free from contamination and shall be decontaminated after use. Refer to Section 4.7 of this FSP for decontamination procedures.

Groundwater sample collection is discussed in Section 4.5 of this FSP.

Laboratories, Sampling Containers, Preservation, and Holding Times: American Radiation Services, Inc. (DBA ARS International), of Port Allen, Louisiana, an independent off-site laboratory, will provide radiochemical analysis. TestAmerica of Earth City, Missouri, also an independent off-site laboratory, will provide non-radiochemical analysis. The TestAmerica laboratory has U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) accreditation in the non-radiochemistry analytical parameters associated with the project. The ARS laboratory will be audited for DoD ELAP accreditation the first week in October for the radiochemistry analytical parameters associated with the project. All sample bottles and preservation requirements will be provided by the laboratory and documented in the QAPP. Holding times and requirements will also be specified in the QAPP. As a minimum, sample container, preservation, and holding time requirements shall conform to the guidance provided in EM-200-1-3. Sample container, preservation, and holding time requirements are contained in Appendix D. To ensure that required temperatures are met for volatile organic compound (VOC) samples, after sample collection, VOC sample containers will be placed in an onsite sample refrigerator or a cooler to ensure 4° C from the time of collection until being shipped to the laboratory.

4.4 Temporary Well Point Installation

ARSEC will install up to 14 temporary well points in accordance with the requirements of the RFP. The well points will be installed in previously drilled soil boring locations using the Geoprobe drilling rig under the direction of the Project Geologist. The well points will be installed to a depth of 20-feet bgs and constructed with 1.25-inch Schedule 40 polyvinyl chloride (PVC) tubing, with a maximum 10-foot section of slotted 0.010-inch well screen. The screen shall be surrounded with filter sand fine enough to prohibit the entry of soil fines into the temporary wells. Bentonite chips will be added into the annulus space from the base of the hole to ground surface and hydrated. The completed well point will be finished with a locking cap. Final disposition of the wells has not yet been decided by the USACE. Wells will be either properly finished at grade if needed for additional monitoring (pads and pro-casings) or decommissioned according to NYSDEC guidelines by a NYS licensed driller.

4.5 Groundwater Sample Collection

All temporary well points will be sampled in accordance with standard low-flow technologies delineated in EPA/540/S-95-504 (April 1996) using either peristaltic and/or bladder pumps connected to dedicated (by location) high-density polyethylene (HDPE) tubing for radiological testing or Teflon tubing for radiological and organic testing. The wells shall be purged at a rate of 100 ml per minute or less. If wells cannot provide enough water volume, and purge dry at a

purge rate of 100 ml/min or less, priority shall be given to collection of radiological parameters once the well has recovered. Wells will be sampled with dedicated sampling equipment (tubing) to avoid cross contamination between sampling locations.

Field parameters such as temperature, pH, redox potential, turbidity, dissolved oxygen, and specific conductivity will be collected using a Yellow Springs Instrument (YSI) Company Model 556 Handheld Multi-parameter Instrument for each well during the sampling activities in accordance with EM 200-1-3 C 2.4.7.

All purge water will be containerized in DOT approved containers and managed as investigation derived waste (IDW).

Filtering of ground water samples will be performed by the laboratory performing the required analysis. ARSEC will communicate with the laboratory that the ground water sample should be divided into equal segments, and that one of the two groundwater segments should be filtered to remove suspended solids. Required analyses shall be performed on both the filtered and unfiltered segments of the ground water sample.

4.6 QA Samples

In order to comply with USACE sampling protocols, the number of field duplicates, MS/MSD samples, and Quality Assurance (QA) splits shall be 10%, 5%, and 5%, respectively, of the total number of soil samples collected. Field QA and USACE QA duplicate samples will be collected simultaneously, or in immediate succession, with the original sample.

The duplicates will be recovered in the same manner as the original, homogenized and split between the appropriate containers. Duplicate samples will be numbered, logged, and transferred, under the ARSEC chain of custody procedures, to the off-site laboratory for analyses. The off-site laboratory will prepare and provide containers that meet their analytical requirements. The containers will have sufficient capacity to hold the contents of a one-liter marinelli sample container.

4.7 Decontamination

Sampling equipment used during surface/subsurface soil sampling and groundwater sampling will be free from contamination and decontaminated prior to use. A field decontamination location shall be established and approved by the COR prior to use. Equipment requiring decontamination may include stainless steel scoops, bowls, spoons, core barrels, etc. Other equipment used during sampling activities that does not directly contact sample materials (such as down-hole rods, shovels, etc.) shall be cleaned to remove potential soil contamination. Decontamination activities shall be conducted so that all solid and liquid wastes generated can be properly contained and collected. Decontamination waste materials shall be collected daily and stored in 55-gallon drums.

If needed, the Geoprobe drill rig will be decontaminated by constructing a decontamination pad on a level ground area. A depression will be dug in one corner of the area where the pad will be constructed to allow for a sump. The pad will be constructed using a 2” x 6” wooden frame of the required size and overlain by a dense HDPE plastic sheet. The plastic sheet will be nailed to the wooden framing using a self sealing roofing nail. The drilling portion of the unit will be decontaminated using a pressure washer. Personnel performing decontamination will utilize

proper PPE, including tyvek, rubber boots, rubber gloves and a face splash shield attached to the hard hat.

A trash pump will be used to pump the decon liquids into an approved container for subsequent disposal.

4.8 Air Monitoring

Air monitoring will be performed in accordance with the HSRPP to ensure exposure to workers, the public, and the environment from airborne radioactivity and/or hazardous substances (VOCs, carbon monoxide) is maintained as low as reasonably achievable (ALARA). Air monitoring will be performed during site clearing activities which have the potential to generate dust and during initial intrusive activities (i.e., direct push soil borings). The Site Manager and SSHO in conjunction with the Site RSO will determine the duration of the air sampling to take place, and obtain approval from the COR.

The air monitoring will be divided into two categories; radiological and non-radiological. Both radiological and non-radiological air sampling shall take place during site clearing activities which have the potential to generate dust and during initial intrusive activities. A discussion on sampling equipment, sample collection techniques, and analysis is provided below.

4.8.1 Radiological: The two types of radiological air sampling planned for this effort are *area* and *breathing zone* (BZ).

Limited area sampling will be performed around the site perimeter to measure airborne particulate concentrations as a result of the soil boring activities. Samples will be collected using calibrated low volume air samplers such as F&J Model LV-1 or equivalent. Air samplers will be in place prior to commencement of intrusive activities at locations specified by the RSO or the SSHO. At a minimum, these locations will include one sampler downwind from the immediate work area. The sample will be collected on 47 millimeter glass fiber filter paper. The sample will be collected continuously throughout the duration of the initial boring activities.

BZ sampling will be performed concurrently to measure potential airborne radioactivity exposure to workers during the soil boring installation. These samples will be collected using a calibrated personal air sampler (PAS) such as SKC PXR4 or equivalent. The PAS will be worn by at least one individual within the work area. The sample will be collected on a 25 millimeter glass fiber filter paper. The sample will be collected continuously throughout the duration of the intrusive activity.

Upon completion of the sampling event, the filter will be removed from the sample head and placed in a sample envelope or other container for on-site screening. After sufficient time has elapsed for short-lived radon progeny to decay (a minimum of 72 hrs), the filter will be screened on site for gross alpha-beta activity using a Ludlum Model 2929 dual scintillation sample counter or equivalent. Results of the sample will be compared against the derived air concentration (DAC) values identified in 10 CFR 20, Appendix C. For the purpose of the onsite screening, all activity will be assumed to be from Th-232. The Appendix C DAC values for Th-232 are as follows.

5 E-13 µCi/ml	**-**	**Occupational Value (Work Area)**
4E-15 µCi/ml	**-**	**Effluent Concentration (Perimeter)**

4.8.2 Non-Radiological: Two types of non-radiological air monitoring will also be performed concurrently with the radiological sampling discussed above; particulate dust and organic vapor.

Particulate dust monitoring will be performed to measure ambient levels of dust as a result of soil boring activities. Dust monitoring will be performed using a real-time aerosol monitor which produces real-time readings and computes time-weighted averages such as a TSI Dustrak or equivalent. Dust monitors will be in place prior to commencement of boring activities at locations specified by the SSHO. The SSHO will determine the Time Weighted Average (TWA) and maximum concentration of dust identified during the monitor period. Monitoring will be completed during initial intrusive operations to establish a baseline and effectiveness of dust suppression engineering controls.

Organic vapor monitoring will be performed with a multi-detection instrument such as a MultiRAE Plus or equivalent to monitor for VOCs and hazardous gases. Periodic readings will be taken during soil boring installation. The instrument will be calibrated the morning of each day of use in accordance with the manufacturers' procedures. Additional calibration may be completed at the discretion of the instrument operator if significant weather variations occur during the course of the day. Suspect soil will be screened by placing a sufficient quantity of soil collected into a one-gallon Ziploc baggie, or in an eight ounce clear glass jar covered with aluminum foil wrap. The baggie/jar will be sealed, shaken, and the PID probe tip will be inserted into a corner of the baggie or pierced through a small opening in the foil wrap, to evaluate the "headspace," while maintaining a tight seal over the remainder of the opening. This method will be used for screening purposes only; soil gas or soil vapor samples will not be collected for off-site analysis.

The Site Manager and the SSHO will review the monitoring results, and provide the results to the COR to verify that no exposure from drilling activities is present before discontinuing any monitoring event.

5.0 FIELD QUALITY CONTROL

Project QC will be maintained through the implementation of the ARSEC Quality Control Plan (QCP), the Site QAPP, and ARSEC'S corporate QA procedures. Procedures from the HSRPP will be implemented for the duration of this project. Controlled copies of pertinent plans and procedures shall be available on-site for the duration of the project. The ARSEC PM and Contractor Quality Control Systems Manager (CQCSM) shall be responsible for the execution of the QC Program.

ARSEC will maintain direct, concise, and daily contact/coordination with the USACE concerning field operations and scheduling field activities. The primary POCs for all communications regarding the Site project will be Steve Shirley (ARSEC PM). The ARSEC PM, or designee, will participate in a weekly project meeting throughout the period of performance of the Contract. Participation may be by phone when field activities are not scheduled.

5.1 Daily Quality Control Report

ARSEC will submit to the COR a Daily Quality Control Report (DQCR) for each day that field activities are conducted. The DQCR form is provided in the project QCP. The field DQCR will identify the current activities, any unanticipated delays or occurrences, departures from the FSP, communications with other USACE contractors or regulators, and any needed corrective actions. The DQCR will be signed and dated by the ARSEC CQCSM or designee and will be submitted to the COR on a daily basis. Any deviation that may affect the project DQOs will be immediately communicated to the COR. The DQCR shall include, at a minimum, the following information:

- A daily summary of site activities;
- Weather information;
- Field instrument measurements;
- Identification of all field and control samples collected;
- QA sample tables that match up primary, replicate (QC/QA), and other field control samples (e.g., blanks);
- Copies of chain-of-custody forms, field-generated analytical results, and any other project forms that are generated;
- Results of QC activities performed including field instrument calibrations;
- Any deviations from the FSP including the justification for the deviation;
- AHAs, JSAs, CQM paperwork, photos, controlled access forms, equipment surveys, weekly surveys, and monthly surveys;
- Contractor/subcontractor personnel on-site and areas of responsibility and list equipment on-site;
- Safety section listing any safety issues and details on the daily tailgate meeting;
- Planned upcoming activities or planned areas / schedule of work;
- Any problems encountered during daily field activities; and,
- A summary of any instructions received from USACE or government personnel.

Any deviations that may affect the project objectives shall be immediately conveyed to the COR. ARSEC shall not commence with any deviations from the work plans without formal acceptance by the COR and/or Contracting Officer Representative.

5.2 Corrective Actions

Any non-conformance with established procedures presented in the project plans will be identified and corrected. The ARSEC PM will issue a non-conformance report for each non-conforming condition. In addition, corrective actions will be implemented and documented in the appropriate field logbook. Non-conforming conditions include, but are not limited to:

- Improper instrument calibrations or operational checks,
- Improper survey or sampling procedures,
- Physical or documentation discrepancies with samples upon receipt at the laboratory.

5.3 Field Documentation

5.3.1 Field Logbooks: Information pertinent to field activities including field instrument calibration data will be recorded in field logbooks. Each logbook shall have the site name and project name and number on the inside front cover. Sufficient information shall be recorded in the logbooks to permit reconstruction of all conducted field investigative activities. The logbooks will be bound and the pages will be consecutively numbered. Sufficient information will be recorded in the logbooks to permit reconstruction of site characterization activities conducted. Information recorded on other project documents will not be repeated in the logbooks except in summary form where determined necessary.

All field logbooks shall be kept in the possession of the Site Manager or the recording author in a secure place when not being utilized for field work. Upon completion of the field activities, all logbooks shall become part of the final project evidence file. The title page of each logbook shall be labeled as follows:

- Logbook title (e.g., Town of Tonawanda Landfill OU Site Characterization);
- Project name (e.g., Town of Tonawanda Landfill OU, USACE-Buffalo District FUSRAP Project);
- USACE contract number and project delivery order number (Contract No. W912P4-07-D-0009, Delivery Order 0003);
- Start date for field investigative activities recorded in the logbook; and,
- End date for field investigative activities recorded in the logbook.

The following will be contained in the field Logbook along with any other pertinent information:

- Name and title of author, date, and times of arrival at and departure from site
- Purpose of the site characterization activity
- Name and address of the field contact(s)
- Names and responsibilities of field crew members
- Names and titles of any field visitors
- Type, matrix, and characterization method for generated IDW
- Sample collection method
- Number and volume of sample(s) collected
- Location, description and log of sampling point photographs
- References of all maps and photographs of the sampling site(s)
- Information regarding sampling changes, scheduling modifications and change orders
- Information regarding site characterization decisions not recorded by other mechanisms
- Information regarding access agreements, if applicable

- Details of each sampling location, including a sketch map showing the location
- Date and time of sample collection, including the name of the collector
- Field observations
- Type of field instruments used and purpose of use, including calibration methods and results
- Any field measurements made (e.g. radiological activity and landfill gas)
- Sample identification number(s)
- Information on containers, reagent used, deionized and organic-free water used, etc.
- Sample type and methodology, including distinction between grab and composite samples.
- Sample preservation methods
- Sample distribution and transportation (e.g. name and address of the laboratory and courier)
- Name and address of the government QA laboratory for the project and the associated project Laboratory Information Management System (LIMS) number
- Sample documentation information including:
  - chain-of-custody record numbers
  - description of the number of shipping containers packaged (including COC records) and the shipping method employed (noting applicable tracking numbers)
- Decontamination procedures
- IDW documentation including
  - types of containers/drums
  - contents, type, and approximate volume of waste
  - type of contamination and predicted level of contamination based on available information
- Summary of daily task (including costs where appropriate) and documentation on any cost or scope of work changes required by field conditions
- Signature and date entered by personnel responsible for the recorded observations.

Field data collected during invasive soil sampling shall be recorded on boring logs formatted specifically for the field investigative activities at the Tonawanda site.

If any recorded information is noticed to be in error, the original entry shall be crossed out so that the original entry is still legible and shall be replaced with the new entry. All such changes shall be initialed by the Site Superintendent. At the conclusion of each work day, the person responsible for maintaining the logbook shall sign and date the day's documentation entries.

5.3.2 Photographs: A photographic record documenting selected aspects of the field operations will be kept. Items to be included shall be decided by the on-site government representative with input from on-site participants. For each photograph taking during field operations, the following items will be recorded in the field logbook:

- date and time
- photographer (name and signature)
- site name
- aspect and description of the subject taken
- roll number of film or memory stick number and sequential number of photograph.

Photographs taken to document sampling points will include two or more permanent reference points within the photograph to facilitate relocating the point at a later date. In addition to the information recorded in the field log book, one or more photograph reference maps shall be prepared. If available, a GPS-enabled camera is preferred to allow map-based referencing of each photo.

5.3.3 Electronic Data: Electronic data collected during the day will be backed-up at the end of the same day in the field (e.g. to tape or zip drive) and before processing or editing. This is an archive of the raw data and, once created, shall not be altered. More than one day's data may go on a single tape or zip disk. Field computer(s) used to store GPS data will be backed up weekly. Raw archived data will be stored in a different location from weekly backups. Electronic GPS data will be provided daily to off-site data processing specialists. The date and time that data files are transmitted will be recorded in the data logbook. File names will be verified by comparison with field notes and corrected if necessary, following approval by the ARSEC PM.

5.3.4 Post-Processing: Post-processing specialists will convert daily GWS/GPS data to state plane coordinates, as necessary, and review the data for errors to fluctuations/interferences in the GPS signal. Post-processing specialists will be able to determine qualitatively, by density of recorded GPS positions, rapid or increased velocity of the surveyor performing the GWS, which could have an adverse effect on the predicted scan MDC. Post-processing specialists will inform the project manager of any identified deficiencies and will make corrections as directed. Conversions, errors, corrections, and/or adjustments to project data shall be documented in the data logbook.

5.4 Sample Documentation

5.4.1 Sample Numbering System: A unique sample numbering system specific to the project shall be used to identify each sample collected and submitted for laboratory analysis. The unique sample number shall ensure those sample identifiers are not duplicated, and do not coincide sample identifiers used during any previous sampling efforts. The sample identification numbers shall be maintained by the Site Superintendent in the field logbook and on sample field sheets. Sample identification numbers shall be used on all sample labels or tags, field data sheets and/or logbooks, chain of custody records, and all other applicable documentation used during the project. Each container used to collect samples shall be properly handled. Other field QC samples, however, shall be numbered so that they can be readily identified.

A summary of the sample-numbering scheme to be used for the project is presented in Table 5-1.

5.4.2 Sample Labels: Sample labels shall be affixed to all containers during sampling activities at the time of sample collection and securely affixed to the container prior to shipment. Sample label information shall include, but not be limited to, the following:

- Contractor name
- Sample identification number
- Site name
- Sample station number
- Requested analysis
- Type of sample (discrete, grab, or composite)
- Type of chemical preservative present in container

Table 5-1. Sample ID Numbering Scheme

Sample ID Component	Description	
Project Code	TLS	Tonawanda Landfill Site
Sample Matrix Code	SS	Surface Soil Sample
	SB	Subsurface Soil Sample
	GW	Groundwater Sample
	RS	Radiological Survey Sample
	AS	Air Sample (air monitoring station/breathing zone)
	IDW	Soil – waste characterization
Location Code	IA-	Investigative Area Number – i.e. IA-1, IA-2, etc
	X	Sequence Identifier within IA- 1 - 6
	#.# -#.#	#.# -#.# – Sample collection depth interval, in feet below ground surface (i.e., 0.0-0.5, 1.5 – 2.0)
Date Code	MMDDYY	Date of collection – i.e. 051109

- Date and time of sample collection
- Sampler's name and signature or initials

5.4.3 Cooler Receipt Checklist: The condition of shipping coolers and enclosed sample containers will be documented upon receipt at the analytical laboratory. This documentation will be accomplished using the cooler receipt checklist presented in the QAPP (ARSEC 2009).

One checklist will be placed either into each shipping cooler along with the completed COC form or provided to the laboratory at the start of the project. A copy of the checklist will be faxed to the contractor's field manager immediately after it has been completed at the laboratory. The original completed checklist will be transmitted with the final analytical results from the laboratory.

5.4.4 Chain of Custody Records: Chain of custody procedures provide documentation of the handling of each sample from the time it is collected until it is destroyed. Chain of custody procedures are implemented so that a record of sample collection, transfer of sample between personnel, sample shipping, and receipt by the laboratory that will analyze the sample is maintained. The chain of custody record serves as a legal record of possession of the sample. To simplify the chain of custody record and eliminate potential litigation problems, as few people as possible should handle the sample. The chain of custody procedures implemented for the project shall document the handling and security of each sample from the time of collection through and including completion of the laboratory analysis. A sample is considered under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession;
- The sample is in the sampler's view after being in possession;
- The sample was in the sampler's possession and then was placed into a locked area to prevent tampering; and
- The sample is in a designated secure area.

In addition to the chain of custody record, there is also a chain of custody seal. The chain of custody seal is an adhesive seal placed in areas such that if a sealed container is opened, the seal would be broken. The chain of custody seal ensures that no sample tampering occurred between the field and the laboratory analysis.

Custody shall be documented throughout the field investigative activities for all collected samples using the standard chain of custody form with one form initiated each day samples are collected. The record shall accompany the samples from the site to the laboratory and shall be returned to the laboratory coordinator with the final analytical report. All personnel with sample custody responsibilities shall be required to sign, date, and note the time on the chain of custody form when relinquishing the samples from their immediate custody (except in the case where samples are placed into designated secure areas for storage prior to shipment). Bills of lading or air bills shall be used as custody documentation during times when samples are shipped from the site to the laboratory. These documents shall be retained as part of the permanent sample custody documentation. The air bill number or registered mail serial number shall be recorded in the remarks section of the chain of custody record. Information shall be documented on all chain of custody forms as follows:

- Sample number (for each sample in the shipment);
- Collection date and time (for each sample in the shipment);
- Number of containers for each sample;
- Sample description (i.e., environmental matrix);
- Analysis required for each sample;
- Sample preservation technique(s);
- Chain of custody or shipment number;
- Shipping address of the laboratory;
- Date, time, method of shipment, courier, and air bill number; and
- Signatures when custody is transferred between individuals.

The individual trained and responsible for shipping the samples from the field to the laboratory shall be responsible for completing the chain of custody form. This individual shall also inspect the form for completeness and accuracy and shall be responsible for ensuring International Air Transportation Association (IATA) compliance. In addition, this individual shall be responsible for determining the shipping classification for samples under United States Department of Transportation (USDOT) Regulatory Requirements. After the form has been inspected and determined to be satisfactorily completed, the responsible individual shall sign, date, and note the time of transfer on the form. For commercial carriers, the chain of custody form shall be placed in a sealable plastic bag and placed inside the cooler used for sample transport after the field copy of the form has been detached.

Shipping containers shall be secured using nylon strapping tape and chain of custody seals. Chain of custody seals shall be placed on each cooler used for sample transport. These seals shall consist of a tamper-proof adhesive material placed across the lid and body of the coolers in such a manner that if the cooler is opened, the seals will be broken. Chain of custody seals placed in this manner will ensure that no sample tampering occurs between the time of sample placement in the coolers to the time the coolers are opened for analysis at the laboratory. Cooler custody seals shall be signed and dated by the individual responsible for completing the chain of custody form contained within the cooler.

5.4.5 Receipt of Sample Forms: The contracted analytical laboratory shall document the receipt of analytical samples by accepting custody of the samples from the approved shipping company. In addition, the contracted laboratory shall document the condition of the shipping coolers and received samples upon receipt and shall immediately inform the USACE Buffalo District Project Manager and ARSEC's Project Manager if any sample containers are broken or

if any tampering occurred with the seals on the cooler(s). This documentation shall be accomplished by completing the cooler receipt checklist as provided in ARSEC's QAPP (ARSEC 2009).

A cooler receipt check list shall be placed either into each shipping container together with the completed chain of custody form, or provided to the laboratory at the start of the project. A copy of the completed check list shall be faxed to both the USACE Buffalo District Project Manager and the ARSEC Project Manager immediately after it has been completed at the laboratory. The original completed checklist shall be transmitted with the final analytical results from the laboratory.

5.5 Documentation Procedures

The tracking procedure to be utilized for documentation of all samples collected during the project will involve the following series of steps:

- Collect and place samples into laboratory sample containers;
- Complete sample container label information, as defined in **Section 5.4**;
- Complete sample documentation information in the field logbook, as defined in **Section 5.3**;
- Complete project and sampling information sections of the COC form(s), as defined in **Section 5.4**, and in the QAPP (ARSEC 2009);
- Complete the air bill for the cooler to be shipped;
- Perform a completeness and accuracy check of the COC form(s);
- Complete the sample relinquishment section of the COC form(s) and place the form(s) into cooler;
- Place COC seals on the exterior of the cooler;
- Package and ship the cooler to the laboratory;
- Receive cooler at the laboratory, inspect contents, and transmit via fax of contained COC form(s), and cooler receipt form(s); and
- Transmit original COC form(s) with final analytical results from laboratory.

5.6 Corrections to Documentation

Original information and data in field logbooks, on sample labels, on COC forms, and on any other project-related documentation will be recorded in black waterproof ink and in a completely legible manner. Errors made on any accountable document will be corrected by crossing out the error and entering the correct information or data. An error discovered on a document will be corrected by the individual responsible for the entry, as possible. Erroneous information or data will be corrected in a manner that will not obliterate the original entry, and corrections will be initialed and dated by the individual responsible for the entry.

5.7 Sample Packaging and Shipping

5.7.1 Sample Packaging: Sample containers shall be packaged in thermally insulated rigid-body coolers. Sample packaging and shipping shall be conducted in accordance with applicable DOT specifications. Packaging and shipping procedures for all samples collected during the project shall include:

- Contents of sample containers shall be identified with definitive labels placed onto each container.

- All bottles containing samples shall be tightly closed to prevent leakage.
- Each sample bottle shall be placed into a separate plastic bag, which will be sealed closed. As much air as possible shall be forced from the sample container bags before sealing.
- The sample containers shall be placed upright in the shipping coolers. Ice is not required for shipping most radiological solid samples, but must be used for shipping radiological groundwater samples and TCL/TAL samples. Before initial placement of samples into a rigid-body cooler, the cooler drain plug shall be taped shut both inside and outside the container, and the cooler shall be lined with a large plastic bag.
- Inert packing material shall be placed into the cooler, if required, to prevent shifting of the sample containers during transport.
- All required laboratory paperwork, including the COC form(s), will be placed inside a plastic bag and taped to the inside of the cooler lid. If a laboratory-provided courier is used, the paperwork may be attached to the outside of the cooler to facilitate exchange of sample custody.
- Upon completion of the packing process, the cooler lid shall be closed and two signed/dated custody seals shall be placed on the cooler, one across the front and one across the side of the cooler, such that opening the cooler will result in breaking the custody seals.
- Rigid-body coolers shall be sealed by applying strapping tape directly to the cooler body.
- The airbill for the shipment shall be completed and attached to the top of the cooler, which will then be transferred to the courier for delivery to the laboratory.

5.7.2 Requirements for Samples Classified as Radioactive Materials: Transportation of radioactive waste is regulated by the International Air Transportation Association (IATA) and by the Department of Transportation (DOT). Overnight shippers (e.g. Federal Express) typically ship by air and follow IATA regulations (IATA 2005), while overland transport is governed by regulations promulgated in 49 CFR Subpart I. Samples generated during project activities will be transported in accordance with procedures that ensure compliance with regulatory requirements. Historical data and processing information has demonstrated that no Town of Tonawanda FUSRAP material contains fissile material.

Radiological samples will be shipped in accordance with the following, or equivalent, specifications:

- Each bagged sample container will be placed in a cooler in upright position
- Each cooler shall have its drain plug taped shut, both inside and out
- Inert packaging material shall be placed in the cooler to prevent shifting during transport
- All required laboratory paperwork, including the COC form(s) shall be placed in a plastic bag and taped to the inside of the cooler lid. If a laboratory-provided courier is used, the paperwork may be attached to the outside of the cooler to facilitate exchange of the sample custody.
- Rigid-body coolers shall be sealed by applying strapping tape directly to the cooler body.
- Upon completion of the packing process, the cooler lid shall be closed and two signed/dated custody seals shall be placed on the cooler, one across the front and one across the side.

- The cooler shall be surveyed for radiation and contamination in accordance with HP-702 "Transfer of Radioactive Material" to ensure the package meets the requirements for limited quantity as found in 49 CFR.
- A notice must be placed on the outside of each cooler that includes the name of the cosigner and the statement "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910". The outside of the inner packaging or, if there is no inner packaging, the outside of the package itself, must be labeled "Radioactive" if fully applicable.
- The following label will be placed on the cooler(s):
  - Arrows indicating "This way up"
  - Appropriate hazard class label
  - "Cargo Aircraft Only", if applicable
- The airbill for the shipment shall be completed and attached to the top of each cooler, which will then be transferred to the courier for delivery to the laboratory. If required, dangerous goods airbills shall be used for the shipment.

5.7.3 Sample Shipping: All environmental samples collected during the project shall be shipped no later than 48 to 72 hours after time of collection. The latter time of 72 hours may be necessary if the samples are collected on a Friday and have to be shipped Monday via commercial courier. During the time between collection and shipment, all samples shall be stored in a secure area to maintain custody. All coolers containing environmental samples shall be shipped overnight to the laboratory by Federal Express, similar courier, or laboratory courier. Due to holding time limitations, the Contractor shall discourage shipping of samples on Fridays unless it is absolutely necessary and provided that the laboratory has assured that personnel will be present on Saturdays to receive and carry out any necessary processing within the holding time and temperatures when applicable.

5.8 Documentation Procedures/Data Management and Retention

Original copies of field data, field records, analytical data, training records, and other project-specific documentation will be retained in the ARSEC Knoxville Office.

5.9 Investigation-Derived Waste

Investigation-Derived Waste (IDW) will be generated as a result of the field activities for this project. When accumulated, the media must be managed appropriately to minimize the exposure to human health and the environment while adhering to applicable regulatory requirements. All IDW management will be under the direct oversight of our proposed Site Manager, Randy McCrone. Mr. McCrone will be assisted by ARSEC environmental technicians and laborers. Care will be exercised to ensure that the IDW does not cross contaminate the site and that all non-indigenous wastes will be containerized and proactively managed.

IDW includes all materials generated during the field activities at the Tonawanda Landfill that cannot be effectively reused, recycled, or decontaminated in the field. Two types of IDW will be generated during the implementation of field activities: indigenous and non-indigenous. The types of indigenous IDW expected to be generated include subsurface and surface soils. The types of non-indigenous IDW expected to be generated include decontamination fluid/water and miscellaneous trash including PPE. All IDW will be scanned with a PID for the presence of

VOCs. ARSEC will implement proactive protocols and procedures to ensure that incoming and outgoing equipment and tools are free from contamination. To the extent practical, ARSEC will use dry decontamination techniques to minimize liquid IDW. When generated, decontamination fluids will be collected and stored in DOT approved 55-gallon drums that will be sampled when full to determine the disposition pathway.

Consolidated wastes stored within the IDW containers will be sampled and the samples will be submitted to the off-site Laboratory for waste characterization analysis. The waste characterization analysis shall be based on the Waste Acceptance Criteria for the USACE accepted disposal facility. All wastes will be characterized and dispositioned in accordance with guidance from USACE. All IDW will be cataloged and tracked. All tracking will be documented in logbooks and those results reported in the Final Reports.

In the event that off-site disposal for any of the wastes is the selected alternative, all wastes shall be handled and transported by a Contractor licensed and/or permitted to transport waste both in the State of New York and all states through which the waste must travel to reach the approved disposal facility. Generated wastes shall be disposed only at facilities licensed and permitted to accept the material.

PPE and associated wastes that are non-contaminated shall be bagged and placed in a sanitary waste dumpster. The dumpster type and supplier shall be approved by the USACE prior to use. No free liquids or hazardous substances shall be place in the dumpster. Contaminated non-hazardous waste of this type shall disposed of off-site in accordance with all applicable EPA, DOT and State of New York regulations at a permitted landfill capable of accepting the waste.

6.0 LABORATORY ANALYSIS

ARS of Port Allen, Louisiana, an independent off-site laboratory, will provide radiochemical analysis. TestAmerica of Earth City, Missouri, also an independent off-site laboratory, will provide non-radiochemical analysis. ARS and TestAmerica are National Environmental Laboratory Accreditation Program (NELAP) accredited laboratories with prior FUSRAP and USACE experience and are fully capable of providing the analytical services required to meet the project DQOs. The TestAmerica laboratory has DoD ELAP accreditation for the non-radiochemistry analytical parameters associated with the project. The ARS laboratory will be audited for DoD ELAP accreditation the first week in October for the radiochemistry analytical parameters associated with the project. Samples will be transferred to ARS and TestAmerica for analyses in accordance with documented laboratory specific standard methods.

All soil and core samples, including field QA/QC samples, will be analyzed for the radiological parameters specified in Table 6-1. In addition, 10% of all soil and core samples will be analyzed for the non-radiological parameters specified in Table 6-1. Selection of soil and core samples for non-radiological analysis will be biased first towards those samples exhibiting the highest radioactivity levels and secondly towards those samples exhibiting the highest XRF uranium readings.

Table 6-1. Soil and Core Sample Analytical Requirements for the Tonawanda Landfill Project

Analytical Parameter	Test Method
Ra-226	EPA 901.1 (Gamma Spec)
Ra-228	EPA 901.1 (Gamma Spec)
Uranium-234, 235 & 238	EPA 901.1 (Gamma Spec) for Uranium-235, 238
Isotopic Thorium-228, 230 and 232	DOE EML HASL 300 Series for Thorium
Americium-241	EPA 901.1 (Gamma Spec)
Total VOCs	SW-846 8260
TCLP Volatile Organic Compounds (VOCs)	EPA SW-846 1311 (ZHE) followed by SW-846 8260
Total SVOCs	SW-846 8270
TCLP Semi-Volatile Organic Compounds (SVOCs)	EPA SW-846 1311 followed by SW-846 8270
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471
TCLP Metals	EPA SW-846 1311 Followed by SW-846 6010/6020/7471
Pesticides	EPA SW-846 8081
TCLP Pesticides	EPA SW-846 1311 followed by SW-846 8081
PCBs	EPA SW-846 8082

Temporary well point samples, including temporary well point QA/QC samples, will be analyzed as outlined in Table 6-2. Analysis shall be performed on both filtered and unfiltered temporary well point samples. It will be the responsibility of the laboratory performing the analysis to filter the temporary well point samples.

Table 6-2. Temporary Well Point Analytical Requirements for the Tonawanda Landfill

Parameter	Analytical Method	# of Samples	# of Field Duplicates	# of MS/MSD Samples	# of USACE QA Samples
Ra-226	EPA 903.1	14	1	-	1
Ra-228	EPA 904	14	1	-	1
Isotopic U (234, 235, 238)	HASL 300 - Alpha Spectroscopy – Eichrom Modification	14	1	-	1
Isotopic Th (228, 230, 232)	HASL 300 - Alpha Spectroscopy – Eichrom Modification	14	1	-	1
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471	14	1	1	1
Anions (Cl, F, NO_2/NO_3 o-PO_4, SO_4)	EPA SW-846 9056/EPA 300 Series	14	1	-	-
Total Dissolved Solids (Filtered Only)	EPA 160.1	14	1	-	-
Alkalinity (Carbonate/Bicarbonate)	EPA 310.2	14	1	-	-

Analysis of IDW samples will be based on the acceptance criteria of the anticipated disposal facilities. At a minimum, IDW solids will be analyzed for the parameters defined for soil analysis in Table 6-1. IDW liquids will be analyzed as outlined in Table 6-3.

Table 6-3. IDW Liquid Sample Analytical Requirements for the Tonawanda Landfill Project

Analytical Parameter	Test Method
Ra-226	EPA 903.1
Ra-228	EPA 904
Isotopic U (234, 235, 238)	HASL 300 - Alpha Spectroscopy – Eichrom Modification
Isotopic Th (228, 230, 232)	HASL 300 - Alpha Spectroscopy – Eichrom Modification
Total VOCs	SW-846 8260
Total SVOCs	SW-846 8270
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471
Pesticides	EPA SW-846 8081
PCBs	EPA SW-846 8082
Ignitability	EPA SW-846 1010A/1020A
Corrosivity	EPA SW-846 9040C
Reactivity	No required methods

7.0 REPORTING

Several reporting requirements exist for the project, including:

- Electronic Data Deliverable (EDD)
- Risk Assessment Database Deliverable
- Final Project Report

7.1 Electronic Data Deliverable (EDD)

Analytical laboratory results for the Tonawanda Landfill investigation shall be provided from the laboratory to the USACE District Chemist in Microsoft Excel (xls) or .cvs format and that of the defensible data package in Adobe (.pdf). The contractor shall review and confirm 100% data verification of the project data. The required content of each sample delivery group (SDG) is described in Attachment 4, Sections 2.1.2 and 2.1.3 of the SOW. See SOW Attachment 4: Analytical Laboratory Requirements, and Data Deliverables Section: 4.0 Analytical Requirements Tables for method detection limits and methodology.

The contents presented in the EDD (xls/cvs file) will contain those items necessary (DoD QSM – April 2009, Appendix E – SW-846 Reporting Requirements, reference applicable contents of Sections 4, 5, and 6) to conduct a data validation with a minimum of, but not limited to, those items listed in the SOW. The EDD file is subject to approval by USACE. ARSEC shall make the file content available to USACE prior to data generation for review.

7.2 Risk Assessment Data Deliverable

In addition to providing the EDD, the contractor shall generate a separate electronic data deliverable, database, for use by USACE for performing the project risk assessment. The database record contents shall include those of the above EDD and that of the below table. Final format will be approved by the USACE.

- The contractor shall review the EDD data base for completeness of the fields as shown below.
- The data base shall be delivered in Microsoft Access format.
- A separate file containing all the locations and X and Y coordinates shall be provided
- Quality results shall be removed to their own separate table in the data base.

Data must be present for each record in the following fields shown below.

Field	Comment
Location	
Date Collected	
Matrix	Review for consistency
Starting Depth	In feet bgs, use the “#.#” format (e.g., 0.5, 2.0, 4.5, etc.). Use “NA” if not applicable.
Ending Depth	In feet bgs, use the “#.#” format (e.g., 0.5, 2.0, 4.5, etc.). Use “NA” if not applicable.
Sample Code	N for Normal, FD for Field Duplicate, etc.
Analyte Category	RAD, VOC, etc. review for consistency
Parameter Name	Review for consistency
CAS Number	
Units	

Field	Comment
MDL	
Final Data Validator's Flag (in addition to the laboratory qualified/flag)	One field that contains final flag to be used for risk assessment (U indicates non-detect, R indicates rejected, etc)
Analytical Method Code	Review for consistency
Uncertainty	Rad only

7.3 Final Project Report

ARSEC shall prepare a Project Report that includes all results associated with the data collection and field investigation efforts tasked in this study, as well as the QA/QC procedures utilized to verify field investigative results.

ARSEC will ensure the Project Report identifies any additional data that must be collected, if any, to further delineate the boundaries of the vertical and horizontal extent of any soil contamination requiring excavation during future remedial activities. The Project Report shall include, but not be limited to, the following components:

- An executive summary containing the objective(s) and generalized interpretation;
- Purpose and scope of the investigation including data quality objectives;
- Dates and location of the investigation (i.e. figures, maps);
- Personnel and organization(s) involved;
- Amount and type of data collected;
- Quality (reliability) of data collected;
- Methods of investigation and equipment employed;
- Methods of analyses and interpretations;
- Figures/maps showing sampling locations and results;
- Tables/figures showing location and magnitude of radiological and chemical contamination;
- Form I laboratory analytical results;
- Summary and conclusions of field investigative results and data;
- Appendices, which shall include, but not be limited to, field data and notes (originals or usable/reproducible copies), finalized response to comments package, QC information, data summary tables, waste manifests, field logbooks, boring logs, and other relevant information related to the field investigative activities; and
- Airborne monitoring data and any dose data.

Five (5) hard copies and one (1) electronic copy of the draft Project Report shall be supplied in Microsoft Word, Excel, and Adobe Acrobat PDF formats to the Tonawanda Landfill Project Manager within thirty-one (31) calendar days after data acquisition. The draft project report will be reviewed by USACE personnel and comments will be supplied to the Contractor. The Contractor shall formally respond to these comments and revise the report accordingly within fifteen (15) calendar days from receipt of the comments. The Contractor shall send ten (10) hard copies and five (5) compact discs (in Adobe PDF and Microsoft Word format) of the final Project Report.

The draft Project Report will be submitted for USACE's review and comment and a comment resolution log developed and submitted to the District prior to the revision of the document and its resubmission to USACE. ARSEC is committed to fully support the overall requirements of the Task Order in the following areas:

- Correspondence and Progress Reporting
- Public Affairs,
- Submittals,
- Written Weekly Reports,
- Payment Requests,
- Accruals,
- Other Project Management activities, and
- American Recovery and Reinvestment Act of 2009 (ARRA) reporting and certifications.

8.0 REFERENCES

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DOE (Department of Energy) 1992. *Document No. 098386, Memorandum – Designation of Tonawanda Vicinity Properties.* United States Department of Energy. December.

EPA 2000b. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, EPA 402-R-97-016, Rev. 1, August 2000.

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USACE (United States Army Corps of Engineers) 2005. *Remedial Investigation Report Tonawanda Landfill Vicinity Property, Tonawanda, New York.* April.

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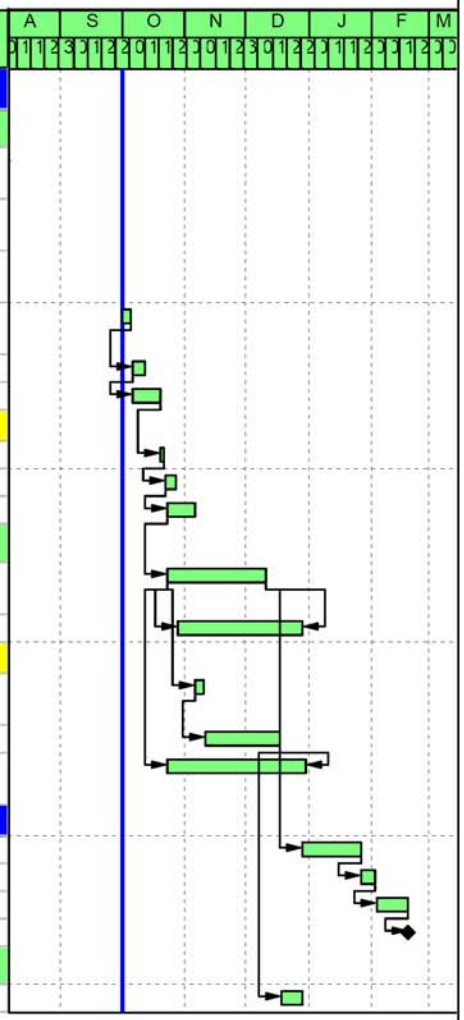
U.S. Department of Transportation; *Class 7 (Radioactive) Materials*; 49 CFR Subpart I; Current.

APPENDIX A

PROPOSED SCHEDULE FOR FIELD ACTIVITIES

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Predecessors	Successors
RI Addendum for Tonawanda Landf		137	03-Aug-09 A	18-Feb-10	6		
General		68	03-Aug-0	05-Nov-09	6		
10	Notice of Award	0	03-Aug-09 A				20, 30
20	Site Visit	2	06-Aug-09 A	07-Aug-09 A		10	70
30	Preparation of Submittals and Work Plans	27	03-Aug-09 A	09-Sep-09 A		10	40
40	Customer Review of Work Plans	18	10-Sep-09 A	05-Oct-09	6	30	50
50	ARSEC Revise and Resubmit WP's	5	06-Oct-09	12-Oct-09	6	40	60
60	CORP Review / Accept Final WP's	10	06-Oct-09	19-Oct-09	6	50	70
Mobilization		13	20-Oct-09	05-Nov-09	6		
70	Mobilization	2	20-Oct-09	21-Oct-09	6	60, 20	80
80	Clearing and Grubbing	4	22-Oct-09	27-Oct-09	6	70	90
90	Gamma Walkover Survey	10	23-Oct-09	05-Nov-09	6	80	100
Delineation Tasks		79	23-Oct-09	18-Feb-10	6		
100	Sampling of Surface and Subsurface Soil	33	23-Oct-09	10-Dec-09	6	90	120, 110, 140, 110, 150
110	Reporting Sampling Results	40	28-Oct-09	28-Dec-09	6	100, 100	
Optional Tasks		79	23-Oct-09	18-Feb-10	6		
120	Groundwater Sampling Temporary Wellpoints	3	06-Nov-09	10-Nov-09	11	100	130
130	Reporting Sampling Results	25	11-Nov-09	17-Dec-09	11	120	190, 140, 150
140	Characterization, Handling and Disposal of Investigative Derived Waste (IDW)	45	23-Oct-09	30-Dec-09	11	100, 130	
Final investigation and Project Report		36	29-Dec-09	18-Feb-10	6		
150	Preparation of Draft Final Report	20	29-Dec-09	26-Jan-10	6	130, 100	160
160	USACE Review of Draft Final Report	5	27-Jan-10	02-Feb-10	6	150	170
170	Preparation of Final Project Report	11	03-Feb-10	18-Feb-10	6	160	180
180	Submit Final Project Report	0		18-Feb-10	6	170	
Demobilization		5	18-Dec-09	28-Dec-09	42		
190	Demobilization from Site	5	18-Dec-09	28-Dec-09	42	130	



Remaining Level of Effort ◆ ◆ Milestone
Remaining Work
Critical Remaining Work

Page 1 of 1

ARSEC

APPENDIX B

FIGURE SHOWING PROPOSED SYSTEMATIC SAMPLING LOCATIONS

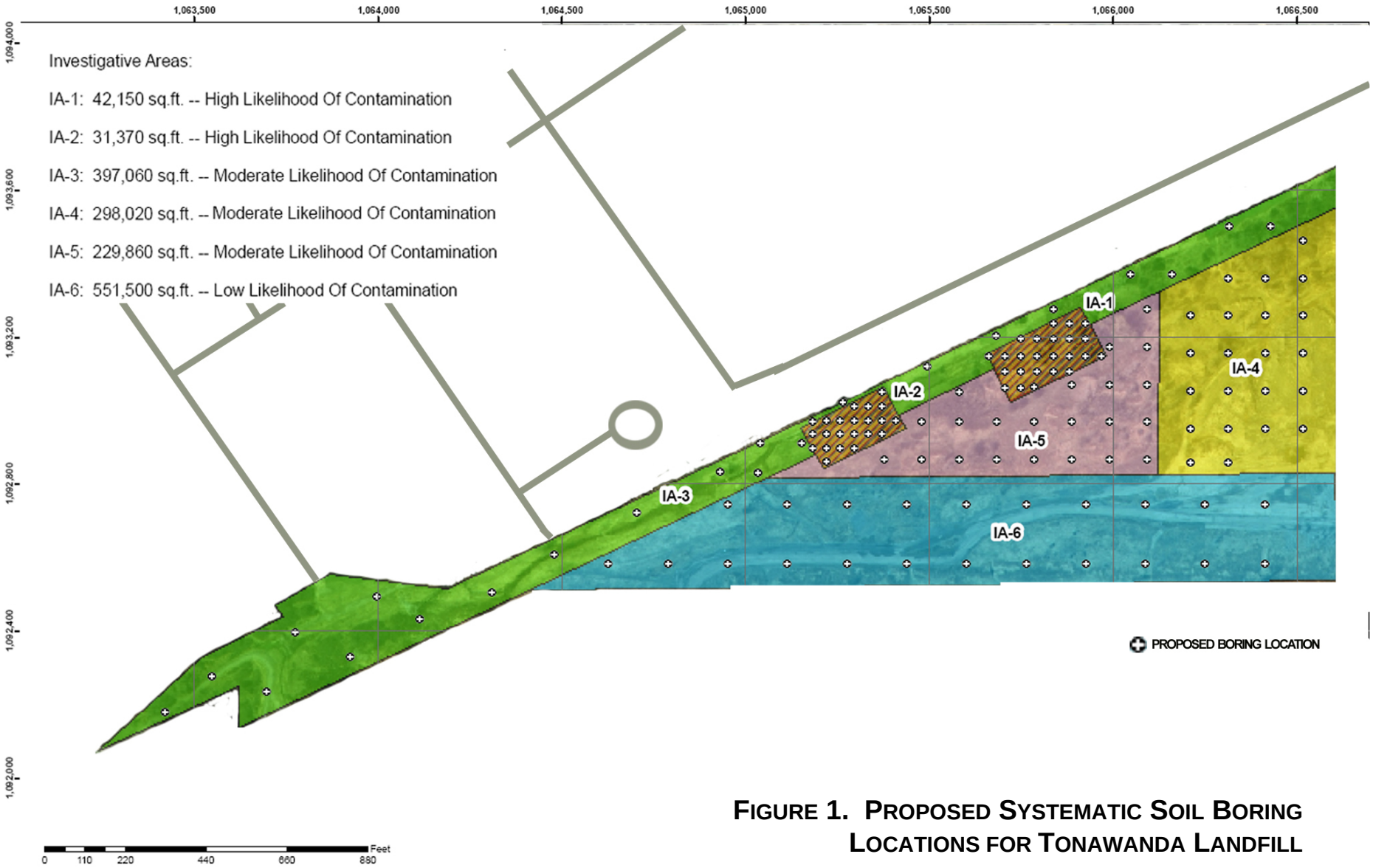


FIGURE 1. PROPOSED SYSTEMATIC SOIL BORING LOCATIONS FOR TONAWANDA LANDFILL

APPENDIX C

SCAN MINIMUM DETECTABLE CONCENTRATIONS (NaI)

C.0 SCAN MDC CALCULATIONS

C.1 INTRODUCTION

The purpose of this Appendix is to provide estimated gamma walkover scan sensitivities for the COCs. Site-specific scan sensitivity analyses (bench tests) will be performed in the field for 2-inch by 2-inch, 3-inch by 3-inch and FIDLER scintillation detectors. These results will be applied for the surveys to be performed.

C.2 ESTIMATION OF MINIMUM DETECTABLE CONCENTRATIONS (MDC)

ARSEC will utilize standard operating procedures that follow the methodology and approach documented in MARSSIM[1] for MDC calculations for the different detectors. Scan MDCs will be derived using MARSSIM/NUREG-1507 methods. Factors included in the analyses are the surveyor scan efficiency, index of sensitivity, the natural background of the surveyed area, scan rate, detector to source geometry, areal extent of the potential hot spot(s), and energy and yield of gamma emissions.

The computer code Microshield will be used to model the presence of normalized sources of the COCs and K-40 in soil with the assumption that the activity is uniformly distributed to a depth of 15 cm and spread over a disk shaped area with a diameter of 56 cm. This is consistent with the NUREG-1507 methodology and provides for a count rate to exposure ratio (CPM/µR/hr) to be calculated.

The tables provided herein are examples of estimated MDC values that are based upon the NUREG-1507 methodology. Additional details and discussion describing the NUREG analysis methodology are described in that publication. Factors for determining MDC are presented below.

C.3 FLUENCE RATE TO EXPOSURE RATE (FRER)

The fluence rate to exposure rate (FRER) may be approximated by: 1µR / hr

$$FRER \approx \frac{1\mu R/hr}{(E_y)(\mu_{en}/\rho)_{air}}$$

Where:

E_γ = energy of the gamma photon of concern, keV

(μ_{en}/ρ) = the mass energy absorption coefficient for air, cm^2/g

C.4 PROBABILITY OF INTERACTION (P) THROUGH DETECTOR END FOR A GIVEN ENERGY

The probability, P, of a gamma ray interaction in the NaI scintillation crystal entering through the end of the crystal is given by:

[1] Nuclear Regulatory Commission; *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*; NUREG-1575, Rev. 1; August 2000

$$\Pr obability(P) = 1 - e^{-(\mu/\rho)_{NaI}(X)(\rho_{NaI})}$$

Where:

$(\mu/\rho)_{NaI}$ = the mass attenuation coefficient for NaI, cm^2/g

X = the thickness through the end of the NaI crystal, cm

(ρ_{NaI}) = the density of the NaI crystal, $g/cm^{3)}$

C.5 RELATIVE DETECTOR RESPONSE (RDR)

The Relative Detector Response (RDR) as a function of energy is determined by multiplying the relative fluence rate to exposure rate (FRER) by the probability (P) of an interaction and is given by:

$$RDR = (FRER)(P)$$

C.6 DETERMINATION OF CPM PER µR/HR AS A FUNCTION OF ENERGY

The equivalent FRER, P, and finally RDR may be calculated for the NaI scintillation detector at the Cesium-137 (Cs-137) energy of 662 keV. Manufacturers of this equipment typically provide an instrument response in terms of CPM and µR/hr at the Cs-137 energy. This point allows one to determine the CPM per µR/hr and ultimately activity concentration and minimum detection sensitivity level in terms of pCi/g for a specific instrument.

Based on a manufacturer's NaI response specification and using the same methodology as shown above, the FRER, P, and RDR are calculated. The mass energy absorption coefficient for air and the mass attenuation coefficient for NaI are interpolated from tables in the Radiological Health Handbook[2], Revised Edition January 1970, pages 139, and 140.

FRER = 0.0514

$Energy_{\gamma}$, keV = 662

$(\mu_{en}/\rho)_{air}$, cm^2/g = 0.0294

$(\mu/\rho)_{NaI}$, cm^2/g = 0.0780

P = 0.89

therefore:

Cs-137 RDR (662 keV) = 0.0456

[2] Radiological Health Handbook, U.S. Department of HEW, 1970 Edition

The detector response (CPM) to energy is based upon the ratio of the RDR at a specific energy to the known CS-137 energy RDR:

$$CPM / \mu R / hr, E_i = \frac{(CPM / \mu R / hr_{Cs-137})(RDR_{E_i})}{(RDR_{Cs-137})}$$

C.7 MINIMUM DETECTABLE COUNT RATE

The minimum detectable count rate (MDCR) is calculated using the NUREG-1507 methodology where:

- There is a six inch layer of compacted brush/cattail cuttings on the ground surface with an estimated density of 0.4 g/cc,
- The detector scan rate is such that the detector is over the source for a time interval of one second at nine inches above the ground surface (six inches of compacted brush/cattails and a three inch air gap),
- The average number of background counts in a one second interval, b_i = CPM/60, and
- The detector generic count rate to exposure rate ratio value (XXXX CPM per µR/hr) and actual measured background gives:

$$Bi = (BKG\mu R/hr)(XXXX\ CPM/\mu R/hr)/(60) = XXX\ counts$$

The MDCR is therefore calculated as:

$$MDCR = (d')(b_i)^{0.5}(60\ sec/1\ min)$$

Where d' represents the rate of detections at 95% and a false positive rate of 60%, and b_i is the background counts

The MDCR for the surveyor is given as:

$$MDCR_{surveyor} = MDCR / (P)^{0.5}$$

Where P is the surveyor efficiency equal to 0.5 to 0.75 as given by NUREG-1507. A conservative value of 0.5 will be used for surveyor efficiency.

C.8 ESTIMATE OF SCAN MDC

The minimum detectable exposure rate is obtained from the $MDCR_{surveyor}$ divided by the weighted count rate to exposure rate value for a 1 pCi/g normalized concentration.

The scan MDC is then equal to the ratio of the Minimum Detectable Exposure Rate in the field to the exposure rate determined for the normalized 1 pCi/g concentration.

C.9 TABLES

Table C-1. Typical Detector Scan MDCs for Common Radiological Contaminants

Gamma Scan with a 2"x2" NaI detector for:	B (cpm)	ε_i (cpm /µR/h)	d'	s_i (counts)	MDCR (ncpm)	$MDCR_s$ (ncpm)	Scan MDC (µR/h)	CF (pCi/g / µR/h)	Scan MDC (pCi/g)
Ra-226[a]	6500	760	1.380	20	609	704	0.93	1.41	1.3
	10000	760	1.380	18	1069	1512	1.99	1.41	2.8
U-natural[b]	5000	3990	1.380	13	756	1069	0.27	211	57
	10000	3990	1.380	18	1069	1512	0.38	211	80
Th-232[a]	5000	830	1.380	13	756	1069	1.29	0.99	1.3
	10000	830	1.380	18	1069	1512	1.82	0.99	1.8

Gamma Scan with a 3"x3" NaI detector for:	B (cpm)	ε_i (cpm /µR/h)	d'	s_i (counts)	MDCR (ncpm)	$MDCR_s$ (ncpm)	Scan MDC (µR/h)	CF (pCi/g / µR/h)	Scan MDC (pCi/g)
Cs-137	5000	2300	1.380	13	756	1069	0.46	3.81	1.8
	10000	2300	1.380	18	1069	1512	0.66	3.81	2.5
Co-60	5000	1100	1.380	13	756	1069	0.97	0.97	0.9
	10000	1100	1.380	18	1069	1512	1.37	0.97	1.3

Gamma Scan with a FIDLER detector for:	B (cpm)	ε_i (cpm /µR/h)	d'	s_i (counts)	MDCR (ncpm)	$MDCR_s$ (ncpm)	Scan MDC (µR/h)	CF (pCi/g / µR/h)	Scan MDC (pCi/g)
Natural U	12500	44786	1.38	20	1195	1690	0.04	191	7.2
Natural Th	12500	3881	1.38	20	1195	1690	0.44	1.03	0.4

Notes:

B = background count rate (cpm)
cpm = counts per minute
i = scan time interval
p = surveyor efficiency (ranges from 0.5 to 0.75)
ε_i = instrument efficiency (from Table 6.4 of NUREG-1507)
d' = value selected from Table 6.1 of NUREG-1507
s_i = minimal number of net source counts
MDCR = minimum detectable count rate
$MDCR_s$ = surveyor MDCR
MDC = minimum detectable concentration
CF = conversion factor (Microshield/NUREG-1507)
ncpm = net counts per minute
pCi/g = pico-curies per gram
µR/h = micro- Roentgen per hour
[a]In Equilibrium with progeny
[b]Sum of U-234, 235 and 238
CF - Derived using Microshield software code and NUREG-1507 standard geometry.

APPENDIX D

SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME TABLES

D.0 SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

Table D-1. Soil Sample Container, Preservation and Holding Time Requirements

Analytical Parameter	Test Method	Bottle Type	Preserv.	Holding Time
Ra-226	EPA 901.1 (Gamma Spec)	500 mL WM HDPE	None	180 days
Ra-228	EPA 901.1 (Gamma Spec)	500 mL WM HDPE	None	180 days
Uranium-234, 235, and 238	EPA 901.1 (Gamma Spec) for Uranium-235, 238	500 mL WM HDPE	None	180 days
Isotopic Thorium-228, 230, and 232	DOE EML HASL 300 Series for Thorium	500 mL WM HDPE	None	180 days
Americium-241	EPA 901.1 (Gamma Spec)	500 mL WM HDPE	None	180 days
Total VOCs	SW-846 8260	125 ml WM clear glass	None,<6°C	14 days
TCLP Volatile Organic Compounds (VOCs)	EPA SW-846 1311 (ZHE) followed by SW-846 8260	101		
Total SVOCs	SW-846 8270	500 ml WM clear glass	None,<6°C	14 days to extraction, 40 days after extraction
TCLP Semi-Volatile Organic Compounds (SVOCs)	EPA SW-846 1311 followed by EPA SW-846 8270	101		
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471	250 mL WM HDPE	None,<6°C	180 days except mercury (mercury 28 days)
TCLP Metals	EPA SW-846 1311 followed by SW-846 6010/6020/7471	101		
Pesticides	EPA SW-846 8081	250 ml WM clear glass	None,<6°C	7 days to extraction, 40 days after extraction
TCLP Pesticides	EPA SW-846 1311 followed by SW-846 8081	101		
PCBs	EPA SW-846 8082	500 ml WM clear glass	None,<6°C	No holding time

Table D-2. Groundwater Sample Container, Preservation and Holding Time Requirements

Analytical Parameter	Test Method	Bottle Type	Preserv.	Holding Time
Isotopic Uranium (234,235,238)	HASL 300 – Alpha Spectroscopy – Eichrom Modification	1 L HDPE	HNO3 pH<2	180 days
Isotopic Thorium (228,230,232)	HASL 300 – Alpha Spectroscopy – Eichrom Modification	1 L HDPE	HNO3 pH<2	180 days
Radium 226	EPA 903.1	1 L HDPE	HNO3 pH<2	180 days
Radium 228	EPA 904	1 L HDPE	HNO3 pH<2	180 days
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471	125 mL HDPE	HNO3 pH<2	180 days except mercury (mercury 28 days)
Anions (Cl,F,NO_2, NO_3, o-PO_4, SO_4)	EPA SW-846 9056/EPA 300 Series	1 L HDPE	HNO3 pH<2	None for Fluoride, Nitrite, and ortho-phosphate; 28 days for Chloride; 48 hrs for Nitrate; 28 days for Sulfate
Total Dissolved Solids (Filtered Only)	EPA 160.1	500 mL HDPE	None,<6°C	None
Alkalinity (Carbonate/Bicarbonate)	EPA 310.2	500 mL HDPE	None,<6°C	None

Table D-3. IDW Liquid Sample Container, Preservation and Holding Time Requirements

Analytical Parameter	Test Method	Bottle Type	Preserv.	Holding Time
Ra-226	EPA 903.1	1 L HDPE	HNO3 pH<2	180 days
Ra-228	EPA 904	1 L HDPE	HNO3 pH<2	180 days
Isotopic U (234, 235, 238)	HASL 300 - Alpha Spectroscopy – Eichrom Modification	1 L HDPE	HNO3 pH<2	180 days
Isotopic Th (228, 230, 232)	HASL 300 - Alpha Spectroscopy – Eichrom Modification	1 L HDPE	HNO3 pH<2	180 days
Total VOCs	SW-846 8260	125 ml WM clear glass	None,<6°C	14 days
Total SVOCs	SW-846 8270	500 ml WM clear glass	None,<6°C	40 days
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471	125 mL HDPE	HNO3 pH<2	180 days except mercury (mercury 28 days)
Pesticides	EPA SW-846 8081	250 ml WM clear glass	None,<6°C	40 days
PCBs	EPA SW-846 8082	500 ml WM clear glass	None,<6°C	No holding time
Ignitability	EPA SW-846 1010A/1020A	500 ml WM clear glass	None,<6°C	No holding time
Corrosivity	EPA SW-846 9040C	500 ml WM clear glass	None,<6°C	No holding time
Reactivity	No required methods	500 ml WM clear glass	None,<6°C	No holding time

Requirements for IDW solid container, preservation, and holding time requirements are the same as those defined for soil analysis in Table D-1.

Volume II
Quality Assurance Project Plan

SAMPLING AND ANALYSIS PLAN

Volume II – Quality Assurance Project Plan for Phase 2 Remedial Investigation – Tonawanda Landfill Operable Unit

Revision 0

Buffalo District
Formerly Utilized Sites Remedial Action Program

Prepared by:
American Remediation Solutions and Environmental Corporation (ARSEC)
2609 North River Road
Port Allen, LA 70767

For:
U.S. Army Corps of Engineers – Buffalo District
Formerly Utilized Sties Remedial Action Program
Contract No. W912P4-07-D-0009, Delivery Order 0002

October 2009, Revision 0

Sampling and Analysis Plan

Volume II – Quality Assurance Project Plan for Phase 2 Remedial Investigation – Tonawanda Landfill Operable Unit

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October 2009, Revision 0

QUALITY ASSURANCE PROJECT PLAN (QAPP)
TONAWANDA LANDFILL OPERABLE UNIT, TONAWANDA, NEW YORK

Contract No. W912P4-07-D-0009, Delivery Order 003

QAPP APPROVALS

By their specific signature, the undersigned certify that they reviewed and provided comments on this QAPP for sampling and analysis at the Tonawanda Landfill Site, Tonawanda, NY.

APPROVED BY:

[redacted] 10/19/09
ARSEC – Project Manager Date
[redacted]

[redacted] 10/19/09
ARSEC – Quality Assurance Coordinator Date
[redacted]

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AEC	Atomic Energy Commission
Am-241	Americium-241
ARS	American Radiation Services, Inc.
ARSEC	American Remediation Solutions and Environmental Corporation
ASTM	American Society for Testing and Materials
CAR	Corrective Action Report
CF	Confidence Factor
CFR	Code of Federal Regulations
COC	Chain of Custody
COR	Contracting Officer's Representative
CQCP	Contractor Quality Control Plan
CQCSM	Contractor Quality Control System Manager
CR	Chemical Recovery
CSU	Combined Standard Uncertainty
CU	Counting Uncertainty
CV	Coefficient of Variation
DER	Normalized Absolute Difference Statistic
DF	Decay Correction Factor
D.O.	Delivery Order
DoD QSM	Department of Defense Quality Systems Manual
DOE	U.S. Department of Energy
DOT	Department of Transportation
dpm	disintegrations per minute
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
eV	electron Volt
FSP	Field Sampling Plan
ft	foot (or feet)
FUSRAP	Formerly Utilized Sites Remedial Action Program
HP	Health Physicist
HSRPP	Health, Safety, and Radiation Protection Plan
IDW	Investigation Derived Waste
ITR	Independent Technical Review
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LQAP	Laboratory Quality Assurance Plan
LQAO	Laboratory QA Officer
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
µCi/ml	microCuries per milliliter
mrem	millirem
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NCR	Nonconformance Report

NELAP	National Environmental Laboratory Accreditation Program
NRC	U.S. Nuclear Regulatory Commission
PCB	Polychlorinated Biphenyl
pCi	picoCuries
PDF	Adobe® Acrobat Portable Document Format
PM	Project Manager
POC	Point of Contact
PQCR	Project Quality Control Representative
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QM	Quality Manager
QSM	Quality Systems Manual
Ra-226	Radium-226
RCA	Radiological Control Area
RE	Relative Error
RDL	Reporting Limit
RPD	Relative Percent Difference
RPP	Radiation Protection Plan
RSD	Relative Standard Deviation
RSP	Radiation Safety Program
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SEC	Safety and Ecology Corporation
SM	Site Manager
SOW	Scope of Work
SSHO	Site Safety and Health Officer
SVOC	Semi-Volatile Organic Compound
TA	TestAmerica
TAL	Target Analyte List
TAT	Turnaround Time
TBD	To Be Determined
TCLP	Toxicity Characteristic Leaching Procedure
Th-228	Thorium-228
Th-230	Thorium-230
Th-232	Thorium-232
TWP	Temporary Well Point
U-234	Uranium 234
U-235	Uranium-235
U-238	Uranium-238
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound
Y	Yield
YU	Yield Uncertainty
ZHE	Zero Headspace Extraction

1.0 INTRODUCTION

1.1 Overview

American Remediation Solutions and Environmental Corporation (ARSEC) has been contracted by the United States (U.S.) Army Corps of Engineers (USACE) – Buffalo District under Contract Number **W912P4-07-D-0009, Delivery Order (D.O.) 0003** (hereafter referred to as the "contract"), to perform Phase 2 Remedial Investigation activities at the Tonawanda Landfill Operable Unit (hereafter referred to as the "Site") located in Tonawanda, New York. This Remedial Investigation is being completed under the USACE's Formerly Utilized Sites Remedial Action Program (FUSRAP), which was established to identify, investigate, and clean up or control sites previously used by the Atomic Energy Commission (AEC). Historical data has indicated that the site has concerns related to radioactive contamination from past Manhattan Engineer District/Atomic Energy Commission (MED/AEC) activities. Identified contaminants of concern include uranium-238 (U-238), thorium-230 (Th-230) and radium-226 (Ra-226). In addition, other hazardous substances, pollutants or contamination resulting both from MED/AEC activities and non MED/AEC activities that have been comingled with MED/AEC waste must be investigated.

The primary objective of this remedial investigation effort is to better delineate the extent of radiological contamination and to update the radiological fate and transport assessment.

This *Quality Assurance Project Plan* (QAPP, or Plan), which is Volume II of the *Sampling and Analysis Plan* (SAP), establishes an overall project quality assurance (QA) plan for measurement and analytical operations on this project. The *Field Sampling Plan* (FSP) (ARSEC, 2009), Volume I of the SAP, addresses field activities, including all aspects of sampling and any field data gathering activities. Together, the FSP and QAPP provide the background, site description, study objectives, technical approaches, and QA/quality control (QC) procedures for project measurement and analytical requirements for pre-remediation sampling operations on this project. This document follows the recommended format for QAPPs described in USACE Engineering Manual EM-200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001).

This QAPP identifies data quality objectives (DQOs), laboratory analysis methodologies and requirements, specific QA/QC activities, and data assessment activities designed to achieve the data quality goals of the project. This QAPP also presents the project organization, objectives, procedures, functional activities, and specific QA/QC activities associated with the radiological surveying, sampling and analysis activities to be performed at the site. The collection, screening, and management of samples and other field data gathering activities for this project are described in the project FSP (ARSEC, 2009).

1.2 Purpose and Scope

The purpose of this QAPP is to describe the standards for laboratory analysis activities in support of remedial investigation activities. These standards include the DQOs, work to be performed to fulfill the objectives, and methods used to obtain defensible, interpretable data.

This document provides appropriate QA procedures and QC measures to be applied for analysis of remedial investigation samples from the Tonawanda Landfill Operable Unit FUSRAP Site and to describe the following items:

- The organization and responsibilities of key individuals on ARSEC's project team and the ARS laboratory;
- QA objectives;
- Analytical laboratory procedures;
- Laboratory custody procedures;
- Equipment Calibration and maintenance
- Data reduction, validation, and reporting;
- Internal QC checks;
- QA performance and system audits;
- Preventive maintenance procedures and schedules;
- Data assessment and presentation;
- Nonconformance and Corrective actions

The organization for the projects is designed to provide clear lines of responsibility and authority. This control structure provides for the following:

- Identifying lines of communication and coordination;
- Monitoring project schedules and performance;
- Managing key technical resources;
- Providing periodic progress reports;
- Coordinating support functions such as laboratory analysis and data management; and Rectifying deficiencies.

American Radiation Services, Inc. (dba ARS International), the majority member of ARSEC, will provide the offsite radioanalytical services for this Task Order. TestAmerica Laboratories (TA) will provide the standard chemistry services. Both laboratories participate in the DOD Environmental Laboratory Approval Program (DOD ELAP) and are accredited by the National Environmental Laboratory Accreditation Program (NELAP). Laboratory personnel providing services in support of this project will perform work in strict compliance with the scope of work (SOW) for the activity. Laboratory QA personnel (independent of the project QA personnel) will have the authority to review, audit, document compliance, identify deficiencies, and recommend corrective actions and will have sufficient authority, organizational freedom, and ability to:

- Identify QA problems;
- Stop Work if necessary;
- Initiate, recommend, or provide solutions to QA problems through designated channels;

- Ensure that program activities, including processing of information, deliverables, and installation or use of equipment, are reviewed in accordance with QA objectives;
- Ensure that deficiencies and non-conformances are corrected; and
- Ensure that further processing, delivery, or use of data is controlled until the proper disposition of a non-conformance, deficiency, or unsatisfactory condition.

2.0 ORGANIZATION AND RESPONSIBILITIES - OFF-SITE LABORATORIES

American Radiation Services, Inc. (ARS) of Port Allen, Louisiana is responsible for performing laboratory analyses of environmental samples for radiological parameters on this project. ARS will subcontract the standard chemistry analyses to TestAmerica Laboratories (TA) of Earth City, Missouri. Both laboratories participate in the DOD Environmental Laboratory Accreditation Program (DOD ELAP) and are accredited by the National Environmental Laboratory Accreditation Program (NELAP).

The functional roles for ARS and for ARS oversight of the subcontracted analyses are described in this subsection. From the project perspective, the structure is designed to facilitate information exchange between the ARS laboratory, USACE and ARSEC project team members. Information exchanges include planning, technical requirements, schedules, sample identification; preservation procedures; sample container requirements; sample collection procedures; decontamination protocols; and sample labeling, packing, holding times, and shipping.

2.1 Technical Manager

The ARS Vice President of Laboratory Services, Virgene Ideker-Mulligan (phone: 225-381-2991), will be the Technical Manager and the Data Management Coordinator. She will ensure that project needs are identified to ARS laboratory personnel and to the TA laboratory. She will ensure that the laboratories understand and conform with elements of this QAPP as they relate to their activities. She will provide direction/support for administrative and technical project staff, interface with laboratories on technical issues and overall QA oversight for analytical data.

2.2 Laboratory Project Manager

The ARS laboratory Project Manager (PM), Shonda Joshua (phone: 225-381-2991), will schedule project analytical requirements, monitor analytical status/deadlines, approve laboratory reports, and coordinate data revisions/corrections and re-submittal of packages to project staff. She will be the primary point of contact (POC) for ARSEC project personnel.

2.3 Laboratory QA Coordinator

The ARS laboratory QA Officer (LQAO), Tony Byrd (phone: 225-381-2991), reports to the Vice President for Laboratory Services and is independent of daily operation and production requirements. Therefore, the LQAO is able to evaluate data objectively and perform assessments without production influence. The LQAO has authority to stop work if systems are sufficiently out of control to compromise the integrity of the data generated.

The LQAO has documented training and/or experience in QA/QC procedures; knowledge of quality systems as defined by the DOD Quality Systems Manual (QSM); and a general knowledge of the analytical test methods for which data review is performed.

The LQAO (and/or designee) is responsible for:

- Defining and implementing the quality system;

- Developing and maintaining a pro-active program for prevention and detection of improper, unethical, or illegal practices (e.g., single- or double-blind proficiency testing studies, electronic data audits, maintaining documents that identify appropriate and inappropriate laboratory and data manipulation practices);
- Ensuring continuous improvement of laboratory procedures via training, control charts, proficiency testing studies, internal audits, and external audits;
- Coordinating the laboratory's participation in state and Federal certification programs;
- Scheduling the review and distribution and maintaining distribution records of controlled documents, including standard operating procedures;
- Reviewing Requests For Proposal to ensure compliance with required QA/QC practices;
- Facilitating external audits;
- Overseeing or conducting internal audits of the entire operation annually (technical, system, data, electronic);
- Coordinating and preparing external and internal audit responses and corrective actions;
- Managing the laboratory's participation in proficiency testing studies;
- Reviewing non-conformances and approving corrective actions;
- Reviewing and updating control chart QC limits per established procedures;
- Ensuring that Method Detection Limit (MDL) studies are analyzed per requirements;
- Managing the reference standards used in the calibration and/or verification of support equipment (e.g., weights, thermometers, balances);
- Revising the LQAP annually in accordance with industry standards;
- Maintaining an archival system for data records;
- Maintaining technical and QA training records including employee demonstrations of capability; and
- Ensuring subcontract laboratories conform to all contractual and quality requirements.

2.4 Information Systems Manager

The laboratory Information Systems Manager reports to the Chief Administrative Officer (CAO) and supports the Laboratory Information Management System (LIMS) and network, which serves the needs of the technical, business and management functions of the laboratory.

2.5 Laboratory Analysts

ARS Laboratory Analysts have the following QA/QC responsibilities:

- Maintaining familiarity with, and conforming to, the procedures and policies contained in the LQAP;
- Conducting routine maintenance, standardization, and calibration of instruments and other analytical equipment;

- Reviewing analytical results with the Laboratory PM; and
- Reporting irregular results or practices to the Laboratory PM.

2.6 Sample Custodians

ARS laboratory Sample Custodians will receive samples from the field, sign and date Chain-of-Custody forms, record the date and time of sample receipt, perform a radioactive survey on the shipping and sample containers, and record the condition of both shipping containers and sample containers.

Sample Custodians will verify and record agreement with information on sample documents. The Sample Custodian will record the problems/inconsistencies for the samples, complete a "Discrepant Sample Receipt Report" form and submit the form to Laboratory PM to resolve the discrepancy. The Sample Custodian will also label samples with laboratory sample numbers, and place samples and spent samples into appropriate storage and/or secure areas in accordance with laboratory standard operating procedures.

2.7 Subcontracted Laboratory Services

The TestAmerica laboratory, which the ARS laboratory employs for providing chemical analyses for this project, will maintain its own internal quality assurance system. The TestAmerica Quality Assurance Program must meet the standards defined in the DOD QSM and the ARS Laboratory Quality Assurance Program and shall have been audited by the DOD ELAP. ARS will maintain records of the subcontracted laboratory's quality assurance system and ARS shall be responsible to the USACE for TestAmerica's work.

3.0 DATA QUALITY OBJECTIVES

The overall QA objective for laboratory analysis on this project is to provide legally defensive results by implementing procedures for Chain-of-Custody, analysis and reporting of physical/chemical and radiological data. Specific procedures for Chain-of-Custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of equipment and corrective action are described in other sections of this QAPP. DQOs for analysis of Site remedial investigation samples are presented below.

3.1 Requirements for Data Quality Objectives

DQOs are designed to address the data requirements of a project and should include the following elements:

Data Need Requirements:

- Data user perspective (i.e., risk, compliance, remedy, or responsibility) satisfied;
- Contaminant or characteristic of interest identified;
- Media of interest identified;
- Reference concentration of interest or other performance criteria (e.g., action level, compliance standard, decision level, design tolerance) identified.
- Analytical method (e.g., sample preparation, laboratory analysis, MDL and quantification limit, laboratory QA/QC) identified.

Appropriate Analysis Methods:

DQOs are qualitative and quantitative statements that specify the quality of data required to support decisions during pre-remediation activities. Overall, the objective is to assure that the analytical data meets qualitative standards for adequacy (i.e., how "good" is the data) and produces quantitative values to document/confirm compliance of the data with respect to reference standards or values. This requires that data meet certain basic characteristics of satisfactory usability (e.g., precision, accuracy, representativeness, completeness, comparability, and sensitivity of data) as well as be able to meet or exceed certain numerical standards or values such that the end user(s) can reasonably rely on the data.

The characteristics of precision, accuracy, representativeness, completeness and comparability (PARCC) are discussed in Sections 3.2 through 3.6, respectively. Details on how each of these characteristic requirements are calculated and implemented as part of the QA process are described in Section 7.0.

3.2 Precision

3.2.1 Definition

Precision is a measure of the degree to which two or more measurements are in agreement.

3.2.2 Laboratory Precision Objectives

Precision in the laboratory is assessed through the calculation of relative percent differences (RPDs) and relative standard deviations (RSDs) for two or more replicate samples. Precision can be expressed as standard deviation. The control limits will be at least as stringent as the Department of Defense Quality Systems Manual (DoD QSM).

3.3 Accuracy

3.3.1 Definition

Accuracy is the degree of agreement between observed and accepted reference values.

3.3.2 Laboratory Accuracy Objectives

Laboratory accuracy is assessed through the analysis of laboratory control samples (LCSs) and the determination of percent (%) recoveries. The equation to be used for accuracy in this project can be found in Section 7.0 of this QAPP. Accuracy control limits are given in the laboratory standard operating procedures. The control limits will be at least as stringent as the DoD QSM.

3.4 Completeness

3.4.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that would be expected under normal conditions.

3.4.2 Laboratory Completeness Objectives

Laboratory completeness is an indication of the amount of valid measurements made on a project. Laboratory completeness for this project will be greater than 90%.

3.5 Representativeness

3.5.1 Definition

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

3.5.2 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing laboratory duplicated samples. The sampling network is designed to provide data representative of facility conditions.

3.6 Comparability

3.6.1 Definition

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is also dependent on similar QA objectives. USACE has indicated collection and laboratory analysis of duplicate/replicate samples are required for this project.

3.6.2 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar analytical methods are used and documented as defined by the QAPP. Comparability is also dependent on similar QA objectives.

3.7 Analytical Data Quality Objectives

Laboratory analysis of soil, groundwater and Investigation Derived Waste (IDW) samples will provide data with which decisions can be made and the success of project operations can be assessed in support of remedial investigation. Laboratory analyses will be conducted for samples of the media identified below for the purposes stated.

3.7.1 Soil Samples

Perform chemical and radiological analysis to determine extent of contamination.

3.7.1.1 Radiological Parameters for Soil and IDW Characterization samples

- Radiological Analysis will be performed on 132 Soil Borings (a total of 910 samples) from 6 Investigative Areas, the fence line and the ditch. **Table 3-1** defines the analytical parameters, test methods and the number of analyses for the radiological testing on the solid matrices.

Table 3-1. Radioanalytical Parameters for Solid Samples for the Tonawanda Landfill Operable Unit

Analytical Parameter	Test Method	Field Samples[a]	Field Duplicate Samples	Number MS/MSDs	Total Analyses[b]	Bottle Type[c]	Preservative
Ra-226	EPA 901.1 (Gamma Spectroscopy)	910	46	N/A	956	500 mL Wide Mouth	None
Ra-228	EPA 901.1 (Gamma Spectroscopy)	910	46	N/A	956		
Americium 241	EPA 901.1 (Gamma Spectroscopy)	910	46	N/A	956		
Uranium 235,238	EPA 901.1 EPA 901.1 (Gamma Spectroscopy)	910	46	N/A	956		
Isotopic Thorium (Th-228, Th-230, Th-232)	DOE EML-HASL 300 Th -01-RC - Eichrom mod	910	46	N/A	956		

Table 3-1. (Continued)

[a]Sample numbers are based on information provided in the SOW by USACE
[b]Estimates may be adjusted as additional data become available
[c]Solid Radiological Samples can all be collected in one bottle.

- Laboratory analytical batches will be no greater than 20 samples per batch. Laboratory Quality Control samples will be used based upon the SOW requirements, the test method and guidelines established in Multi-Agency Radiological Laboratory Analytical Protocol (MARLAP) Chapter 18 and the DOD QSM.
- Quality Control Samples for the Gamma Spectroscopy analysis are run with each batch of samples. The control samples consist of a blank, a source and a source duplicate analysis. The source consists of a prepared geometry containing Am-241 at 59.5 keV, Cs-137 at 661.7 keV, and Co-60 at 1332.5 keV.
- **Table 3-2** delineates the Quality Control Samples and the Acceptance Criteria that will be used by ARS for the isotopic thorium analysis of these samples. The purpose of each Quality Control Sample is defined below.
  - Reagent Blank: A reagent blank consists of the reagents used in the procedure without the target analyte or sample matrix and carried through all steps of the procedure to determine whether any radiological contamination is introduced through the reagents.
  - Laboratory Replicate: A laboratory replicate is two or more aliquots of the sample taken after homogenization. The results of the laboratory replicates are used to determine laboratory precision. Since isotopic tracers and chemical carriers are used for the analyses required, Laboratory Replicates will be used in place of the Matrix Spike/Matrix Spike Duplicate (MS/MSD) as defined in MARLAP 18.4.3 and the DOD QSM Section D.4.
  - Laboratory Control sample: The LCS is a clean matrix that is spiked with the target analyte. It is analyzed in the same manner as the samples. The LCS provides for an evaluation of the measurement uncertainty.
  - Tracers:
    - For isotopic analysis of Thorium, a radioactive tracer will be used to determine the yield. The Thorium tracer is Thorium-229.
    - A low yield is an indication of problems with the procedure, including matrix interference, incomplete chemical separation or missing a step in the procedure. Variability in temperature, concentration and time can also affect yields.

Table 3-2. Radiochemistry Quality Control Samples and Acceptance Criteria

QC Sample	Frequency	Acceptance Criteria
Reagent Blank	1 per batch	< MDA
Laboratory Replicate	1 per batch	% Difference < 10%
Laboratory Control Sample	1 per batch	75% - 125% of known
Isotopic Tracer	Every Isotopic sample	30% - 110% of known

- Minimum Detectable Activities (MDA) limits for the radiological constituents have been defined in the SOW and are shown in **Table 3-3**.

Table 3-3. Minimum Detectable Activities for Soil

Radiological Parameter	MDA (pCi/g)
Radium 226	0.5
Radium 228	0.5
Americium 241	0.5
Uranium 235,238	0.5
Isotopic Thorium	0.5

3.7.1.2 Chemical Parameters for Soil Samples

- 10% of the soil samples, including the associated field QC samples, shall be analyzed for the chemical parameters defined in **Table 3-4**.

Table 3-4. Chemical Parameters for Solid Samples for the Tonawanda Landfill Operable Unit

Analytical Parameter	Test Method	Field Samples	Field Duplicate Samples	Field Blank Samples	Number MS/MSD Samples	Total Analyses	Bottle Type	Preserv.
Total VOCs	SW-846 8260	91	5	5	5	106	125 ml WM clear glass	None,<6 °C
TCLP Volatile Organic Compounds (VOCs)	EPA SW-846 1311 (ZHE) followed by SW-846 8260	91	5	N/A	5	101		
Total SVOCs	SW-846 8270	91	5	5	5	106	500 ml WM clear glass	None,<6 °C
TCLP Semi-Volatile Organic Compounds (SVOCs)	EPA SW-846 1311 followed by EPA SW-846 8270	91	5	N/A	5	101		
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471	91	5	5	5	106	250 mL WM HDPE	None,<6 °C
TCLP Metals	EPA SW-846 1311 followed by SW-846 6010/6020/7471	91	5	N/A	5	101		
Pesticides	EPA SW-846 8081	91	5	5	5	106	250 ml WM clear glass	None,<6 °C
TCLP Pesticides	EPA SW-846 1311 followed by SW-846 8081	91	5	N/A	5	101		
PCBs	EPA SW-846 8082	91	5	5	5	106	500 ml WM clear glass	None,<6 °C

- The DOD QSM Version 4.1 Appendix G delineates the Quality Control Samples and the Acceptance Criteria that will be used by ARS for the analysis.
- Field Quality Assurance samples for the non-radiological analyses include Field Duplicates and Field Blanks taken at a frequency of one (1) per every 20 samples at an Investigative Area or one (1) per Investigative area if fewer than 20 samples are taken. The field duplicates and field blanks will be analyzed for all parameters. Field duplicates indicate the precision of

the sampling and the heterogeneity of the sample. Field blanks are analyzed to determine if cross contamination occurred during the sampling process.

- Holding Times for Chemical Parameters are defined in **Table 3-5** below:

Table 3-5. Chemical Parameter Holding Times

Chemical Parameter	Holding Time
VOC	14 days
SVOC	14 days to extraction 40 days after extraction
Metals (except Mercury)	180 days
Mercury	28 days
Pesticides	7 days to extraction 40 days after extraction
PCBs	No Holding Time

- Instrument Detection Limits (IDLs) and Practical Quantitation Limits (PQLs) for the specified analyses are delineated in **Table 3-6 to Table 3-10** below.

Table 3-6. Metals Instrument Detection Limits (IDLs) for Soil/Sed/Solid and IDW

Method	Analyte	CAS Number	IDL (µg/kg)
SW-846 6010/6020/7471	Aluminum	7429-90-5	3000
	Antimony	7440-36-0	400
	Arsenic	7440-38-2	1000
	Barium	7440-39-3	400
	Beryllium	7440-41-7	100
	Boron	7440-42-8	3000
	Cadmium	7440-43-9	200
	Calcium	7440-70-2	20000
	Chromium	7440-47-3	600
	Cobalt	7440-48-4	200
	Copper	7440-50-8	200
	Iron	7439-89-6	5000
	Lead	7439-92-1	400
	Lithium	7439-93-2	2000
	Magnesium	7439-95-4	3000
	Manganese	7439-96-5	3000
	Mercury	7439-97-6	0.99
	Nickel	7440-02-0	100
	Potassium	7440-09-7	16000
	Selenium	7782-49-2	500
	Silver	7440-22-4	40
	Sodium	7440-23-5	16000
	Thallium	7440-28-0	40
	Vanadium	7440-62-2	400
	Zinc	7440-66-6	400

Table 3-7. Volatile Organic Analysis Practical Quantitation Limits (PQLs) in Soil/Sed/Solid and IDW

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8260C	1,1,1,2-Tetrachloroethane	630-20-6	1
	1,1,1-Trichloroethane	71-55-6	1
	1,1,2,2-Tetrachloroethane	79-34-5	1
	1,1,2-Trichloroethane	79-00-5	1
	1,1-Dichloroethane	75-34-3	1
	1,1-Dichloroethylene	75-34-4	1
	1,1-Dichloropropene	563-58-6	1
	1,2,3-Trichlorobenzene	87-61-6	1
	1,2,3-Trichloropropane	96-18-4	1
	1,2,4-Trichlorobenzene	120-82-1	1
	1,2,4-Trimethylbenzene	95-63-6	1
	1,2-Dibromo-3-chloropropane	96-12-8	1
	1,2-Dibromoethane	106-93-4	1
	1,2-Dichlorobenzene	95-50-1	1
	1,2 Dichloroethane	107-06-2	1
	1,2-Dichloroethylene (total)	540-59-0	1
	1,2-Dichloropropane	78-87-5	1
	1,3,5-Trimethylbenzene	108-67-8	1
	1,3-Dichlorobenzene	541-73-1	1
	1,3-Dichloropropane	142-28-9	1
	1,4-Dichlorobenzene	106-46-7	1
	1,4-Dioxane	123-91-1	50
	2,2-Dichloropropane	594-20-7	1
	2-Butanone	78-93-3	5
	2-Chloro-1,3-butadiene	126-99-8	1
	2-Chloroethylvinyl ether	110-75-8	5
	2-Chlorotoluene	95-49-8	1
	2-Hexanone	591-78-6	5
	2-Methylpentane	107-83-5	1
	2-Nitropropane	79-46-9	5
	4-Chlorotoluene	106-43-4	1
	4-Isopropyltoluene	99-87-6	1
	4-Methyl-2-pentanone	108-10-1	5
	Acetone	67-64-1	5
	Acetonitrile	75-05-8	25
	Acrolein	107-02-8	10
	Acrylonitrile	107-13-1	5
	Allyl Chloride	107-05-1	5
	Benzene	71-43-2	1
	Benzyl chloride	100-44-7	5
	Bromobenzene	108-86-1	1
	Bromochloromethane	74-97-5	1
	Bromodichloromethane	75-27-4	1
	Bromoform	75-25-2	1
	Bromomethane	74-83-9	1
	Carbon disulfide	75-15-0	5
	Carbon tetrachloride	56-23-5	1
	Chlorobenzene	108-90-7	1
	Chloroethane	75-00-3	1
	Chloroform	67-66-3	1
	Chloromethane	74-87-3	1
	Cyclohexane	110-82-7	2

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8260C	Cyclohexanone	108-94-1	50
	Dibromochloromethane	124-48-1	1
	Dibromomethane	74-95-3	1
	Dichlorodifluoromethane	75-71-8	1
	Ethyl acetate	141-78-6	10
	Ethyl ether	60-29-7	1
	Ethyl methacrylate	97-63-2	5
	Ethylbenzene	100-41-4	1
	Hexachlorobutadiene	87-68-3	1
	Hexane	110-54-3	10
	Iodomethane	74-88-4	5
	Isobutyl alcohol	78-83-1	50
	Isopropylbenzene	98-82-8	1
	Methacrylonitrile	126-98-7	5
	Methyl acetate	79-20-9	10
	Methyl methacrylate	80-62-6	5
	Methylcyclohexane	108-87-2	2
	Methylene chloride	75-09-2	5
	Napthalene	91-20-3	1
	Pentachloroethane	76-01-7	5
	Propionitrile	107-12-0	5
	Styrenne	100-42-5	1
	Tetrachloroethylene	127-18-4	1
	Tetrahydrofuran	109-99-9	5
	Toluene	108-88-3	1
	Trichloroethylene	79-01-6	1
	Trichlorofluoromethane	75-69-4	1
	Trichlorotrifluoroethane	76-13-1	5
	Vinyl acetate	108-05-4	5
	Vinyl chloride	75-01-4	1
	Xylenes (total)	1330-20-7	1
	Bis(2-Chloroisopropyl) ether	108-60-1	5
	Cis-1,2-Dichloroethylene	156-59-2	1
	Cis-1,3-Dichloropropylene	10061-01-5	1
	Cis-1,4-Dichloro-2-butene	1476-11-5	5
	M,p-Xylenes	179601-23-1	2
	n-Butyl alcohol	71-36-3	50
	n-Butylbenzene	104-51-8	1
	n-Propylbenzene	103-65-1	1
	o-Xylene	95-47-6	1
	sec-Butylbenzene	135-98-8	1
	tert-Butyl methyl ether	1634-04-4	1
	tert-Butylbenzene	98-06-6	1
	trans-1,2-Dichloroethylene	156-60-5	1
	trans-1,3-Dichloropropylene	10061-02-6	1
	trans-1,4-Dichloro-2-butene	110-57-6	5

Table 3-8. Semi-Volatile Organic Analysis Practical Quantitation Limits (PQLs) in Soil/Sed/Solid and IDW

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8270D	1,2-Dichlorobenzene	95-50-1	330
	1,2-Diphenylhydrazine	122-66-7	330
	1,3-Dichlorobenzene	541-73-1	330
	1,4-Dichlorobenzene	106-46-7	330
	2,4,6-Trichlorophenol	88-06-2	330
	2,4-Dichlorophenol	120-83-2	330
	2,4-Dimethylphenol	105-67-9	330
	2,4-Dinitrophenol	51-28-5	330
	2,4-Dinitrotoluene	121-14-2	330
	2,6-Dinitrotoluene	606-20-2	330
	2-Chloronaphthalene	91-58-7	330
	2-Chlorophenol	95-57-8	330
	2-Methylnaphthalene	91-57-6	330
	2-Methylphenol	95-48-7	330
	2-Nitroaniline	88-74-4	330
	2-Nitrophenol	88-75-5	330
	3,3'-Dichlorobenzidine	91-94-1	330
	4-Methylphenol	106-44-5	330
	3-Nitroaniline	99-09-2	330
	4,6-Dinitro-2-methylphenol	534-52-1	330
	4-Bromophenyl phenyl ether	101-55-3	330
	4-Chloro-3-methylphenol	59-50-7	330
	4-Chloroaniline	106-47-8	330
	4-Chlorophenyl phenyl ether	7005-72-3	330
	4-Nitroaniline	100-01-6	330
	4-Nitrophenol	100-02-7	330
	Acenaphthene	83-32-9	330
	Acenaphthylene	208-96-8	330
	Antracene	120-12-7	330
	Benz(a)anthracene	56-55-3	330
	Benzo(a)pyrene	50-32-8	330
	Benzo(b)fluoranthene	205-99-2	330
	Benzo(g,h,i)perylene	191-24-2	330
	Benzo(k)fluoranthene	207-08-9	330
	Benzoic acid	65-85-0	330
	Benzyl alcohol	100-51-6	330
	Bis(2-chlorethoxy) methane	111-91-1	330
	Bis(2-chloroethyl) ether	111-44-4	330
	Bis(2-chloroisopropyl) ether	108-60-1	330
	Bis(2-ethylhexyl) phthalate	117-81-7	330
	Butyl benzyl phthalate	85-68-7	330
	Carbazole	86-74-8	330
	Chrysene	218-01-9	330
	Dibenz(a,h)anthracene	53-70-3	330
	Dibenzofuran	132-64-9	330
	Diethyl phthalate	84-66-2	330
	Dimethyl phthalate	131-11-3	330
	Di-n-butyl phthalate	84-74-2	330
	Di-n-octyl phthalate	117-84-0	330
	Hexachlorobutadiene	87-68-3	330
	Fluoranthene	206-44-0	330

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8270D	Fluorene	86-73-7	330
	Hexachlorobenzene	118-74-1	330
	Hexachloroethane	67-72-1	330
	Indeno(1,2,3-cd)pyrene	193-39-5	330
	Isophorone	78-59-1	330
	Naphthalene	91-20-3	330
	Nitrobenzene	98-95-3	330
	N-Nitrosodi-n-propylamine	621-64-7	330
	N-Nitrosodiphenylamine	86-30-6	330
	2,4,5-Trichlorophenol	95-95-4	330
	Pentachlorophenol	87-66-5	330
	Phenanthrene	85-01-8	330
	Phenol	108-95-2	330
	Pyrene	129-00-0	330
	Hexachlorocyclopentadiene	77-47-4	330

Table 3-9. Pesticide Analysis Practical Quantitation Limits (PQLs) in Soil/Sed/Solid and IDW

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8081A	4,4'-DDD	72-54-8	3.0
	4,4'-DDE	72-55-9	3.0
	4,4'-DDT	50-29-3	3.0
	Aldrin	309-00-2	3.0
	Dieldrin	60-57-1	3.0
	Endosulfan I	959-98-8	3.0
	Endosulfan II	33213-65-9	3.0
	Endosulfan sulfate	1031-07-8	3.0
	Endrin	72-20-8	3.0
	Endrin aldehyde	7421-93-4	3.0
	Endrin ketone	53494-70-5	3.0
	Heptachlor	76-44-8	3.0
	Heptachlor epoxide	1024-57-3	3.0
	Methoxychlor	72-43-5	3.0
	Toxaphene	8001-35-2	3.0
	Alpha-BHC	319-84-6	3.0
	Alpha-Chlordane	5103-71-9	3.0
	Beta-BHC	319-85-7	3.0
	Delta-BHC	319-86-8	3.0
	Gamma-BHC (Lindane)	58-89-9	3.0
	Gamma-Chlordane	5103-74-2	3.0

Table 3-10. PCB Analysis Practical Quantitation Limits (PQLs) in Soil/Sed/Solid and IDW

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8082	Aroclor-1016	12674-11-2	33.0
	Aroclor-1221	11104-28-2	67.0
	Aroclor-1232	11141-16-5	33.0
	Aroclor-1242	53469-21-9	33.0
	Aroclor-1248	12672-29-6	33.0
	Aroclor-1254	11097-69-1	33.0
	Aroclor-1260	11096-82-5	33.0

3.7.2 Groundwater Samples

- A maximum of 14 Temporary Well Points (TWPs) shall be placed within soil-sample boreholes. The TWPs shall be sampled and analyzed for the parameters defined in **Table 3-11.** The samples will be filtered at the laboratory and the analyses shall be performed on filtered and unfiltered groundwater samples.

Table 3-11. Sampling and Analytical Parameters for TWP Groundwater

Analytical Parameter	Test Method	Field Samples	Field Duplicate Samples	Number MS/MSD Samples	Total Analyses (Filtered and Unfiltered)	Bottle Type	Preser.
Isotopic Uranium (234,235,238)	HASL 300 – Alpha Spectroscopy – Eichrom Modification	14	1	N/A	30	1 L HDPE	HNO3 pH<2
Isotopic Thorium (228,230,232)	HASL 300 – Alpha Spectroscopy – Eichrom Modification	14	1	N/A	30	1 L HDPE	HNO3 pH<2
Radium 226	EPA 903.1	14	1	N/A	30	1 L HDPE	HNO3 pH<2
Radium 228	EPA 904	14	1	N/A	30	1 L HDPE	HNO3 pH<2
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471	14	1	1	32	125 mL HDPE	HNO3 pH<2
Anions (Cl,F,NO_2, NO_3, o-PO_4, SO_4)	EPA SW-846 9056/EPA 300 Series	14	1	N/A	30	1 L HDPE	HNO3 pH<2
Total Dissolved Solids (Filtered Only)	EPA 160.1	14	1	N/A	15	500 mL HDPE	None,<6° C
Alkalinity (Carbonate/Bicarbonate)	EPA 310.2	14	1	N/A	30	500 mL HDPE	None,<6° C

- Laboratory analytical batches will be no greater than 20 samples per batch. Laboratory Quality Control samples will be used based upon the SOW requirements, the test method and guidelines established in *USEPA SW-846 Test Methods for Evaluating Solid Waste Physical/Chemical Methods* and the DOD QSM.
- Minimum Detectable Activities (MDAs), Instrument Detection Limits (IDLs) and Practical Quantitation Limits (PQLs) for the Groundwater Analysis are found in **Tables 3-12** to **3-14** below.

Table 3-12. Minimum Detectable Activities for Water

Radiological Parameter	MDA (pCi/L)
Uranium 234	0.2
Uranium 235	0.2
Uranium 238	0.2
Thorium-228	0.2
Thorium-230	0.2
Thorium-232	0.2
Radium 226	0.5
Radium 228	0.5

Table 3-13. Wet Chemistry Method Detection Limits (MDLs), Practical Quantitation Limits (PQLs), Bottle Types, Preservation and Holding Times for Water

Method	Analyte	CAS Number	MDL (µg/L)	PQL (µg/L)	Bottle Type	Preserv.	Holding Time
EPA 310.2	Alkalinity as $CaCO_3$	N/A	725	1000	500 mL HDPE	None,<6°C	None
EPA 160.1	Total Dissolved Solids	N/A	2000	N/A	500 mL HDPE	None,<6°C	None
EPA SW-846 9056/EPA 300 Series	Chloride	16887-00-6	66	200	500 mL HDPE	None,<6°C	28 days
	Fluoride	16984-48-8	33	100			None
	Nitrate	14797-55-8	33	100			48 hrs
	Nitrite	14797-65-0	33	100			None
	Ortho-phosphate		66	200			None
	Sulfate	14808-79-8	100	400			28 days

Table 3-14. Metals Instrument Detection Limits (IDLs) for Water

Method	Analyte	CAS Number	IDL (µg/L)
SW-846 6010/6020/7471	Aluminum	7429-90-5	5
	Antimony	7440-36-0	0.5
	Arsenic	7440-38-2	1.5
	Barium	7440-39-3	0.5
	Beryllium	7440-41-7	0.1
	Boron	7440-42-8	4
	Cadmium	7440-43-9	0.11
	Calcium	7440-70-2	20
	Chromium	7440-47-3	1
	Cobalt	7440-48-4	0.1
	Copper	7440-50-8	0.2
	Iron	7439-89-6	10
	Lead	7439-92-1	0.5
	Lithium	7439-93-2	2
	Magnesium	7439-95-4	5
	Manganese	7439-96-5	1
	Mercury	7439-97-6	0.03
	Nickel	7440-02-0	0.5
	Potassium	7440-09-7	80
	Selenium	7782-49-2	1
	Silver	7440-22-4	0.2
	Sodium	7440-23-5	80
	Thallium	7440-28-0	0.3
	Vanadium	7440-62-2	3
	Zinc	7440-66-6	2.6

3.7.3 Investigative Derived Waste (IDW)

IDW samples will be analyzed for waste characterization parameters to comply with the acceptance criteria of the disposal facilities. At a minimum, the IDW solids will be analyzed for the parameters defined for soil analysis in Section 3.7.1. The IDW liquid samples will be analyzed for radiological parameters as defined in Table 3-12 and for chemical parameters as per the following tables:

Table 3-15. Chemical Parameters for IDW Liquids

Analytical Parameter	Test Method
Total VOCs	SW-846 8260
Total SVOCs	SW-846 8270
Target Analyte List (TAL) Metals	EPA SW-846 6010/6020/7471
Pesticides	EPA SW-846 8081
PCBs	EPA SW-846 8082
Ignitability	EPA SW-846 1010A/1020A
Corrosivity	EPA SW-846 9040C
Reactivity	No required methods

Table 3-16. Metals Instrument Detection Limits (IDLs) for IDW Liquids

Method	Analyte	CAS Number	IDL (µg/L)
SW-846 6010/6020/7471	Aluminum	7429-90-5	5
	Antimony	7440-36-0	0.5
	Arsenic	7440-38-2	1.5
	Barium	7440-39-3	0.5
	Beryllium	7440-41-7	0.1
	Boron	7440-42-8	4
	Cadmium	7440-43-9	0.11
	Calcium	7440-70-2	20
	Chromium	7440-47-3	1
	Cobalt	7440-48-4	0.1
	Copper	7440-50-8	0.2
	Iron	7439-89-6	10
	Lead	7439-92-1	0.5
	Lithium	7439-93-2	2
	Magnesium	7439-95-4	5
	Manganese	7439-96-5	1
	Mercury	7439-97-6	0.03
	Nickel	7440-02-0	0.5
	Potassium	7440-09-7	80
	Selenium	7782-49-2	1
	Silver	7440-22-4	0.2
	Sodium	7440-23-5	80
	Thallium	7440-28-0	0.3
	Vanadium	7440-62-2	3
	Zinc	7440-66-6	2.6

Table 3-17. Volatile Organic Analysis Practical Quantitation Limits (PQLs) in IDW Liquids

Method	Analyte	CAS Number	PQL(µg/L)
SW-846 8260C	1,1,1,2-Tetrachloroethane	630-20-6	1
	1,1,1-Trichloroethane	71-55-6	1
	1,1,2,2-Tetrachloroethane	79-34-5	1
	1,1,2-Trichloroethane	79-00-5	1
	1,1-Dichloroethane	75-34-3	1
	1,1-Dichloroethylene	75-34-4	1
	1,1-Dichloropropene	563-58-6	1
	1,2,3-Trichlorobenzene	87-61-6	1
	1,2,3-Trichloropropane	96-18-4	1
	1,2,4-Trichlorobenzene	120-82-1	1
	1,2,4-Trimethylbenzene	95-63-6	1
	1,2-Dibromo-3-chloropropane	96-12-8	1
	1,2-Dibromoethane	106-93-4	1
	1,2-Dichlorobenzene	95-50-1	1
	1,2 Dichloroethane	107-06-2	1
	1,2-Dichloroethylene (total)	540-59-0	1
	1,2-Dichloropropane	78-87-5	1
	1,3,5-Trimethylbenzene	108-67-8	1
	1,3-Dichlorobenzene	541-73-1	1
	1,3-Dichloropropane	142-28-9	1
	1,4-Dichlorobenzene	106-46-7	1
	1,4-Dioxane	123-91-1	50
	2,2-Dichloropropane	594-20-7	1
	2-Butanone	78-93-3	5
	2-Chloro-1,3-butadiene	126-99-8	1
	2-Chloroethylvinyl ether	110-75-8	5
	2-Chlorotoluene	95-49-8	1
	2-Hexanone	591-78-6	5
	2-Methylpentane	107-83-5	1
	2-Nitropropane	79-46-9	5
	4-Chlorotoluene	106-43-4	1
	4-Isopropyltoluene	99-87-6	1
	4-Methyl-2-pentanone	108-10-1	5
	Acetone	67-64-1	5
	Acetonitrile	75-05-8	25
	Acrolein	107-02-8	5
	Acrylonitrile	107-13-1	5
	Allyl Chloride	107-05-1	5
	Benzene	71-43-2	1
	Benzyl chloride	100-44-7	5
	Bromobenzene	108-86-1	1
	Bromochloromethane	74-97-5	1
	Bromodichloromethane	75-27-4	1
	Bromoform	75-25-2	1
	Bromomethane	74-83-9	1
	Carbon disulfide	75-15-0	5
	Carbon tetrachloride	56-23-5	1
	Chlorobenzene	108-90-7	1
	Chloroethane	75-00-3	1
	Chloroform	67-66-3	1
	Chloromethane	74-87-3	1
	Cyclohexane	110-82-7	1

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8260C	Cyclohexanone	108-94-1	50
	Dibromochloromethane	124-48-1	1
	Dibromomethane	74-95-3	1
	Dichlorodifluoromethane	75-71-8	1
	Ethyl acetate	141-78-6	10
	Ethyl ether	60-29-7	1
	Ethyl methacrylate	97-63-2	5
	Ethylbenzene	100-41-4	1
	Hexachlorobutadiene	87-68-3	1
	Hexane	110-54-3	10
	Iodomethane	74-88-4	5
	Isobutyl alcohol	78-83-1	50
	Isopropylbenzene	98-82-8	1
	Methacrylonitrile	126-98-7	5
	Methyl acetate	79-20-9	10
	Methyl methacrylate	80-62-6	5
	Methylcyclohexane	108-87-2	2
	Methylene chloride	75-09-2	5
	Napthalene	91-20-3	1
	Pentachloroethane	76-01-7	5
	Propionitrile	107-12-0	5
	Styrenne	100-42-5	1
	Tetrachloroethylene	127-18-4	1
	Tetrahydrofuran	109-99-9	5
	Toluene	108-88-3	1
	Trichloroethylene	79-01-6	1
	Trichlorofluoromethane	75-69-4	1
	Trichlorotrifluoroethane	76-13-1	5
	Vinyl acetate	108-05-4	5
	Vinyl chloride	75-01-4	1
	Xylenes (total)	1330-20-7	1
	Bis(2-Chloroisopropyl) ether	108-60-1	5
	Cis-1,2-Dichloroethylene	156-59-2	1
	Cis-1,3-Dichloropropylene	10061-01-5	1
	Cis-1,4-Dichloro-2-butene	1476-11-5	5
	M,p-Xylenes	179601-23-1	2
	n-Butyl alcohol	71-36-3	50
	n-Butylbenzene	104-51-8	1
	n-Propylbenzene	103-65-1	1
	o-Xylene	95-47-6	1
	sec-Butylbenzene	135-98-8	1
	tert-Butyl methyl ether	1634-04-4	1
	tert-Butylbenzene	98-06-6	1
	trans-1,2-Dichloroethylene	156-60-5	1
	trans-1,3-Dichloropropylene	10061-02-6	1
	trans-1,4-Dichloro-2-butene	110-57-6	5

Table 3-18. Semi-Volatile Organic Analysis Practical Quantitation Limits (PQLs) in IDW Liquids

Method	Analyte	CAS Number	PQL (µg/L)
SW-846 8270D	1,2-Dichlorobenzene	95-50-1	10
	1,2-Diphenylhydrazine	122-66-7	10
	1,3-Dichlorobenzene	541-73-1	10
	1,4-Dichlorobenzene	106-46-7	10
	2,4,6-Trichlorophenol	88-06-2	10
	2,4-Dichlorophenol	120-83-2	10
	2,4-Dimethylphenol	105-67-9	10
	2,4-Dinitrophenol	51-28-5	10
	2,4-Dinitrotoluene	121-14-2	10
	2,6-Dinitrotoluene	606-20-2	10
	2-Chloronaphthalene	91-58-7	10
	2-Chlorophenol	95-57-8	10
	2-Methylnaphthalene	91-57-6	10
	2-Methylphenol	95-48-7	10
	2-Nitroaniline	88-74-4	10
	2-Nitrophenol	88-75-5	10
	3,3'-Dichlorobenzidine	91-94-1	10
	4-Methylphenol	106-44-5	10
	3-Nitroaniline	99-09-2	10
	4,6-Dinitro-2-methylphenol	534-52-1	10
	4-Bromophenyl phenyl ether	101-55-3	10
	4-Chloro-3-methylphenol	59-50-7	10
	4-Chloroaniline	106-47-8	10
	4-Chlorophenyl phenyl ether	7005-72-3	10
	4-Nitroaniline	100-01-6	10
	4-Nitrophenol	100-02-7	10
	Acenaphthene	83-32-9	10
	Acenaphthylene	208-96-8	10
	Antracene	120-12-7	10
	Benz(a)anthracene	56-55-3	10
	Benzo(a)pyrene	50-32-8	10
	Benzo(b)fluoranthene	205-99-2	10
	Benzo(g,h,i)perylene	191-24-2	10
	Benzo(k)fluoranthene	207-08-9	10
	Benzoic acid	65-85-0	10
	Benzyl alcohol	100-51-6	10
	Bis(2-chlorethoxy) methane	111-91-1	10
	Bis(2-chloroethyl) ether	111-44-4	10
	Bis(2-chloroisopropyl) ether	108-60-1	10
	Bis(2-ethylhexyl) phthalate	117-81-7	10
	Butyl benzyl phthalate	85-68-7	10
	Carbazole	86-74-8	10
	Chrysene	218-01-9	10
	Dibenz(a,h)anthracene	53-70-3	10
	Dibenzofuran	132-64-9	10
	Diethyl phthalate	84-66-2	10
	Dimethyl phthalate	131-11-3	10
	Di-n-butyl phthalate	84-74-2	10
	Di-n-octyl phthalate	117-84-0	10
	Hexachlorobutadiene	87-68-3	10
	Fluoranthene	206-44-0	10

Method	Analyte	CAS Number	PQL (µg/kg)
SW-846 8270D	Fluorene	86-73-7	10
	Hexachlorobenzene	118-74-1	10
	Hexachloroethane	67-72-1	10
	Indeno(1,2,3-cd)pyrene	193-39-5	10
	Isophorone	78-59-1	10
	Naphthalene	91-20-3	10
	Nitrobenzene	98-95-3	10
	N-Nitrosodi-n-propylamine	621-64-7	10
	N-Nitrosodiphenylamine	86-30-6	10
	2,4,5-Trichlorophenol	95-95-4	10
	Pentachlorophenol	87-66-5	10
	Phenanthrene	85-01-8	10
	Phenol	108-95-2	10
	Pyrene	129-00-0	10
	Hexachlorocyclopentadiene	77-47-4	10

Table 3-19. Pesticide Analysis Practical Quantitation Limits (PQLs) in IDW Liquids

Method	Analyte	CAS Number	PQL (µg/L)
SW-846 8081A	4,4'-DDD	72-54-8	0.10
	4,4'-DDE	72-55-9	0.10
	4,4'-DDT	50-29-3	0.10
	Aldrin	309-00-2	0.10
	Dieldrin	60-57-1	0.10
	Endosulfan I	959-98-8	0.10
	Endosulfan II	33213-65-9	0.10
	Endosulfan sulfate	1031-07-8	0.10
	Endrin	72-20-8	0.10
	Endrin aldehyde	7421-93-4	0.10
	Endrin ketone	53494-70-5	0.10
	Heptachlor	76-44-8	0.10
	Heptachlor epoxide	1024-57-3	0.10
	Methoxychlor	72-43-5	0.10
	Toxaphene	8001-35-2	0.10
	Alpha-BHC	319-84-6	0.10
	Alpha-Chlordane	5103-71-9	0.10
	Beta-BHC	319-85-7	0.10
	Delta-BHC	319-86-8	0.10
	Gamma-BHC (Lindane)	58-89-9	0.10
	Gamma-Chlordane	5103-74-2	0.10

Table 3-20. PCB Analysis Practical Quantitation Limits (PQLs) in IDW Liquids

Method	Analyte	CAS Number	PQL (µg/L)
SW-846 8082	Aroclor-1016	12674-11-2	33.0
	Aroclor-1221	11104-28-2	67.0
	Aroclor-1232	11141-16-5	33.0
	Aroclor-1242	53469-21-9	33.0
	Aroclor-1248	12672-29-6	33.0
	Aroclor-1254	11097-69-1	33.0
	Aroclor-1260	11096-82-5	33.0

4.0 LABORATORY OPERATIONS

The ARS laboratory will follow laboratory standard operating procedures for handling, identifying, and controlling samples, and Chain-of-Custody procedures to maintain the validity of the samples. A Laboratory Information Management System (LIMS) will be used for tracking samples from receipt through reporting of analytical results and excess sample disposal.

4.1 Sample Receipt

All samples will be delivered to the ARS Sample Receiving/Shipping Area. Upon receipt, the sample custodian will sign the Chain-of-Custody form (with date and time of receipt), thus assuming custody of the samples. External surveys of the sample shipping containers will be conducted. External exposure rate and count rate survey measurements must be at or below the maximum allowable levels before moving a shipping container to the inspection area.

After survey clearance, and the visual inspection of the Shipping Container shows no apparent sign of leakage, the sample shipping container(s) are moved to the Sample Inspection area (Radiological Controlled Area) and placed in a hood or within the airflow of a hood where the SC will perform a thorough examination of the shipping container(s).

If no issues were identified with the condition of the shipping container and exposure rate and removable contamination levels are within acceptable limits, the shipping containers will be opened for further inspection by the Sample Custodian (SC). Smears and a Count Rate Measurement of the inside surface of the shipping container and the external surface of individual sample containers are taken.

Upon survey clearance of sample containers, the SC will remove the samples from the shipping container and place them in a hood for inspection. All documents will be removed and inspected. The following information is recorded on the Sample Receipt Form:

- Sample Matrix
- Number of Samples Received
- Volume/weight of each sample
- Brief description of sample material
- Temperature
- Presence/absence of Custody Seals
- Condition of sample containers

Samples are logged in the Laboratory Information Management System where a unique SDG and ARS Sample IDs are assigned. A Sample Label is applied on each container within a SDG. Information includes the ARS Sample ID, Client ID, Client Name, the date of sample receipt, the analysis due date, storage location, the number of containers for a given sample and an Internal Chain of Custody barcode. A label for each analysis requested within an SDG is generated for attachment to the ARS Label Sheet. The label information includes the ARS Sample ID, Analysis Code, Client Name, the number of samples in the SDG requiring the analysis, the date of sample receipt and the analysis due date.

The SC will initiate a Discrepant Sample Receipt Report (DSRR) for discrepancies identified during the sample receiving process.

Samples for radiological or geotechnical analysis do not require temperature controls. However, samples for chemical analysis do have temperature controls and holding time (prior to analysis) constraints. ARS will store samples for chemical analyses in appropriate refrigerated units. All samples will be stored in controlled-access areas, accountability will be maintained, and provisions will be in place to address handling and potential contamination control issues.

4.2 Chain-of-Custody

The Laboratory Internal Chain of Custody (ICOC) is a system that records the movement of Samples and Sample aliquots throughout the laboratory. It is a continuous record of individuals in possession of samples or sample aliquots. When not in an individual's possession, it records the controlled zone where the sample or sample aliquot is located.

A Sample is in considered in custody if:

- It is in one's actual physical possession
- It is in one's view after being in one's physical possession
- It is one's physical possession and then locked or sealed so that no one can tamper with it; and/or
- It is kept in a secured area, restricted to authorized personnel only.

A barcoding system is utilized by ARS to track all samples and sample fractions throughout the laboratory processes.

4.3 Record Keeping

Data related to sample preparation and analysis, as well as observations by Laboratory Analysts, will be permanently recorded in bound laboratory notebooks. Laboratory notebook pages will be signed and dated daily by Laboratory Analysts. Corrections to notebook entries will be made by drawing a single line through the erroneous entry and writing the correct entry next to the one that was crossed out. Corrections will be initialed and dated by the Analyst.

4.4 Standard Operating Procedures (SOPs)

ARS maintains standard operating procedures that accurately reflect all phases of current laboratory activities including assessing data integrity, corrective actions, handling customer complaints and all test methods. Each SOP clearly indicates the effective date of the document, the revision number and the signature(s) of the approving authority.

The Standard Operating Procedures (SOP) and Plans of ARS fall into two categories; Operational and Administrative. Operational SOPs constitute the in-house methods for each test method performed by ARS and include processes that require step-by step instructions for performing hands-on operations. Included in Operational SOPs are ancillary processes (e.g. balance and temperature checks, preventive maintenance) integral to the support of method generated data. Administrative SOP and Plans document and record control procedures,

Information Technology (IT) and software configuration control procedures, quality assurance plans (QAP), health and safety plans (HSP), radiation protection plans (RPP), etc.
All Operational SOPs shall contain sections addressing all of the following items. Items that do not apply to a specific Operational SOPs shall be indicated as such in that SOP.

- identification of the test method;
- applicable matrix or matrices;
- detection limit;
- scope and application, including components to be analyzed;
- summary of the test method;
- definitions;
- interferences;
- safety;
- equipment and supplies;
- reagents and standards;
- sample collection, preservation, shipment and storage;
- QC;
- calibration and standardization;
- procedure;
- data analysis and calculations;
- method performance;
- waste minimization and pollution prevention;
- data assessment and acceptance criteria for QC measures;
- corrective actions for out-of-control data;
- contingencies for handling out-of-control or unacceptable data;
- waste management;
- references; and, where applicable; and
- any tables, diagrams, flowcharts and validation data.

4.5 Laboratory Equipment

4.5.1 Preventive Maintenance

The primary objective of a preventive maintenance program is to promote the timely and effective completion of a measurement effort. The preventive maintenance is designed to minimize the downtime of crucial analytical equipment due to expected or unexpected component failure.

Preventive maintenance procedures and/or manufacturer-supplied operator's manuals are utilized by ARS. ARS maintains a major equipment and measurement standards list. A record of instrument maintenance, calibration and repair is maintained.

Each analytical instrument is assigned an instrument logbook. Maintenance activities are recorded in the instrument logbook. The information entered includes:

- Date of maintenance,
- Person performing maintenance,
- Type of maintenance performed and reason for maintenance,
- Replacement parts installed (if appropriate), and
- Miscellaneous information.

If maintenance is performed by the manufacturer, a copy of the service record is maintained as a permanent record.

Along with a schedule for maintenance activities, an adequate inventory of spare parts is maintained to minimize equipment down time.

4.5.2 Calibration Procedures and Frequency

This subsection provides the general requirements for calibration of measuring and test equipment and instruments used in laboratory analysis. This program is designed to ensure that instruments are calibrated to operate within manufacturers' specifications and that the required traceability, sensitivity, and precision of the equipment/instruments are maintained. Measurements that affect the quality of an item or activity will be taken only with instruments, tools, gauges, or other measuring devices that are accurate, controlled, calibrated, adjusted, and maintained at predetermined intervals to ensure the specified level of precision and accuracy.

An instrument's response to known reference materials must be determined before being used as a measuring device. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. Sample measurements will be performed within the calibrated range of the instrument. Preparation of reference materials used for calibration will be documented in a laboratory notebook.

ARS has a comprehensive calibration program involving all instrumentation and equipment used for making determinations, the results of which are reported.

Laboratory instrument calibration typically consists of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is expressed as a correlation coefficient.

Continuing calibration usually includes measurement of the instrument response to fewer calibration standards and requires instrument response to compare certain limits (e.g., 10%) of

the initial measured instrument response. Continuing calibration may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of nonuse.

Records are maintained as evidence of required calibration frequencies. All equipment is be marked to indicate calibration status.

5.0 PERFORMANCE AND SYSTEM AUDITS

5.1 Laboratory Internal Audits

Specific audits and surveillances are scheduled to be performed during a given calendar quarter. The audit and surveillance program addresses all elements of the quality system, including environmental testing and/or calibration activities. The assigned audit or surveillance may be conducted anytime during the calendar quarter.

It is the responsibility of the Quality Assurance Officer(s) to plan and organize audits and surveillances as required by the schedule and as requested by management.

An audit related to data integrity with respect to any evidence of inappropriate actions or vulnerabilities is also conducted on an as needed basis.

Audits and surveillances are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel do not audit their own activities. The person assigned the audit or surveillance conducts a thorough review of the applicable procedure before conducting the audit or surveillance. Findings and observations are documented on an "Audit and Surveillance" form. Findings are evaluated and corrected in accordance with *ARS-013 Nonconformance Reporting and Corrective Action Program.* Documentation is maintained of all audits and surveillances, associated findings, and any corrective actions taken for a minimum of five years.

5.2 Contractor Quality Control

ARSEC‘s Corporate QC Manager and PQCR are the persons responsible for the design and/or performance of QC systems and audits for this project, while USACE’s designated QA Representative is responsible for designing and implementing QA audits. Since audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. However, the auditor is experienced with the objectives, principles, and procedures of the measurement efforts to perform a thorough and effective evaluation of the measurement system. The auditor's technical background and experience provide a basis for appropriate audit standard selection, audit design, and data interpretation. The ability to identify components of the system that are critical to overall data quality is especially important, so the audit focuses heavily upon these elements. The auditor also has writing skills sufficient to clearly document the findings and recommendations of the audit. The function of the auditor is to:

- Observe procedures and techniques in use in the various measurement efforts, including field sampling and analysis;
- Check and verify instrument calibration records;
- Assess the effectiveness of and adherence to the prescribed QC procedures;
- Review document control and COC procedures;
- Submit audit samples of comparable composition as those being tested for analysis;

- Review the malfunction reporting procedures;
- Identify and correct any weaknesses in the sampling/analytical approach and techniques;
- Assess the overall data quality of the various sampling/analytical systems; and
- Challenge the various measurement systems with certified audit standards.

5.3 Project System Audits

The auditor may, on an announced or unannounced basis, call for a corporate project audit (system audit). ARSEC's PM will respond by submitting this project QAPP and the project CQCP . The auditor will determine if the QAPP and CQCP are in place functionally and whether the required reviews have been and are being conducted. Certain projects may be identified for a more formal audit. These audits will involve an in-depth evaluation of the implementation of the QAPP for the project as they apply to field and data analysis and reduction procedures.

5.4 Technical Performance Audits

Technical performance audits will be performed on an ongoing basis during the project as field data are generated, reduced, and analyzed. Numerical analyses, including manual calculations, mapping, and computer modeling, will be documented and will be the subject of performance audits in the form of QC review, numerical analysis, and peer review. Records of numerical analyses will be legible, reproduction quality, and complete enough to permit logical reconstruction by a qualified individual other than the originator.

5.5 Field Audits

Periodic in-field performance audits may be conducted by the PQCR, or designee, for the particular discipline of field activities. The purpose of field audits is to ensure that the methods and protocols detailed in this QAPP and the standard operating procedures are being consistently adhered to in the field. The QA auditor will prepare checklists prior to an audit to ensure completeness of the review and to document the results of the audit. Items to be examined may include, as appropriate:

- The availability and implementation of approved work procedures,
- Calibration and operation of equipment,
- Packaging, storage, and shipping of samples obtained, and
- Documentation procedures.

The records of field operations will be reviewed to verify that field-related activities were performed in accordance with appropriate project procedures. Items reviewed would include, but not be limited to:

- The calibration records of field equipment,
- Daily field activity logs,

- COC documentation, and
- Field logs.

During an audit and upon its completion, the auditors will discuss the findings with the individuals audited and cite any corrective actions to be initiated. Findings will be noted on the audit checklist and the results provided to ARSEC's PM and USACE's Project Engineer. ARSEC's PM will ensure that the corrective actions are implemented.

6.0 NON-CONFORMANCE/CORRECTIVE ACTIONS

During the course of the site project, it is the responsibility of ARSEC's PM, SM, PQCR, and the Field Team Members to see that measurement procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. It is imperative that prompt action be taken to correct the problem(s) in the event that a problem arises.

Problems or questions about field or analytical data quality that may require corrective action are documented by the SM and reported to ARSEC's PM. Corrective actions may be required if QC results exceed method or project criteria, reporting or flagging errors are identified, or requested information has not been reported. Laboratory response usually involves a written explanation of the problem or reissuing laboratory reports and/or electronic data files. If significant data quality problems have occurred and the data are critical to decision making, samples may be reanalyzed or recollected and reanalyzed. That determination must be made by ARSEC's PM in association with ARSEC's Corporate QC Manager, PQCR, Project Health Physicist, and through discussions with USACE project staff.

6.1 Field Activities

The initial responsibility for monitoring the quality of field measurements and observations lies with the field personnel. ARSEC's PQCR is responsible for verifying that QC procedures are followed. This requires that the PQCR assess the correctness of field methods and the ability to meet QC/QA objectives. Any non-conformance with established procedures presented in the project plans will be identified and corrected. ARSEC's PM will be notified and will be responsible for issuing a non-conformance report for each non-conforming condition. In addition, corrective actions will be implemented and documented in the appropriate field logbook. Non-conforming conditions include:

- Improper instrument calibrations or operational checks,
- Improper survey or sampling procedures,
- Physical or documentation discrepancies with samples upon receipt at the laboratory, and
- Physical or documentation discrepancies with waste material upon receipt at disposal facility.

ARSEC's PM shall be notified in the event discrepancies are discovered by field personnel, during a desk or field audit or during data assessment. ARSEC's PM will immediately suspend applicable operations until the extent of the discrepancy and its impact on the accuracy and the validity of the data can be assessed. The cause of the discrepancy will be identified and corrective actions, such as procedure revisions or personnel retraining, will be instituted to prevent a reoccurrence. Re-surveys or re-sampling will be performed, if necessary, to correct the discrepancy. ARSEC's PM will notify USACE's Project Engineer of the identified problem, corrective action(s), and the impact on the overall project.

6.2 Laboratory Activities

Quality Assurance Discrepancies, Nonconforming Work and Corrective Actions are discussed in detail in Procedure *ARS-013 Nonconformance Reporting and Corrective Action Program*. The

purpose of the SOP is to specify a system to identify, investigate, control and document nonconformances; to notify applicable organizations and affected clients of deficiencies; and to provide a process for the development and implementation of corrective measures when warranted. The Nonconformance and Corrective Action Program provides a means for tracking and trending lessons learned to prevent reoccurrence of nonconformances.

6.2.1 Investigation of Nonconformance

ARS will conduct the following tasks:

- Determination of Extent: The extent and any generic implications of the Nonconformance shall be determined and documented on a Nonconformance Report (NCR). If analytical results were affected, record the ARS Sample IDs, SDGs, the name(s) of affected client(s), and whether client notification is required.
- Determination of Cause: The apparent cause of the nonconformance is determined and documented on the (NCR).
- Determination of Root Cause: An investigation into the root cause of the nonconformance is conducted. This investigation shall include internal and external observations and events leading to or associated with the problem. The investigation shall be documented on the NCR.

6.2.2 Proposed Resolution and/or Corrective Actions

- Develop an Immediate Resolution: A resolution to the nonconformance is developed and documented on the NCR. The individual responsible for implementing the resolution and a proposed date of completion is assigned. If the nonconformance involves nonconforming items/equipment, lock-out/tag-out procedures are followed and this action is documented on the NCR.
- Develop Corrective Actions and Preventive Measures**:** Corrective actions and preventive measures are developed to eliminate the root cause(s) of the nonconformance, while taking into consideration the magnitude of the problem and the risk involved. The corrective actions and preventive measures are documented on the NCR. The responsible individual(s) and an estimated completion date are assigned for each action.

7.0 DATA REDUCTION/CALCULATION

Evaluation/assessment of measurement data ensures that QA objectives for a program are met and quantitative measures of data quality are provided. Data evaluation procedures, calculations, and applications used for this project are based on the *Guidance for Data Quality Assessment Process: Practical Methods for Data Analysis* (QA/G-9), (USEPA, 2000).

There is a distinction between routine QC and data assessment conducted as a part of laboratory operations, and the project-related data assessment process conducted after data have been reported. As discussed in this section, both types of data assessment will be addressed for this project. It is assumed that the planning, standard operating procedures, and monitoring activities conducted during the sampling and analysis process serve to control the process as much as possible to produce data of sufficient quality for project needs. Any part of the process that can not be controlled and to what extent that may affect the quality of the reported data will be identified after the data are reported.

Routine QC procedures conducted at ARS are established in the published analytical methods, other information in this QAPP, and ARS LQAP and standard operating procedures. The laboratory is responsible for following those procedures and operating the analytical systems within statistical control limits. These procedures include proper instrument maintenance, calibration and continuing calibration checks, and internal QC sample analyses at the required frequencies for the project (i.e., method blanks, MS/MSDs, laboratory duplicates). ARS will provide the results of associated QC sample analyses when reporting sample data so ARSEC project staff can evaluate the performance of the analytical process.

One of the additional ongoing data assessment processes is maintaining control charts for representative QC sample analyses to monitor system performance. Control charts provide a useful tool in assessing QC efforts through graphical displays of a parameter(s) and variability over time. Control charts are established to monitor trends, warning, or out-of-control situations as they happen. A parameter plotted is related to sample testing, either directly in terms of concentration or indirectly in terms of derived information such as concentration mean (arithmetic) or range of concentration. Quality control data is recorded and monitored in such a way that trends are detectable. Statistical techniques are applied when reviewing the quality control data results, where practicable. The monitoring process is planned and reviewed.

Problems with analytical data often occur in spite of precautions taken in planning and execution of the sampling and analysis task. In these cases, the data assessment conducted by ARSEC project staff after the data have been reported will identify the problem, determine which data are affected, state how these data may be limited for use in the intended applications, and make recommendations for corrective actions as necessary

Several of the data review/assessment acceptance criteria involve specific calculations. The appropriate formulas are presented below.

7.1 Non-radiological Instrument Response Linearity (Calibration)

Acceptance criteria for certain non-radiological instrument response linearity checks are based upon the correlation coefficient, r, of the best-fit line for the calibration data points. The correlation coefficient reflects the linearity of response to the calibration standards and is calculated as:

$$r = \frac{n\sum(xy) - \left(\sum x\right)\left(\sum y\right)}{\sqrt{\left[n\left(\sum x^2\right) - \left(\sum x\right)^2\right]\left[\left(n\sum y^2\right) - \left(\sum y\right)^2\right]}}$$

Where:

x = Calibration concentrations;
y = Instrument response (peak area); and
n = Number of calibration points (x, y data pairs)

7.2 Alpha Spectrometry

7.2.1 Nuclear Data

Default nuclear data for required radionuclides are tabulated below (**Table 7-1**). The tracer and analytes for each test is predefined and are tabulated with associated decay data.

Table 7-1. Default Nuclear Data – Alpha Spectroscopy**

Nuclide	Use*	$T_{1/2}$ (days)	Nuclide Abundance	Energies (keV)	Comments
U -232	T	2.51620E+04	0.997	5320.12, 5263.36	Tracer for Isotopic Uranium
U-233/234	A	8.97454E+07	0.998	4824.2, 4804, 4796, 4783.5, 4774.6, 4758, 4754, 4751, 4729, 4722.4, 4701	Half-life from U-234
U -235	A	2.57060E+11	0.861	4596.4, 4556, 4502, 4435, 4414, 4397.8, 4366.1, 4295, 4271	
U -238	A	1.63194E+12	1.000	4198, 4151	
Th-229	T	2.68056E+06	1.000	5078, 5053, 5047, 5036, 5023, 5009, 4978.5, 4967.5, 4930, 4901, 4861	Tracer for Isotopic Th
Th-230	A	2.75347E+07	0.998	4687, 4620.5, 4479.8	
Th-232	A	5.13194E+12	1.000	4012.3, 3947.2, 3811.1	

* A = Analyte, T = Tracer,
** Queried from NUDAT2. (http://www.nndc.bnl.gov/nudat2/indx_dec.jsp)
Note: The energies in bold are the energies of the most abundant peak.

7.2.2 Confidence Factor

The factor applied to the estimate of uncertainty (i.e., counting uncertainty or Total Propagated Uncertainty - CSU) to obtain the desired confidence interval. While data could be reported at any confidence interval desired, most data are reported at the one-and two-sigma levels. Several multipliers and the corresponding confidence intervals are listed in **Table 7-2**.

Table 7-2. Multipliers and Confidence Intervals

Sigma multiplier	Confidence Interval	Comment
1	68.3%	Also referred to as standard uncertainty – routinely reported under GUM and MARLAP; Routine report basis for LANL
1.65	90%	Not routinely used
1.96	95%	Routinely reported for radiochemistry results in the US. Interchangeable with 2-sigma uncertainty.
2	95.4%	Routinely reported for radiochemistry results in the US. Commonly also referred to as 2-sigma uncertainty.
3	99.7%	Not routinely used for the reporting of results but frequently used to evaluate QC results (e.g. replicates, QC charting)

7.2.3 Decay Correction (DF)

The half-lives used to determine decay correction factors for alpha spectroscopy calculations are tabulated above. Routinely, results are decay corrected to collection date (where available). Given the long half-lives of most alpha emitters of concern, the corrections applied are generally insignificant. In cases where a shorter lived nuclide is determined and one can expect that nuclide to be supported until chemical preparation/separation, the decay reference date for the measurement is assumed to be the appropriate preparation/separation date. The tracer activity added is corrected from its respective reference date to the date of the measurement prior for determining chemical yield.

$$DF_{(nuclide)} = e^{-\lambda_{(nuclide)} t_1}$$

$$\lambda_{(nuclide)} = \frac{\ln 2}{t_{1/2(nuclide)}}$$

Where:

DF	=	decay correction factor
e	=	base of natural logarithms = 2.718282
$\lambda_{(nuclide)}$	=	decay constant for the nuclide in question (days^{-1})
$t_{1/2}$	=	half-life of the nuclide in question (days)
t_1	=	time elapsed between the appropriate reference date and midpoint of sample count (days)

7.2.4 Tracer Yield (Y)

The tracer yield is calculated as the quotient of recovered net tracer activity and the spiked tracer activity corrected for isotopic abundance and decay to the point of the sample count as follows:

$$Y = \frac{\dfrac{N_{S(tracer)}}{t_{S(tracer)}} - \dfrac{N_{B(tracer)}}{t_{B(tracer)}}}{\left(DPM_{(tracer)}\right)\left(A\right)\left(DF_{(tracer)}\right)\left(eff\right)}$$

$$DF_{tracer} = e^{-\lambda_{tracer} t_1}$$

$$\lambda_{(tracer)} = \frac{\ln 2}{t_{1/2 tracer}}$$

Where:

$N_{S(tracer)}$	=	sample gross counts in tracer nuclide ROI
$N_{B(tracer)}$	=	background counts in tracer nuclide ROI
t_S	=	sample count duration (min)
t_B	=	background count duration in tracer ROI
$DPM_{(tracer)}$	=	activity of tracer added to the sample split corrected for any sample splits during analysis and is decay corrected to the date and time of the count
A	=	fractional nuclide abundance (see **Table 7-1** above)
DF	=	decay correction factor
e	=	base of natural logarithms = 2.718282
$\lambda_{(tracer)}$	=	decay constant for the tracer nuclide (days^{-1})
$t_{1/2}$	=	half-life of the tracer nuclide (days)
$DPM_{(tracer)}$	=	activity in disintegrations/minute of tracer nuclide added to sample aliquot (or split)
t_1	=	time elapsed between the tracer activity reference date and midpoint of sample count (days)

7.2.5 Chemical Recovery (CR) Factor

Based on empirical data, the tracer yield is adjusted to account for losses during electroplating (PE = plating efficiency). PE factors are generated empirically for each analyst. Note that application of the plating efficiency for calculating CR simplifies out of final equations and thus does not play any role in the final activity results, uncertainties, MDC or DLC.

$$CR = \frac{Y}{PE}$$

Where:

PE	=	Electroplating efficiency factor – specific factor is applied for each analyst

7.2.6 Sample Activity Concentration

The activity concentration in the sample measured in appropriate reporting units and corrected to a specified reference date is calculated as follows:

$$Activity = \frac{\frac{N_S}{t_S} - \frac{N_B}{t_B}}{(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

Where:

N_S	=	sample counts in nuclide ROI
N_B	=	background counts in nuclide ROI
t_S	=	sample count duration (min)
t_B	=	background count duration (min)
eff	=	fractional detector efficiency (cpm/dpm)
aliquot	=	sample aliquot portion aliquoted/spiked corrected for any split (solids => g, liquids => L)
CR	=	fractional chemical recovery factor
PE	=	empirically determined fractional Plating Efficiency factor (specific to analyst)
DF	=	fractional decay correction factor (see below)
acf	=	aliquot conversion factor <u>from</u> default data entry units of grams for solids or Liters for liquids, or sample (fraction of sample) <u>to</u> desired reporting units (default reporting units are g, L and samples respectively)
ucf	=	units conversion factor from dpm to desired reporting units (default = 2.22 dpm/pCi

7.2.7 Counting Uncertainty (CU)

The counting uncertainty, CU, at the 1-sigma confidence level is calculated as follows:

$$1sCU = \frac{\sqrt{\frac{N_S}{t_S^2} + \frac{N_B}{t_B^2}}}{(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

$$CU = CF \times 1sCU$$

7.2.8 Combined Standard Uncertainty (CSU)

The following general formula is used to calculate the CSU.

$$CSU = CF * \sqrt{(1sCU)^2 + \left(Activity * \sqrt{Factor1^2 + Factor2^2 + Factor3^2 + Factor4^2 + Factor5^2 + Factor6^2}\right)^2}$$

Where:

FACTOR 1 – FACTOR 6 = fractional factors accounting for the relative uncertainty associated with identified sources of systematic uncertainty

NOTE: The CSU formula assumes that the 1sCU is entered at the one-sigma level.

Factor 4 is defined as the relative counting uncertainty of the tracer analyte

$$\text{Factor 4} = \text{CU}_{\text{Rel}} = \frac{\sqrt{\frac{N_{S_{(tracer)}}}{t^2_{S_{(tracer)}}} + \frac{N_B}{t_B^2}}}{\left(\frac{N_{S_{(tracer)}}}{t^2_{S_{(tracer)}}} - \frac{N_B}{t_B^2}\right)}$$

7.2.9 MDC/MDA

The following MDC/MDA formula accounts for differences in sample and background count time:

$$MDC = \frac{2.71 + 3.29 * \sqrt{\frac{N_B}{t_B} t_S \left(1 + \frac{t_S}{t_B}\right)}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

Note that this equation is the origin of, and simplifies to, the widely known MDC expression for paired counts ($t_S = t_B$) as follows:

$$MDC = \frac{2.71 + 3.29 * \sqrt{\frac{N_B}{t_B} t_S (1+1)}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

$$= \frac{2.71 + \left(3.29 * \sqrt{(1+1)}\right) * \sqrt{\frac{N_B}{t_B} t_S}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

$$= \frac{2.71 + 4.65 * \sqrt{\frac{N_B}{t_B} t_S}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

7.2.10 Decision Level Concentration (DLC)

The Decision Level Concentration expression accounts for difference in sample and background count times:

$$DLC = \frac{1.645 \times \sqrt{\frac{N_B}{t_B} t_s \left(1 + \frac{t_S}{t_B}\right)}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

NOTE that analogous to the MDC above, this equation is the parent formula for the tradition L_c expression and simplifies to 2.33*S_b/K for paired counts ($t_s = t_B$) as follows:

$$DLC = \frac{1.645 * 1.414 * \sqrt{\frac{N_B}{t_B} t_S}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

$$DLC = \frac{2.33 * \sqrt{\frac{N_B}{t_B} t_S}}{(t_s)(eff)(CR)(PE)(A)(DF)(aliquot)(acf)(ucf)}$$

7.3 Radium-226 by Method 903.1 (Radon deemanation)

7.3.1 Nuclear Data

Default nuclear data for Radium-226 are tabulated below (**Table 7-3**).

Table 7-3. Default Nuclear Data - Radium-226

Nuclide	α/β	$T_{1/2}$	λ	Nuclide Abundance	Decay Particle Energies (keV)
Ra-226	α	5.844E+05 days	1.186E-06 $days^{-1}$	1.000	Ra-226: 4.784 & 4.601 MeV
Rn-222	α	3.8235 days 5505.8 min	1.8129E-01 $days^{-1}$ 1.2589 E-04 min^{-1}	1.000	Rn-222: 5.489 MeV

7.3.2 Chemical Yield

Method 903.1 does not foresee correcting results for losses due to chemical yield. The yield for calculations is assumed to be unity (1) and may be ignored during calculations.

7.3.3 Radium-226 Activity

Calculate the concentration Act_{Ra226} of 226Ra as follows:

$$Act_{Ra226} = \frac{\left(N_s / t_s\right) - \left(N_B / t_B\right)}{(\mathrm{CC})(IF)(DF1)(DF2)(aliquot)(acf)(ucf)}$$

Where:

N_s = Gross counts registered by the scaler during the counting period (counts)

t_s = Duration of the sample counting period (min)

N_B	=	Gross counts registered by the scaler during the background measurement counting period (counts)
t_B	=	Duration of the background counting period (min)
CC	=	Cell constant for the Lucas Cell counts/disintegration of Ra-226 assuming full ingrowth (counts / disintegration Ra-226)
IF	=	The correction for the ingrowth of Rn-222 between the first and second de-emanations
DF1	=	Correction for the decay of Rn-222 and progeny between the time of separation and the initiation of the count.
DF2	=	Correction for the decay of Rn-222 and progeny during the count
Aliquot	=	Sample aliquot, L or g
acf	=	activity correction factor
ucf	=	aliquot units correction factor

7.3.4 Ingrowth Factor (IF)

An ingrowth correction are used to determine the build-up of Rn-222 between the completion of initial emanation (i.e., Rn purge) of the solution prior to sealing and ingrowth and the final de-emanation of Rn into the alpha scintillation cell as follows:

$$IF = 1 - e^{-\left(\lambda_{222Rn} * t_1\right)}$$

Where:

λ_{222Rn}	=	Decay constant for ^{222}Rn = 0.18129 day^{-1}
t_1	=	Elapsed time between the first and second de-emanations, (days)

7.3.5 Decay Factors

Two decay correction factor correct for decay of Rn-222. The first (DF1) addresses decay between the point of Rn transfer from the bubbler to the Lucas Cell (deemanation). The second factor (DF2) corrects for decay during the actual counting period.

$$\mathrm{DF1} = e^{-\left(\lambda_{222Rn} * t_2\right)}$$

$$\mathrm{DF2} = \frac{1 - e^{-\left(\lambda_{222Rn} * t_3\right)}}{\lambda_{222Rn} * t_3}$$

Where:

λ_{222Rn}	=	Decay constant in matching units for ^{222}Rn = 1.8129E-01 day^{-1} OR 1.2589E-04 min^{-1}
t_2	=	Elapsed time between the second de-emanations and the start time of the count, (days)
t_3	=	Count duration, (min)

7.3.6 Cell Constant Calibration

The Cell Constant (CC) for each Lucas Cell used for analysis is calculated as follows:

$$CC_{Ra} = \frac{\left(N_{cal}/t_{cal}\right) - \left(N_B/t_B\right)}{(Act_{Ra})(IF)(DF1)(DF2)}$$

Where:

Act_{Ra}	=	Activity of Ra-226 added to bubbler (dpm corrected to the time of deemanation)
N_{cal}	=	Gross counts registered by the scaler during the calibration counting period (counts)
T_{cal}	=	Duration of the calibration counting period (min)
N_B	=	Gross counts registered by the scaler during the background measurement counting period (counts)
t_B	=	Duration of the background counting period (min)
IF	=	Correction for the ingrowth of progeny between the time of separation and the mid-point of the count – Assuming that the standards are permitted to come to full ingrowth (i.e. 21-28 days), the IF may be assumed to be equal to 1 and may be omitted from the calculation.
$DF1$	=	Correction for the decay of Rn-222 and progeny between the time of separation and the initiation of the count.
$DF2$	=	Correction for the decay of Rn-222 and progeny during the count

7.3.7 Counting Uncertainty

The one-sigma counting uncertainty (1sCU) is calculated as follows:

$$1sCU = \frac{\sqrt{\left(N_S / t_S^{\,2}\right) + \left(N_B / t_b^{\,2}\right)}}{(\mathrm{CC})(\mathrm{IF})(\mathrm{DF1})(\mathrm{DF2})(\mathrm{aliquot})(\mathrm{acf})(\mathrm{ucf})}$$

The 1sCU is reported at various confidence intervals by applying the appropriate coverage factor from **Table 7-2** as follows:

$$\mathrm{CU} = \mathrm{CF} * 1\mathrm{sCU}$$

7.3.8 Combined Standard Uncertainty (CSU)

The formula for the CSU is defined as follows:

$$CSU = CF * \sqrt{(1sCU)^2 + \left(Activity * \sqrt{Factor1^2 + Factor2^2 + Factor3^2 + Factor4^2 + Factor5^2 + Factor6^2}\right)^2}$$

Where:

FACTOR 1 – FACTOR 6 = fractional factors accounting for the relative uncertainty associated with identified sources of systematic uncertainty

NOTE: The CSU formula assumes that the 1sCU is entered at the one-sigma level.

7.3.9 Minimum Detectable Concentration

The minimum detectable concentration (MDC) is calculated as follows:

$$MDC = \frac{3.29 * \sqrt{\left(\frac{N_B}{(t_B)}(t_s)\right)(1+\frac{t_s}{t_B})} + 2.71}{(t_s)(\mathrm{CC})(IF)(DF1)(DF2)(aliquot)(acf)(ucf)}$$

NOTE that this simplifies to (2.71/t + 4.65*SB)/K for paired counts.

7.3.10 Decision Level Concentration

The Decision Level Concentration (DLC) is calculated as follows:

$$DLC = \frac{1.645 * \sqrt{\left(\frac{N_B}{(t_B)}(t_s)\right)(1+\frac{t_s}{t_B})}}{(t_s)(\mathrm{CC})(IF)(DF1)(DF2)(aliquot)(acf)(ucf)}$$

NOTE that this simplifies to 2.33*SB/K for paired counts.

7.4 <u>Radium-228 by Method 904.0 (Radium-228)</u>

7.4.1 Nuclear Data

Default nuclear data for Radium-228 are tabulated below (**Table 7-4**).

Table 7-4. Default Nuclear Data - Radium-228

Nuclide	α/β	$T_{1/2}$	λ	Nuclide Abundance	Decay Particle Energies (keV)
Ra-228	β	2100	3.301E-04	1.000	β_{avg} = 0.380 MeV
Ac-228	β	0.2563	2.705	1.000	Ac-228: β_{avg} = 0.440 MeV
Sr-89	β	5.053E+01	1.372E-02	1.000	Sr-89: β_{max} = 1.495 MeV; β_{avg} = 0.585 MeV

7.4.2 Abundance

Ra-228 decays 100% by beta emission to Ac-228. Ac-228 also decays 100% by beta emission to Th-228. Thus, the abundance need not be reflected in equations.

7.4.3 Aliquot

The size of the portion of sample taken for analysis is measured at initiation of the sample preparation. It is entered as measured in the appropriate units (grams for solids, liters for liquids, sample (for fraction of sample)). Unless otherwise noted, it is assumed that the aliquot for liquid samples will be entered and reported on an "as-received" basis and that the aliquot for solid samples will be entered and reported on a "dry-weight" basis.

7.4.4 Chemical Yield for Ra-228

The carrier chemical yield for Radium-228, YRa, is calculated as the simple product of the observed yields for Ba/Ra, YBa and Y/Ac, YY as follows:

$$Y_{Ra} = Y_{Ba} * Y_Y$$

$$\%Y_{Ra} = Y_{Ra} * 100$$

The fractional gravimetric yield of Ba/Ra, YBa, is determined by measuring the recovery of a known quantity of Ba added to each sample and recovered as the sulfate. The barium is weighed as the sulfate and the yield is calculated as follows:

$$Y_{Ba} = \frac{\left(M_{g(Ba)} - M_{p(Ba)}\right)\left(1000\right)}{\left(\frac{\left(V_{c(Ba)}\right)\left(C_{c(Ba)}\right)}{\left(F_{(Ba)}\right)}\right)}$$

$$\%\mathrm{Y}_{\mathrm{Ba}} = \mathrm{Y}_{\mathrm{Ba}} \text{ x } 100$$

Where:

Y(Ba)	=	Fractional gravimetric yield for Ba/Ra
%Y(Ba)	=	percent yield for barium = Y(Ba) * 100
Mp(Ba)	=	Tare mass of filter / planchet (g)
Mg(Ba)	=	Gross mass of Ra recovered weighed as BaSO4 plus planchet (g)
Cc(Ba)	=	Concentration of Ba carrier added to sample (mg Ba2+ / mL)
Vc(Ba)	=	Volume of Ba carrier added (mL)
F(Ba)	=	0.5884 = gravimetric factor g Ba2+/g BaSO4

$F_{(Ba)}$ may be determined empirically by precipitating Ba under the same conditions as used for the final precipitation.

The fractional gravimetric yield of Y/Ac, $Y_{Y,}$ is determined by measuring the recovery of a known quantity of Y added to each sample. The yttrium is precipitated as the oxalate and may be weighed as such (in such cases, the known value is obtained empirically by precipitating yttrium under the same conditions as the final precipitation). Alternatively the oxalate precipitate may be converted to the oxide and the yield is calculated as follows:

$$Y_{(Y)} = \frac{\left(M_{g(Y)} - M_{p(Y)}\right)\left(1000\right)}{\left(\frac{\left(V_{c(Y)}\right)\left(C_{c(Y)}\right)}{\left(F_{(Y)}\right)}\right)}$$

$$\%\mathrm{Y_Y} = \mathrm{Y_Y}\ \mathrm{x}\,100$$

Where:

Y(Y)	=	Fractional gravimetric yield for yttrium
%Y(Y)	=	percent yield for yttrium = Y(Y) * 100
Mg(Y)	=	Gross mass of Y recovered weighed as Y2O3 plus planchet (g)
Mp(Y)	=	Tare mass of planchet (g)
Cc(Y)	=	Concentration of Y carrier added to sample (mg Y3+ / mL)
Vc(Y)	=	Volume of Y carrier added (mL)
F(Y)	=	0.7874 = gravimetric factor g Y_3+/g Y_2O_3

NOTE: If yttrium oxalate is weighed, a gravimetric factor (i.e., Y_3+/g $Y_2(C_2O_4)^{3*}$ nH_2O) may be empirically determined by processing replicate aliquots of carrier solution in a manner equivalent to that used in the procedure.

7.4.5 Radium-228 Activity

Calculate the concentration of 228Ra as follows:

$$Act_{Ra} = \frac{\left(N_s/t_s\right) - \left(N_B/t_B\right)}{\left(\mathrm{eff}\right)\left(IF\right)\left(DF1\right)\left(DF2\right)\left(DF3\right)\left(Y_{Ra}\right)\left(aliquot\right)\left(acf\right)\left(ucf\right)}$$

Where:

N_s	=	Beta counts registered during the counting period (counts)
t_s	=	Duration of the sample counting period (min)
N_B	=	Beta counts registered during the background measurement counting period (counts)
t_B	=	Duration of the background counting period (min)
eff	=	Detection Efficiency for Sr-89 for the detector used for the sample measurement
IF	=	Correction for the ingrowth of progeny between the time of separation and the mid-point of the count.
DF1	=	Correction for the decay of Ac-228 between the beginning of Ac-228 decay and the initiation of the count
DF2	=	Correction for the decay of Ac-228 during the count
DF3	=	Correction for the decay of Ra-228 between sample reference date (e.g., collection date) and the beginning of Ac-228 decay, (days)
Aliquot	=	Sample aliquot, L or g
acf	=	activity correction factor
ucf	=	aliquot units correction factor

7.4.6 Ingrowth Factor

An ingrowth correction is used to determine the build-up of Ac-228 following the start of Ac ingrowth (last precipitation of barium prior to ingrowth) and the separation of Ac from Ra and beginning of Ac decay (the first barium sulfate precipitation following ingrowth) as follows:

$$IF = 1 - e^{-\left(\lambda_{228_{Ac}} * t_1\right)}$$

Where:

λ_{228Ac}	=	Decay constant for ^{228}Rn = 2.705 day^{-1}
t_1	=	Elapsed time between the start of Ac-228 ingrowth and the start of Ac-228 decay, (days)

7.4.7 Decay Factors

Three decay correction factors correct for decay of Ac-228. The first (DF1) addresses decay between the start of Ac-228 decay and the initiation of the count. The second decay factor (DF2) corrects for decay during the actual counting period. The third decay factor (DF3) corrects for decay of radium-228 in the original sample to a reference date.

$$\mathrm{DF1} = e^{-\left(\lambda_{228_{Ac}} * t_2\right)}$$

$$\mathrm{DF2} = \frac{1 - e^{-\left(\lambda_{228_{Ac}} * t_3\right)}}{\lambda_{228_{Ac}} \times t_3}$$

$$\mathrm{DF3} = e^{-\left(\lambda_{228_{Ra}} * t_4\right)}$$

Where:

λ_{228Ac}	=	Decay constant for ^{228}Ac = 2.705 day^{-1}
λ_{228Ra}	=	Decay constant for ^{228}Ra = 3.301E-04 day^{-1}
t_2	=	Elapsed time between the beginning of Ac-228 decay and the start time of the count, (days)
t_3	=	Count duration, (days)
t_4	=	Time elapsed between sample reference date (e.g., collection date) and the beginning of Ac-228 decay, (days)

7.4.8 Efficiency Calibration

Sr-89 is used for calibrating each detector for measurement of Ac-228. The efficiency is calculated as follows:

$$Eff_{Sr89} = \frac{\left(N_{cal}/t_{cal}\right) - \left(N_B/t_B\right)}{\left(Act_{Sr89}\right)\left(DF\right)}$$

Where:

Act_{Sr89}	=	Activity of Sr-89 added to the calibration standard (dpm)

N_{cal}	=	Gross counts registered during the calibration counting period (counts)
T_{cal}	=	Duration of the calibration counting period (min)
N_B	=	Gross counts registered during the background measurement counting period (counts)
t_B	=	Duration of the background counting period (min)
DF	=	Correction for the decay of Sr-89 between the activity reference date/time and the midpoint of the calibration count

7.4.9 Counting Uncertainty

The one-sigma uncertainty (1sCU) in the net sample counting rate is calculated as follows:

$$1sCU = \frac{\sqrt{\left(N_s / t_s\right) + \left(N_B / t_B\right)}}{(\text{eff})(\text{IF})(\text{DF1})(\text{DF2})(\text{DF3})(\text{Y}_{\text{Ra}})(\text{aliquot})(\text{acf})(\text{ucf})}$$

The 1sCU is reported at various confidence intervals by applying the appropriate coverage factor.

$$\text{CU} = \text{CF} * 1\text{sCU}$$

7.4.10 CSU (COMBINED STANDARD UNCERTAINTY - A.K.A. TPU)

The formula for the CSU is defined as follows:

$$CSU = CF * \sqrt{(1sCU)^2 + \left(Activity * \sqrt{Factor1^2 + Factor2^2 + Factor3^2 + Factor4^2 + Factor5^2 + Factor6^2}\right)^2}$$

Where:

FACTOR1 – FACTOR 6	=	fractional factors accounting for the relative uncertainty associated with identified sources of systematic uncertainty

NOTE: The CSU formula assumes that the 1sCU is entered at the one-sigma level.

7.4.11 Minimum Detectable Concentration

The minimum detectable concentration (MDC) is calculated as follows:

$$MDC = \frac{3.29 * \sqrt{\left(\frac{N_B}{(t_B)}(t_s)\right)(1 + \frac{t_s}{t_B})} + 2.71}{(t_s)(\text{eff})(\text{IF})(\text{DF1})(\text{DF2})(\text{DF3})(\text{Y}_{\text{Ra}})(\text{aliquot})(\text{acf})(\text{ucf})}$$

NOTE that this simplifies to (2.71/t + 4.65*SB)/K for paired counts

7.4.12 Decision Level Concentration

The Decision Level Concentration (DLC) is calculated as follows:

$$DLC = \frac{1.645 * \sqrt{\left(\frac{N_B}{(t_B)}(t_s)\right)(1+\frac{t_s}{t_B})}}{(t_s)(\text{eff})(\text{IF})(\text{DF1})(\text{DF2})(\text{DF3})(\text{Y}_{\text{Ra}})(\text{aliquot})(\text{acf})(\text{ucf})}$$

NOTE that this simplifies to 2.33* SB/K for paired counts.

7.5 <u>Precision</u>

The degree of agreement between the numerical values of a set of replicate/duplicate samples performed in an identical fashion constitutes the precision of the measurement. Precision is checked during collection of data using field methods and/or instruments by reporting measurements at one location and comparing results. The measurements are considered sufficiently precise only if the values are within a specified % of each other. Control limits for control sample analyses, acceptability limits for replicate analyses, and response factor agreement criteria specified for calibration and internal QC checks are based upon precision.

Control limits for control sample analyses, acceptability limits for replicate analyses, and response factor agreement criteria specified for calibration and internal QC checks for laboratory analyses subject to duplicate analysis are based upon precision in terms of the coefficient of variation (CV) or the RPD. The standard deviation (S) of a sample set is calculated as:

$$S = \sqrt{\frac{\sum\left(x-\bar{x}\right)^2}{(n-1)}}$$

Where:

x	=	Individual measurement result;
$\bar{x}$	=	Mean value of individual measurement results; and
n	=	Number of measurements.

The CV as a % is then calculated as:

$$CV = \left(\frac{S}{\bar{x}}\right) \times 100$$

The RPD calculation allows for the comparison of two analysis values in terms of precision with no estimate of accuracy. RPD is calculated as:

$$RPD = \left(\frac{m-M}{\bar{M}}\right) \times 100$$

Where:

m	=	First measurement value;

M = Second measurement value; and
$\overline{M}$ = Mean value of M and m.

CV is related to RPD for duplicate measurements by the following:

$$CV = \frac{RPD}{\sqrt{2}}$$

Duplicates are also evaluated *Normalized Absolute Difference (DER)*: The Normalized Absolute Difference between the LCS and LCSD is used to determine that the results do not differ significantly (at the 99% confidence interval) when compared to their respective combined standard uncertainty. A DER of less than or equal to 3 is considered acceptable.

$$DER = \frac{|S - D|}{\sqrt{(CSU_S)^2 + (CSU_D)^2}}$$

Where:

S	=	LCS result
D	=	Duplicate result
CSU_S	=	Combined Standard Uncertainty of the LCS
CSU_D	=	Combined Standard Uncertainty of the duplicate

NOTE: A test value of '3' corresponds to a 99+% confidence level.

Unless other requirements are established by the client or program, when either the DER or the RPD meet acceptance criteria, the duplicate is considered to be acceptable. When the duplicate acceptance criteria are not met, all associated samples in the QC batch are reanalyzed beginning with preparation. A nonconformance report is filed in accordance with *ARS-013 - "Nonconformance Reporting and Corrective Action Program."* The occurrence of failed acceptance criteria and the actions taken are noted in the case narrative.

7.6 Accuracy

Accuracy is the degree of agreement of a measurement, X, with an accepted reference or true value, T. Accuracy is usually expressed as the difference between the two values, X-T, or the difference as a % of the reference or true value, 100(X-T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system and is assessed by means of reference samples and % recoveries. Error may arise from personnel, instrument, or method factors.
Two types of analytical check samples can be used: LCS (blank spike) and MS. Analytical accuracy is expressed as the % recovery of an analyte that has been added to the control samples or a standard matrix (e.g., blank soil, analyte-free water, etc.) at a known concentration prior to analysis.

The accuracy of data is typically summarized in terms of relative error (RE). This calculation reflects the degree to which the measured value agrees with the actual value, in terms of % of the actual value. RE is calculated as:

$$\% \ RE = \frac{Measured\ Value - Actual\ Value}{Actual\ Value} \times 100$$

This way of expressing accuracy allows for a comparison of accuracy at different levels (e.g., different concentrations) and for different parameters of the same type (e.g., different compounds analyzed by the same method). Control sample analyses are typically evaluated using this calculation.

Another calculation is frequently used to assess the accuracy of a procedure. Percent recovery is a calculation used to determine the performance of many of the QC checks, where:

$$\% \ \mathrm{Recovery} = \frac{Measured\ Value}{Actual\ Value} \times 100$$

Another similar calculation used to determine the performance of a method for recovery of a spike concentration added to a sample is the % spike recovery calculation. The % spike recovery is determined as:

$$\% \ Spike\ \mathrm{Recovery} = \frac{\left[\left(Measured\ Sample\ Value\ Plus\ Spike\right) - \left(Measured\ Sample\ Value\right)\right]}{\left(Value\ of\ Spike\ Added\right)} \times 100$$

Results that do not satisfy the objectives are assigned a data qualifier flag to indicate uncertainty associated with inaccuracy.

Confidence intervals can be calculated for an analytical method if performance audit samples are submitted or a series of LCSs or MSs are analyzed. The results are used to define confidence intervals for the recovery of each compound analyzed.

7.7 Blank Data Assessment

Method/reagent blanks are analyzed to account for other sources (external to the sample) of interference specific to radiological and chemical analyses. The samples associated with the blank may be qualified to evaluate whether some or all of the detected analytes may be from laboratory sources if interference is indicated in method blanks. If the concentrations reported in the samples are similar to the blank concentrations, it is likely that all of the contamination was introduced, and this assessment is typically made by the analytical laboratory and reported in the analytical deliverable package.

7.8 Completeness

Completeness is a measure of the degree to which the amount of sample data collected meets the scope and a measure of the relative number of analytical data points that meet the acceptance

criteria, including accuracy, precision, and any other criteria required by the specific analytical method used. Completeness is defined as a comparison of the actual numbers of valid data points and expected numbers of points expressed as a %.

The QA objectives for completeness will be based upon a project goal of 90%.
Difficulties encountered while handling samples in the laboratory (radiological or physical/chemical) as well as unforeseen complications regarding analytical methods, may affect completeness during sample analysis.

Accordingly, to ensure that 90% completeness is obtained, certain efforts may need to be employed, including, but not limited to re-sampling.

Completeness is calculated after the QC data have been evaluated, and the results applied to the measurement data. In addition to results identified as being outside of the QC limits established for the method, broken or spilled samples, or samples that could not be analyzed for any other reason are included in the assessment of completeness. The % of valid results is reported as completeness. The completeness will be calculated as follows:

$$Completeness\ (\%) = \frac{T - (I + NC)}{T} \times 100$$

Where:

T	=	Total number of expected measurements for a method and matrix;
I	=	Number of invalidated results for a method and matrix; and
NC	=	Number of results not collected (e.g., bottles broken etc.) for a method and a matrix.

8.0 DATA REPORTING

The data reporting procedures described in this section will ensure that complete documentation is maintained Laboratory data production and management are described in the ARS LQAP (Appendix A). ARSEC will maintain documentation and records to support information provided to USACE for the Tonawanda Landfill Operable Unit FUSRAP Remedial Investigation project. These records will be forwarded to USACE, if requested. Original copies of field data, field records, analytical data, training records, and other project-specific documentation will be retained by ARSEC in a manner and for durations required in ARSEC Operating Procedures.

8.1 Data Package Format and Contents

Analytical data reports will conform to the requirements of DOD QSM Appendix A.
Reports will contain final results, analytical methods, detection limits, and results of QC samples. In addition, special analytical problems and/or any modifications of referenced methods will be noted in the case narrative. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Data are generally reported in units commonly used for the analyses performed. Concentrations in TCLP extracts are expressed in terms of activity or mass per unit volume (e.g., pCi/L or µg/L). Concentrations in solid or semisolid matrices are expressed in terms of activity or mass per unit mass of sample (e.g., pCi/g or mg/kg). QC results will be reported by sample matrix and analytical method in tabular form. The measurement data will be discussed and qualified as appropriate based on the QC results.

The final data reports provided by ARS will include:

- Cover sheet
- Table of Contents
- Case Narrative
- Original Chain of Custody
- Analytical Results
- Sample Management Records
- QA/QC Information
- Raw Data
- Calibration data
- Performance Standards
- Calculations and
- Supporting documentation.

8.2 Electronic Deliverables

8.2.1 Electronic Data Deliverable

The ARS Data Management systems are fully compliant with *EPA 2185 – Good Automated Laboratory Practices* (GALP).

Electronic data submitted by ARS will be thoroughly reviewed to ensure that it is error free and in complete agreement with the hardcopy data. The standard electronic data deliverable (EDD) will be in MS Excel format as either an .xls or .csv file. The file will contain the following fields:

- Sample ID
- Lab ID
- Sample type (normal, dup, LCS, Blank, etc)
- Matrix
- Collection, extraction and analysis dates
- Method of analysis
- Sample Delivery Group Number (SDG#)
- Batch Number
- CAS number
- Compound/Element/Isotope
- Sample result
- Combined Standard Uncertainty
- Units
- Lab qualifier
- MDC/MDL
- Dilution factor
- LCS, MS/MSD, Tracer & Chemical calculated % recoveries
- Spiked Concentration for LCS, MS/MSD, Tracer and Chemical recoveries
- RPD calculated value with upper and lower control limits

If requested by the USACE, the EDD can also be submitted in the Staged Electronic Data Deliverable (SEDD) format.

8.2.2 Risk Assessment Database Deliverable

ARSEC will develop a Microsoft Access database to be used by USACE engineers to perform risk assessment analysis. The database will include all of the information in the above listed EDD as well as the following information:

- Location
- Date Collected
- Matrix
- Starting Depth
- Ending Depth
- Sample Code

- Analyte Category (i.e. radiochemistry, VOC, SVOCs, etc.)
- Parameter Name
- CAS Number
- Units
- Final Flag (in addition to the laboratory qualifier flags)
- Analytical Method Code
- Uncertainty for radiochemical analyses

The final format of the database will be approved by the USACE prior to implementation.

8.3 Laboratory Turnaround Time

In accordance with the USACE SOW (USACE, 2009), the ARS Standard TAT is 28 calendar days (21 working days), defined as the time from sample collection until the receipt of the full data report by USACE.

8.4 Data Archival/Retention Requirements

All Quality Records and Documents which include original observations (including logbooks and forms), calculations and derived data, calibration records, report copies, reports from internal audits and management reviews, and records of corrective actions are controlled. All processes contributing to the generation of quality related data or observations are recorded in a controlled manner.

8.4.1 Security and Confidence

All Quality Records and Documents are safely stored, held secure and in confidence to the client, and available for review. Quality Records and Documents are held in a secure facility or locked storage or on a secure server with controlled access.

8.4.2 Record Retention and Disposition

The ARSEC minimum retention period for Quality Records and Documents is five years. Quality Records and Documents may be retained for longer periods if required by a client and agreed to by ARSEC.

Hardcopy data and data storage media will be archived in a manner and for durations required in ARSEC Operating Procedure, AP-001, *Record Retention* included in the FSP (ARSEC, 2009b) and ARS-049 *Document Control and Records Management*.

9.0 DATA REVIEW

9.1 Data Quality Review

Data quality review includes the review of analytical data, field and laboratory QA reports, and all data submittals. ARSEC's PM will direct the Project Team in the final verification and reconciliation of the data results and the data review process with the project DQOs in regard to:

- The perspective of the end data user;
- Concentrations of the radiological and chemical COCs;
- The final number of samples, sampling locations, and site media;
- Lateral and vertical study boundaries; and
- Performance and appropriateness of the field survey techniques and laboratory analyses and methods that were utilized.

9.2 Analytical Data Review

System reviews are performed at all levels. The individual analyst constantly reviews the quality of data through calibration checks, QC sample results, and performance evaluation samples. These reviews are performed and documented before submitting data to the ARS PM.

Criteria for analytical data review/verification include checks for internal consistency, transmittal errors, laboratory protocol, and laboratory QC. QC sample results and information documented in field notes will be used to interpret and evaluate laboratory data. The ARS QA section independently conducts a review of the data package to eliminate technical errors that might affect the quality of the data.

ARS will complete standard review procedures, including:

- Proofing analyses requested with analyses performed;
- Preliminary data proofing for anomalies—investigation and corrections, where possible;
- Proofing of laboratory data sheets for RDLs, holding times, surrogate recovery performance, and spike recovery performance; and
- Double-checking computerized data entry, if required.

The ARS Laboratory PM will review data for consistency and reasonableness with other generated data and determine whether program requirements have been satisfied. Unusual or unexpected results will be reviewed, and a resolution will be made as to whether the analyses should be repeated.

The ARS PM will verify that the report deliverable is complete and in proper format, and screen the report for compliance with laboratory and client QA/QC requirements prior to final review/signoff. The ARS QA Officer and Laboratory Manager will perform the final review. The ARS Laboratory PM will perform a final completeness check before submitting the data report to ARSEC.

The data review report will include a narrative explanation of what samples the report applies to, a reference to the criteria or procedures used for data review, and a description of which results were determined to be unacceptable for the intended application and why. This report will accompany the QC data summary.

9.3 Data Verification/Validation

Independent, third party review of the laboratory data is not currently scheduled or provided for in the USACE SOWs (USACE, 2001), but may be utilized on an as-needed basis as indicated by data-quality conditions. The USACE will be contacted for direction to proceed prior to utilization, if such is implemented.

9.4 Project Completeness Assessment

Project completeness assessment is the measure of the volume of qualified data compared to the planned data volume and whether that data is sufficient to meet project objectives. The QA objectives for completeness will be based upon a project goal of 90%.

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APPENDIX A

LABORATORY QUALITY ASSURANCE PLANS – ARS INTERNATIONAL AND TESTAMERICA LABORATORIES

(Included on CD)

ARS INTERNATIONAL

LABORATORY QUALITY ASSURANCE PLAN

American Radiation Services, Inc.

LABORATORY QUALITY ASSURANCE MANUAL

Revision 12
Effective Date: 07/17/09
Last Reviewed: 07/17/09

Laboratory Director Approval
2690 North River Rd | Port Allen, Louisiana 70767 | PH: 225.223.8225

Quality Assurance Officer Approval
2690 North River Rd | Port Allen, Louisiana 70767 | PH: 225.505.0596

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APPENDIX D DATA QUALITY OBJECTIVES FOR VARIOUS ANALYSIS AND ANALYTES

1. LEGAL IDENTIFICATION

ARS International was incorporated in the State of Louisiana, Parish of East Baton Rouge on October 29, 1993. The legal name of the corporation is:

AMERICAN RADIATION SERVICES, INC.

The registered agent for the corporation is Danny L. Coleman.

The current mailing address, telephone and facsimile numbers for the corporation are as follows:

ARS International
2609 North River Road
Port Allen, LA 70767
Telephone: (225) 381-2991
Facsimile: (225) 381-2996

2. INTRODUCTION

This manual is issued to describe the quality assurance system employed at ARS International (ARS). The policy of ARS is to apply the system to all testing and analytical activities undertaken on behalf of customers or accrediting organizations. The ARS Quality Assurance program and manual is applicable to all permanent, temporary and mobile laboratory facilities owned and operated by ARS International

ARS International performs analysis of sample material of various matrixes for radioisotope constituents. Analytical services currently offered by ARS include gamma spectroscopy, alpha spectroscopy, low background alpha and beta counting, liquid scintillation analysis, alpha scintillation and tritium enrichment for low level tritium.

ARS International shall use acceptable test methods approved by the Louisiana Department of Environmental Quality and other accrediting agencies when performing radiological analysis. Acceptable methods are defined as methods cited in Title 40 of the Code of Federal Regulations (40 CFR) and subsequent changes published in the Federal Register, other published methods from such sources as the Environmental Protection Agency (EPA), Department of Energy (DOE), Department of Defense (DOD), *Standard Methods for the Examination of Water and Wastewater*, American Standards for Testing and Measurement (ASTM), National Institute for Occupational Safety and Health (NIOSH), United States Geological Survey (USGS), and other approved test procedures. .

This manual provides personnel and customers of ARS International with a description of company policy for maintaining an effective quality assurance system. Standard Operating Procedures and various quality assurance procedures utilized by the laboratory are contained in the manual. Laboratory support procedures describing methodology used to meet various governmental regulations concerning radioactive materials and the requirements of the ARS International Radioactive Material License are also contained in this manual, as they directly affect the operation of the ARS radiological laboratory. Specific ARS International quality assurance procedures are referenced when a more detailed explanation is required. These procedures and the Quality Assurance Manual are binding on all personnel of the laboratory and shall be adhered to implicitly.

The use of the words “shall”, “must” and “will” in this QA Manual constitute a requirement. The use of the word “should” and “may” in this QA Manual constitutes a recommendation, and does not constitute a requirement.

All forms appearing in this QA Manual are represented as examples; actual forms used by the laboratory may differ from the examples.

3. LETTER OF PROMULGATION

The Quality Assurance Program described in this Quality Assurance Manual has the absolute and unquantified support of ARS International management. Our established goal-deliverance of highest quality service at a fair price is the same today as when the laboratory was founded in 1993.

Our testing and analytical services, their precision and accuracy, the care with which they are conducted, and their customer acceptance are the means by which ARS International has gained an enviable reputation and has become a leader in the industry. This high standard of service shall be maintained. Quality is our number one priority and every member of the laboratory staff shares the responsibility of maintaining our present status.

The overall objective of the ARS International quality system is to provide legally defensible results to our clients.

At ARS International quality is the responsibility of every employee. Meeting this commitment will result in the continued satisfaction of our customers and an improved quality of life for our employees.

Executive and Laboratory management are committed to good professional practices and to the quality of environmental testing and calibration services provided to our clients.

Executive and laboratory management are committed to maintaining compliance with the NELAC standard and all other applicable standards include the *DOE Quality Systems for Analytical Services* (QSAS), the *DOD Quality Systems Manual* (QSM) and ANSI NQA-1 – *Quality Assurance Requirements for Nuclear Facility Applications.*.

The provisions of this manual, which define and document ARS International policies and objective for quality, are binding on those individuals given the responsibilities outlined herein. ARS International is committed to acceptance of the practices and quality of testing services described in this manual.

All personnel concerned with environmental testing and calibration activities within the laboratory shall familiarize themselves with this Quality Assurance Manual, quality procedures and quality documentation and shall implement the described quality polices and procedures in their work. I expect everyone concerned to use this manual as a guide to the continued maintenance and improvement of the quality of our laboratory services.

Sincerely,

[redacted]

President, ARS International

4. CERTIFICATIONS AND ACCREDITATIONS

4.1 ARS International, at a minimum, maintains certifications and accreditations with the below listed agencies and regulatory bodies. ARS International may also obtain and maintain additional certifications and accreditations. A listing of additional certifications and accreditations may be obtained by contacting the ARS International Quality Assurance Officer(s).

State of Louisiana, Department of Environmental Quality, Environmental Laboratory Accreditation.

State of Louisiana, Department of Environmental Quality, Radioactive Material License, No. LA-7153-L01

State of New Mexico, Environmental Department – Drinking water Bureau, Drinking Water Certification

NELAC (National Environmental Laboratory Accreditation Conference), State of Florida.

United States Environmental Protection Agency, Region VIII, Drinking Water Laboratory Certification.

United State Department of Agriculture, Permit to Receive Soil, Permit Number P330-07-00074

Envirocare of Utah, Inc., Waste Characterization Certification.

New York Environmental Laboratory Accreditation Program (ELAP)

Pennsylvania Department of Environmental Protection Laboratory Accreditation

Department of Energy (DOE), Department of Defense (DOD) and Homeland Security Approved Laboratory

United Kingdom Nuclear Decommissioning Authority Approved Laboratory

In process

- California
- Arizona
- Nevada
- Texas

4.2 ARS shall display their most recent NELAP certificates on the secure bulletin board located in the breakroom (kitchen).

4.3 ARS uses the current certification numbers identified by the primary certification agencies on general literature such as catalogs, advertising, business solicitations, proposals, quotations, laboratory analytical reports or other materials.

4.4 ARS shall not use their NELAP certificate, NELAP accreditation status and/or any client logo in such a manner as to imply endorsement.

5. ETHICAL STANDARDS FOR ARS INTERNATIONAL

These principles are intended to aid employees of ARS International, individually and collectively, in maintaining a personal and professional level of ethical conduct. They are intended as guidelines by which employees may determine the propriety of their conduct and actions relating to co-workers, clients, and governmental agencies, members of other professions, the public and services performed by ARS International for clients.

5.1 All relations with employers, co-workers, clients, governmental agencies and the general public shall be based upon and shall reflect the highest standard of integrity and fairness.

5.2 Employees shall not falsify or otherwise misrepresent data or reports. Employees may report data integrity issues to laboratory management when the need for further detailed investigation may be required. Such reports shall be maintained in confidence by laboratory management.

5.3 Employees shall protect the sources of confidential materials and communications, provided that such protection is not itself unethical or illegal.

5.4 Each employee shall be a judge of his/her competence and will not undertake any assignment beyond his/her abilities.

5.5 Employees shall never compromise another's welfare and safety in favor of their own interest or an employer's or client's interest.

5.6 No action shall be performed or undertaken which is contrary to law.

5.7 Laboratory personnel should be prepared to testify that applicable samples were in their possession, view, or secured at all times in the laboratory, from the moment received until the time the analyses are complete or the samples disposed.

Employees of ARS International shall be instructed on the Ethical Policy upon employment. A copy of the Ethical Policy shall be signed by each employee and maintained in their training record file.

6. UNRESTRICTED QUALITY PERFORMANCE POLICY

6.1 It is the policy of ARS International to ensure that personnel involved in analytical testing and Quality Assurance / Quality Control operations are free from any commercial, financial and other undue pressures that may adversely affect the quality of their work.

6.2 All personnel involved in analytical testing and Quality Assurance / Quality Control (QA/QC) operations shall be aware that quality must be maintained at the highest possible standards. Management must be aware that personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

6.3 Personnel conducting independent assessments have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the results of such assessments to laboratory management.

6.4 ARS International shall not discriminate against any employee with regards to the employee maintaining the QA/QC standards of ARS International However, failure to maintain QA/QC standards may result in disciplinary actions, up to and including termination of employment.

6.5 Employees of ARS International shall be instructed on the Unrestricted Quality Performance Policy upon employment. A copy of the Unrestricted Quality Performance Policy shall be signed by each employee and maintained in their training record file.

7. QUALITY SYSTEM REVIEW

7.1 Quarterly Review

7.1.1 The Quality Assurance Department shall provide management with quarterly progress reports. Quarterly progress reports shall address calendar quarters and are due by the 15th day of the month following the reporting period. Reports shall be due by the 15th day of January, April, July, and October. In addition to the quarterly reporting requirement, management shall immediately be notified of issues relating to items (7.1.1.5) and (7.1.1.6) below. Emphasis should be placed on the following items for inclusion in the quarterly progress reports.

7.1.1.1 New analysis methods and changes in old methods.

7.1.1.2 Summaries of nonconformance reports (NCRs) and Corrective Action Reports (CARs) for the reporting period.

7.1.1.3 Descriptions of changes in the Quality Assurance Program that affect the analysis of or documentation for samples.

7.1.1.4 Changes in QA and key technical personnel, including resumes of new personnel.

7.1.1.5 Changes in certification status with any regulatory or certifying agencies.

7.1.1.6 Loss of capability to perform any service that is specified in existing laboratory contracts.

7.1.1.7 Results of any internal audits and surveillances performed.

7.1.1.8 Photocopies of new or updated radioactive material licenses shall be included with the quarterly progress report.

7.1.1.9 Results of any Performance Evaluation studies or analysis. All results received by the laboratory since the last quarterly report and more than one week before the due date shall be included. Results received less than one week before the due date may be held for inclusion in the next quarters report.

7.1.1.10 Any discrepancies noted during a review of instrument logbooks and the results of any applicable corrective actions taken.

7.1.1.11 Any procedure revisions.

7.1.1.12 A review of Corrective Action Reports looking for trends.

7.1.2 If no changes occurred concerning subsection (i) through (xi) above during the reporting period, and if no Corrective Action Reports were generated, then a simple statement of these facts may suffice to meet the quarterly progress report requirement.

7.1.3 Quarterly progress reports may also be submitted to clients when required by specific SOWs. E-mail distribution of quarterly progress reports to clients may be acceptable. When applicable, clients should be contacted for submittal requirements.

7.1.4 Clients shall be notified when an audit identifies a concern which has affected the client's data results. *ARS-013 Nonconformance Reporting and Corrective Action Program* should be initiated when an audit identifies a concern which has affected a client's data.

7.2 Management Reviews

See *ARS-123 Management Review*

8. PHYSICAL FACILITIES

8.1 Environment

8.1.1 Laboratory accommodation, test areas, energy sources, lighting, heating and ventilation shall be maintained such that proper performance of analysis and tests can be performed.

8.1.2 The environment in which these activities are undertaken shall be maintained in such a manner as to not invalidate results or adversely affect the required accuracy and precision of a measurement or analysis. Particular care shall be taken when such activities are undertaken at sites other the permanent laboratory premises.

8.1.3 The technical requirements for accommodation and environmental conditions that can affect the results of environmental tests and calibration shall be documented. The laboratory shall provide for the effective monitoring, control and recording of environmental conditions as required by relevant specifications, methods and procedures or where they influence the quality of test results. Such conditions may include, but are not limited to, dust, electromagnetic disturbances, radiation, humidity, electrical supply, temperature and vibration levels. Environmental test shall be stopped when the environmental conditions jeopardize the results of the environmental test. In instances where monitoring or control of any monitored items is specified in a test method or regulation, the laboratory shall meet and document adherence to the monitoring requirements.

8.2 Work Areas

8.2.1 The laboratory shall maintain effective separation between neighboring areas when activities taking place within the areas are incompatible with each other, e.g. sample preparation areas shall be separate from sample counting areas.

8.2.2 Adequate measures shall be taken to ensure good housekeeping in the laboratory to prevent cross contamination and to ensure that contamination does not adversely affect data quality. Prevention of cross contamination shall be in accordance with the Prevention of Sample Contamination section of this Quality Assurance Manual.

8.2.3 Access to and the use of all areas affecting the quality of analytical and testing activities shall be defined and controlled. The extent of the control shall be based on the particular circumstances of the environmental test performed. Special procedures shall be prepared where necessary.

8.2.4 Sizing of work areas shall be such as to ensure an unencumbered and safe work area. Work areas include:

8.2.4.1 Access and entryways to the laboratory;

8.2.4.2 Sample receipt area(s);

8.2.4.3 Sample storage area(s);

8.2.4.4 Chemical and waste storage area(s);

8.2.4.5 Data handling and storage area(s); and,

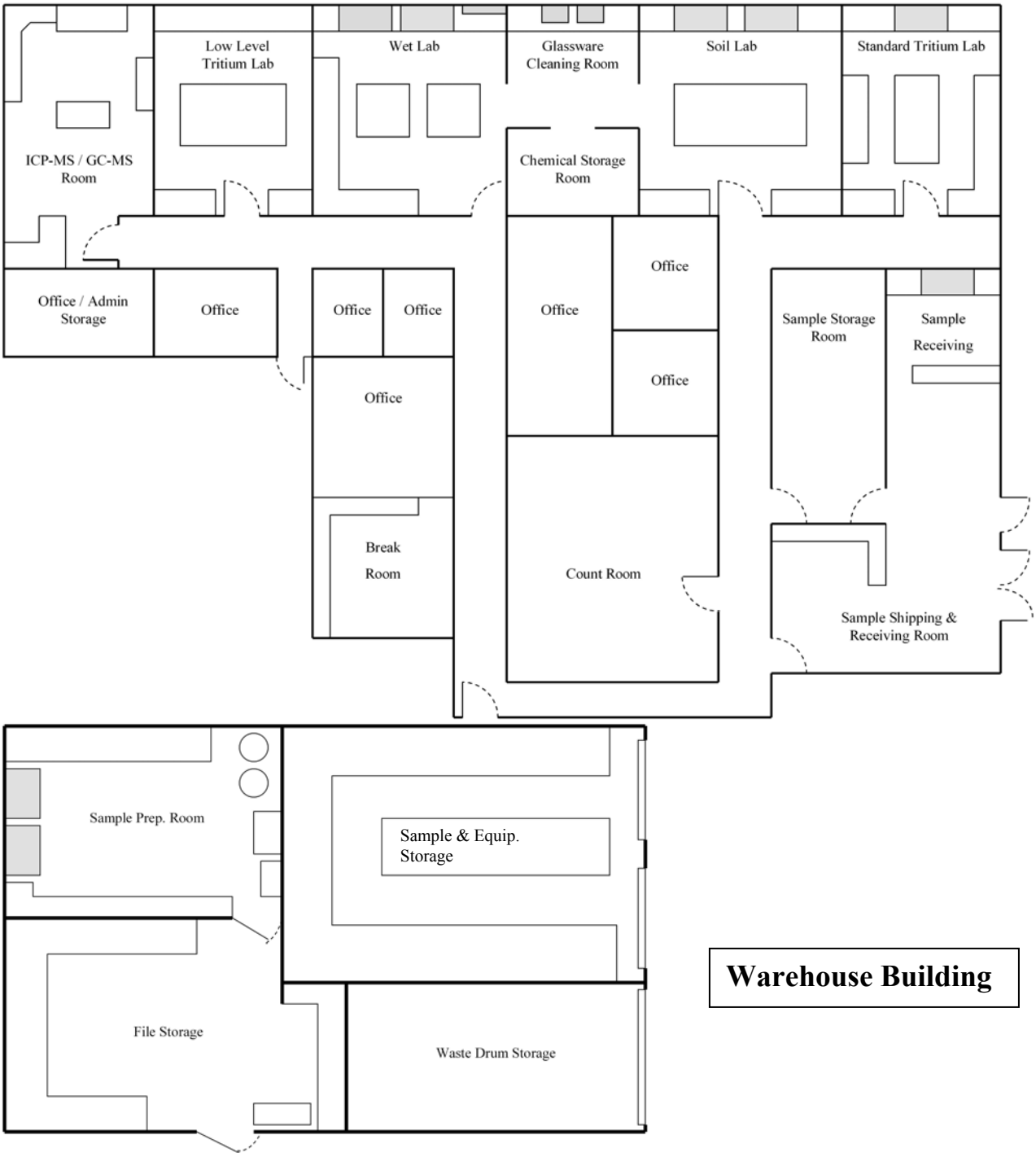
8.2.4.6 Office areas

8.3 New Work

8.3.1 The laboratory shall review all new work e.g., new analysis requested by a client that ARS International has not performed in the past, to ensure that the laboratory has the appropriate facilities and resources available before commencing such work.

ARS International Facility, "Controlled Area"

2609 N. River Road, Port Allen, LA 70767

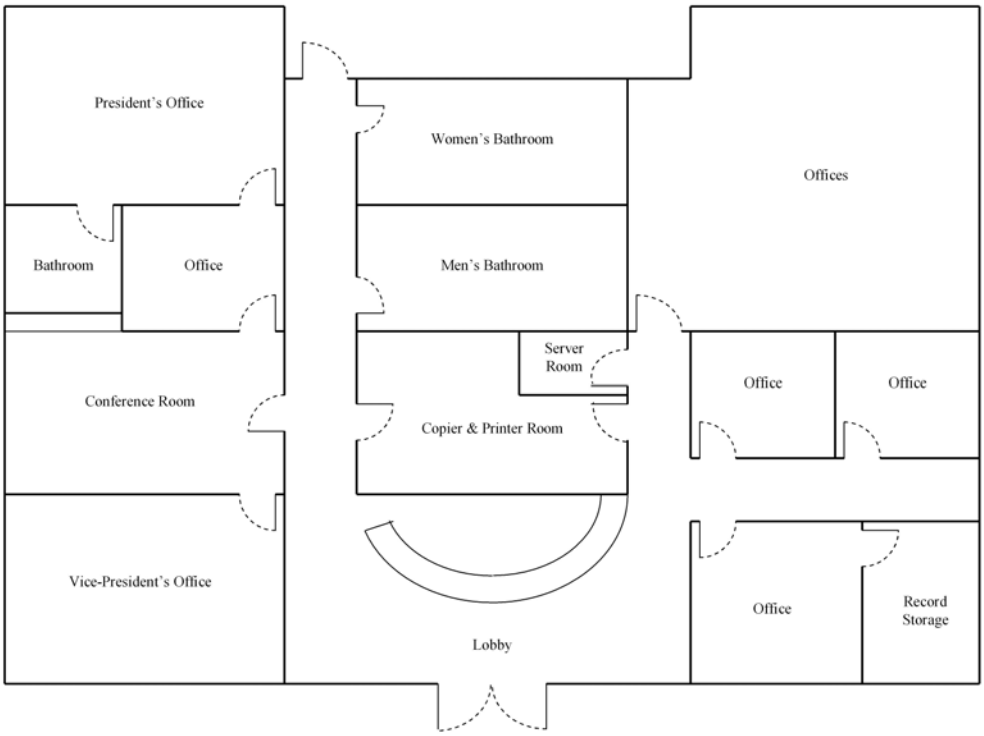


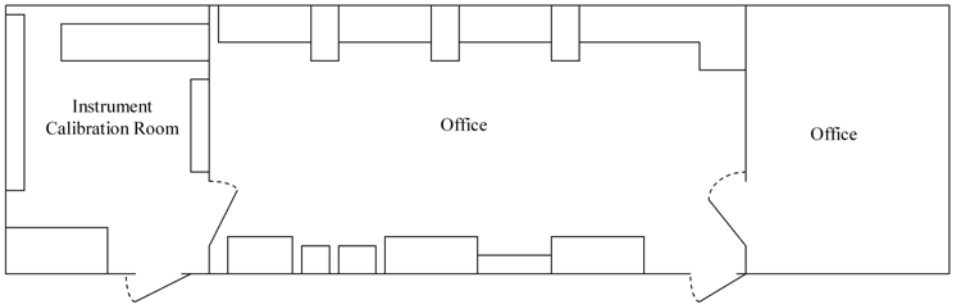
Warehouse Building

ARS International Facility, "Un-controlled Area"

2609 N. River Road, Port Allen, LA 70767

Administrative Offices





Field Trailer

9. FACILITY SECURITY

9.1 Maintaining Facility Security

9.1.1 Security of the ARS International facility shall be maintained by;

9.1.1.1 Key card access entry to the main employee entrance door (on north side of building) and locking all other doors to the facility when ARS International personnel are not present within the facility.

9.1.1.2 Facility keys shall only be issued to ARS International Management employees. Facility keys and key cards shall be collected from personnel upon termination of employment.

9.1.1.3 All visitors and unauthorized employees shall be escorted at all times when in the laboratory facility.

9.1.1.4 Key card access shall be used for all entrance points to all controlled areas of the laboratory, including sample storage, sample preparation and the counting room.

9.1.1.5 Video surveillance is maintained in all laboratory areas for both facility security and safety.

10. QUALITY GOALS AND OBJECTIVES

10.1 Scope

The objective of the ARS International Laboratory Quality Assurance Program is to provide legally defensible data and assure the accuracy, precision, and reliability of laboratory results produced for our customers, or at the request of regulatory or accrediting bodies. Management, administrative, statistical, investigative, preventive, and corrective action techniques will be employed to maximize reliability of the data.

10.2 General Objectives and Requirements

10.2.1 ARS International Management shall be committed to good professional practice and to the quality of its analytical testing and calibration services provided to clients.

10.2.2 ARS International management shall be committed to compliance with NELAC, DOE QSAS, DOD QSM, ANSI NQA 1 and other applicable standards. The

laboratory shall demonstrate compliance with more stringent standards if required in a mandated test method, contract or regulation.

10.2.3 ARS International shall maintain a commitment to accepted laboratory practices and quality of testing services.

10.3 Specific Objectives and Requirements

10.3.1 To develop and put into service test methods capable of meeting the user's needs for precision, accuracy, sensitivity, and specificity.

10.3.2 To provide legally defensible laboratory data to clients.

10.3.3 To establish the level of quality of the laboratory's routine performance as a baseline against which to measure the effectiveness of quality improvement efforts.

10.3.4 To make any changes in quality assurance methodology found necessary.

10.3.5 To monitor the routine operational performance of the laboratory through participation in appropriate interlaboratory testing programs and to provide for corrective actions as necessary.

10.3.6 To improve and validate laboratory methodologies by utilizing data validation techniques and by participating in interlaboratory comparison studies.

10.3.7 To ensure that all staff members receive training in basic quality control and quality assurance, and in sufficient depth to enable them to carry out the provisions of this manual and the ARS International Quality Assurance Procedures.

10.3.8 All personnel concerned with environmental testing and calibration activities within the laboratory shall familiarize themselves with the quality documentation and implement the QA/QC policies and procedures in their work.

10.3.9 Laboratory management shall ensure that the quality policies and objectives are documented in the quality manual.

10.3.10 When the quality manual does not contain the necessary NELAC, DOE QSAS, DOD QSM, ANSI NQA-1 or other contractual requirements, the requirements shall be addressed elsewhere in separate SOP's or policy documents.

11. QUALITY POLICIES

11.1 A total intra-laboratory quality control system to assure continued precision and accuracy of laboratory results shall be established and maintained. The laboratory's QA/QC system's documentation shall be communicated to, understood by, made available to, and implemented by appropriate personnel.

11.2 Quality activities shall emphasize the prevention of quality problems rather than detection and correction of problems after they occur.

11.3 All employees engaged in making decisions affecting the quality of laboratory output shall undergo training designed to be commensurate with their positions, duties, and responsibilities.

11.4 Analytical procedures and test methods based on approved methodologies promulgated by various regulating agencies or published analytical test methods wherever available shall be used.

11.5 Copies of all test and analytical reports shall be retained in a manner and for a period of time specified by this Quality Assurance Manual, approved ARS International quality procedures, contractual requirements and regulatory or accrediting bodies.

11.6 A list of major counting equipment and reference measurement standards used as well as approved facilities and services used by the laboratory in conducting tests. Shall be maintained. The laboratory shall have a comprehensive calibration program involving all instrumentation and equipment used for making determinations, the results of which are reported. Equipment and instrument calibration shall be in accordance with this Quality Assurance Manual and approved ARS International quality procedures.

11.7 Appropriate reagent-grade or better chemicals shall be used. Requirements for reagents and chemicals are contained in approved ARS International analytical procedures or other approved methodologies promulgated by various regulating agencies. The laboratory shall use certified "to deliver" or "to contain" glassware when required by a specific approved analytical procedure.

11.8 All instructions, standards, manuals and reference data relevant to the work of the laboratory shall be readily available to the staff and auditing agencies upon request.

11.9 The laboratory shall establish, implement and maintain a quality system based on the required NELAC, DOE QSAS, DOD QAM, ANSI NQA-1 and/or other contractual elements that are appropriate to the type, range and volume of environmental testing activities it undertakes.

11.10 ARS shall engage in only those activities that do not endanger its competence, impartiality, judgment or integrity.

11.11 The laboratory shall document its policies, systems, programs, procedures and instructions to the extent necessary to assure the quality of the environmental test and/or calibration results.

11.12 The ARS Laboratory Quality Assurance Manual shall include or make reference to supporting procedures including technical procedures and shall outline the structure of the documentation used in the quality system**.**

11.13 Data shall be recorded in such a way that trends are detectable. The monitoring of these trends shall be planned and reviewed, Monitoring shall include, but is not limited to, the following:.

11.13.1 Regular use of certified reference materials and/or internal quality control using secondary reference materials;

11.13.2 Participation in interlaboratory comparison or proficiency testing programs;

11.13.3 Replicate tests or calibrations using the same or different methods;

11.13.4 Retesting or recalibration of retained samples;

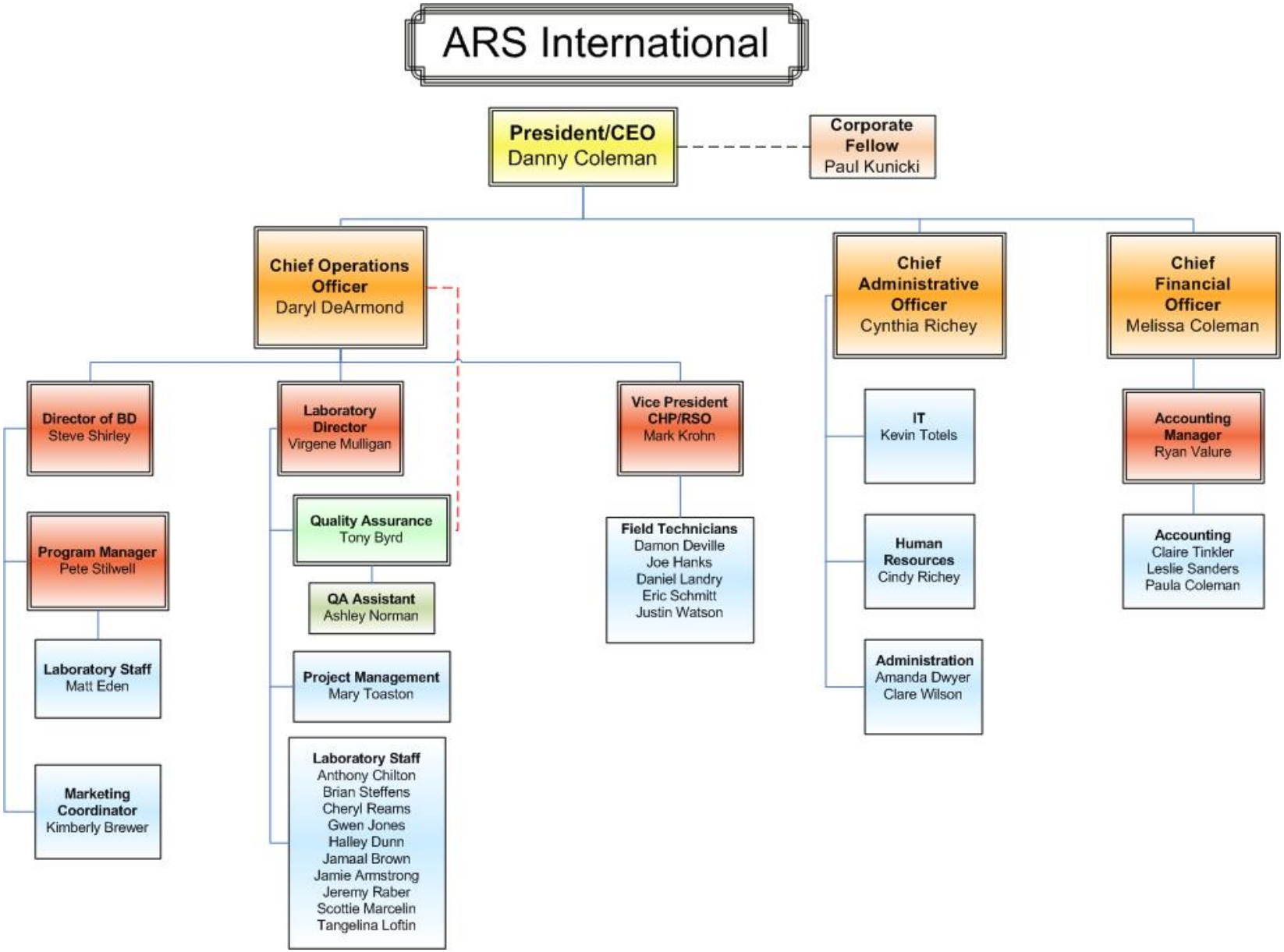
11.13.5 Correlation of results for different characteristics of a sample (for example, total radium should be greater or equal to radium-228).

12. QUALITY ORGANIZATION

12.1 Scope

12.1.1 This section is designed to identify the position of Quality Assurance Management within the overall structure of the laboratory organization. The section also provides basic responsibility, authority, training, experience requirements and interrelation descriptions of all personnel who manage or perform or verify work affecting the quality of tests.

12.1.2 A Quality Organization Chart illustrating the placement of the quality function within the organization is contained in the figure on the next page.


ARS International
President/CEO
Danny Coleman
Corporate Fellow
Paul Kunicki
Chief Operations Officer
Daryl DeArmond
Chief Administrative Officer
Cynthia Richey
Chief Financial Officer
Melissa Coleman
Director of BD
Steve Shirley
Program Manager
Pete Stilwell
Laboratory Staff
Matt Eden
Marketing Coordinator
Kimberly Brewer
Laboratory Director
Virgene Mulligan
Quality Assurance
Tony Byrd
QA Assistant
Ashley Norman
Project Management
Mary Toaston
Laboratory Staff
Anthony Chilton
Brian Steffens
Cheryl Reams
Gwen Jones
Halley Dunn
Jamaal Brown
Jamie Armstrong
Jeremy Raber
Scottie Marcelin
Tangelina Loftin
Vice President CHP/RSO
Mark Krohn
Field Technicians
Damon Deville
Joe Hanks
Daniel Landry
Eric Schmitt
Justin Watson
IT
Kevin Totels
Human Resources
Cindy Richey
Administration
Amanda Dwyer
Clare Wilson
Accounting Manager
Ryan Valure
Accounting
Claire Tinkler
Leslie Sanders
Paula Coleman

12.2 Personnel

12.2.1 Personnel performing specific tasks shall be qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required for the task.

12.2.2 The laboratory shall have sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned functions.

12.2.3 Personnel are responsible for complying with all quality assurance/quality control requirements that pertain to their organizational or technical function.

12.2.4 Technical staff members shall have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and shall have a general knowledge of laboratory operations, test methods, quality assurance/quality control procedures and records management.

12.2.5 Laboratory management shall formulate goals with respect to the education, training and skills of laboratory personnel. Education, training and skills of laboratory personnel shall be in accordance with the requirements contained in this Quality Assurance Manual.

12.2.6 The ARS laboratory shall use personnel who are employed by, or under contract to, the laboratory.

12.2.7 When contracted or additional technical and key support personnel are used, the laboratory shall ensure that such personnel are supervised and competent and that they work in accordance with the ARS International quality system and the requirements of this Quality Assurance Manual.

12.2.8 Current job descriptions for all personnel who manage, perform, or verify work affecting the quality of environmental tests and/or calibrations shall be maintained.

12.2.9 Management shall authorize specific personnel (per job function) to perform particular types of sampling, environmental tests and/or calibrations, to issue test reports and calibration certificates, to give opinions and interpretations and to operate particular types of equipment. Authorization can be found in the personnel position descriptions contained in the Quality Organization section of this Quality Assurance Manual.

12.2.10 The Quality Assurance Department shall maintain records of any relevant authorization(s), competence, educational and professional qualifications, training, skills and experience of all technical personnel, including contracted

personnel.

12.2.11 Records shall be readily available and shall include the date on which authorization and/or competence is confirmed. Demonstration of capability records and/or completion of appropriate training may be used to meet this authorization requirement.

12.2.12 Laboratory management shall define the minimum level of qualification, experience and skills necessary for all positions in the laboratory. Minimum levels of qualification, experience and skills can be found in the personnel position descriptions contained in the Quality Organization section of this Quality Assurance Manual.

12.2.13 Laboratory management shall define basic laboratory skills required for each position, such as using a balance, using a pipette, or using a thermometer. Basic laboratory skills and practices are outlined and defined in the Good Laboratory Practices and Laboratory Safety section of this Quality Assurance Manual.

12.2.14 The Quality Assurance Department shall ensure that the training of each member of the technical staff is kept up-to-date (on-going) by keeping evidence on file that demonstrates that each employee has read, understood, and is using the latest version of the laboratory's in-house quality documentation, which relates to his/her job responsibilities.

12.3 General Organization Policies

12.3.1 The laboratory shall be organized and operated in a manner such that its permanent, temporary and mobile facilities can meet the requirements of this Quality Assurance Manual and any applicable accrediting agencies. Additionally, the laboratory shall be organized in such a way that confidence in its independence of judgment and integrity is maintained at all times.

12.3.2 All managerial staff members have the authority and shall be provided with the appropriate resources required to discharge their duties.

12.3.3 Supervision shall be provided by personnel familiar with the test methods and procedures, the purpose and objective of each environmental test, and the assessment of the environmental test results. The ratio of supervisory to non-supervisory personnel, including trainees, shall be accomplished in such a manner that responsibilities are proportioned to ensure adequate supervision.

12.3.4 The laboratory shall have technical management with overall responsibility for technical operations. Provisions of resources needed to ensure required quality laboratory operations shall be provided.

12.3.5 The Human Resources Department shall maintain documentation or certifications showing that personnel performing tests for which the laboratory is accredited have appropriate educational and/or technical backgrounds. Unless otherwise specified, the following technically relevant experience may be substituted for educational requirements, such that:

-A Master's degree equals a Bachelor's degree and four years of experience.
-A Bachelor's degree equals:
-An Associate's degree and four years of experience, which equals
-A High School diploma and eight years of experience.

12.3.6 The laboratory shall nominate deputies in case of absence of the Laboratory Director and/or QA Officer. The Laboratory Director and the QA Officer shall designate individuals to act on their behalf in their absence.

12.3.7 Since the laboratory is part of an organization performing activities other than environmental testing and/or calibration, the responsibilities of key personnel in the organization shall be defined in order to identify potential conflicts of interest.

12.3.8 The organizational arrangements shall be such that departments having conflicting interest, such as production, commercial marketing or financing do not adversely influence the laboratory's compliance with relevant standards.

12.4 Quality Assurance Officer(s)

12.4.1 Basic Function

The Quality Assurance Officer(s) is responsible for the implementation of the ARS International Quality Assurance Program and for taking or approving measures to ensure the fulfillment of the quality objectives of management. The Quality Assurance Officer(s) is also responsible for carrying out Quality Assurance Policies in the most efficient and economical manner possible commensurate with ensuring continuing accuracy and precision of data produced.

12.4.2 Responsibilities and Authority

12.4.2.1 To implement the ARS International Quality Assurance Program including the development, change, review, revision and approval of this Quality Assurance Manual. The Quality Assurance Officer(s) has the responsibility and authority for ensuring that the quality system is implemented and followed at all times. The Quality Assurance Officer(s) has the responsibility to stop work if conditions exist which could directly

impact the quality system and the production of quality data. The Quality Assurance Officer(s) report to the Laboratory Director.

12.4.2.2 To review and approve all procedures, SOW's and SOP's used as a part of the ARS International Quality Assurance program and analytical procedures used by the laboratory. Review and approval of procedures shall be in accordance with this Quality Assurance Manual.

12.4.2.3 To monitor quality assurance activities of the laboratory to determine conformance with authorized policies, procedures, and governing regulations, and make appropriate recommendations for correction and improvement as may be necessary.

12.4.2.4 The Quality Assurance Officer(s) shall have direct access to the highest level of management for decisions regarding laboratory quality assurance policy and resources. The Quality Assurance Officer(s) shall serve as the focal point for QA/QC and shall be responsible for the oversight and/or review of quality control data. He or she shall have independent authority regarding quality assurance oversight and implementation of the quality assurance program. The functions of the Quality Assurance Officer shall be independent from laboratory operations. The Quality Assurance Officer shall have the opportunity and freedom to evaluate data objectively without influence from technical or financial management or other outside (e.g. managerial) influence.

12.4.2.5 The Quality Assurance Officer(s) is responsible for the oversight of corrective actions.

12.4.2.6 The Quality Assurance Officer(s) is responsible for the oversight of Performance Evaluation (PE) analysis.

12.4.2.7 The Quality Assurance Officer(s) is responsible for the performance of Quality Assurance and Quality Control audits.

12.4.2.8 The Quality Assurance Officer(s) (and/or his/her designee's) is responsible for the conduct of internal QA/QC audits.

12.4.2.9 The Quality Assurance Officer(s) (and/or his/her designee's) is responsible to notify laboratory management of deficiencies in the quality system and shall monitor corrective actions.

12.4.2.10 Pursues and maintains laboratory accreditations.

12.4.2.11 Coordinates and maintains laboratory training.

12.4.3 Academic Training, Experience and Skills

12.4.3.1 The Quality Assurance Officer(s) must have a minimum of a Bachelor's degree in science or equivalent.

12.4.3.2 The Quality Assurance Officer(s) must have a minimum of two years environmental laboratory experience.

12.4.3.3 The Quality Assurance Officer(s) must have a general knowledge of all analytical methods that are performed by the laboratory.

12.4.3.4 The Quality Assurance Officer(s) shall have documented training and/or experience in QA/QC procedures and shall be knowledgeable in the quality system as defined in NELAC, DOE QSAS, DOD QSM standards.

12.4.3.5 The Quality Assurance Officer(s) must have excellent math skills and computer skills (relating to word processing, the use of spreadsheets, and data base construction and maintenance). The Quality Assurance Officer(s) must have good organizational, communication and attention to detail skills.

12.5 Project Managers

12.5.1 Basic Function

Project Managers are responsible for interfacing with clients with regard to required tests and reporting levels and communicating the required information to the laboratory. Project Mangers monitor the progress of sample analysis and report analysis status to clients as necessary. Project Mangers are responsible for the preparation of test reports in accordance with this Quality Assurance Manual, other applicable Quality Assurance Procedures, and any specific client requirements.

12.5.2 Responsibilities and Authority

12.5.2.1 Project Managers routinely interact with the QA Department and report to the Laboratory Director.

12.5.2.2 Project Managers carry out quality assurance programs, including data validation procedures and techniques, which will enable the laboratory to meet desired quality standards.

12.5.2.3 Project Mangers interface with clients with regard to required tests and ard responsible for the sharing of specific client test requirements with the laboratory.

12.5.2.4 Project Mangers are responsible for the generation of test reports and electronic deliverable data in accordance with this Quality Assurance Manual, other applicable Quality Assurance Procedures, and any specific client requirements.

12.5.2.5 Project Managers are responsible for notifying clients of problems or issues identified during the sample receiving process, working with the client for issue resolution, and for providing documentation of the resolution.

12.5.2.6 Project Managers are responsible for scheduling laboratory analysis to ensure on time data delivery to clients.

12.5.3 Academic Training, Experience and Skills

12.5.3.1 Project Managers shall have a minimum of a bachelor's of science degree or equivalent.

12.5.3.2 Project Managers must have a minimum of one year of related experience. On-the-job training under the direct supervision of the Quality Assurance Officer(s) or an experienced Project Manager may be used until the one year experience requirement has been met.

12.5.3.3 Project Managers must have good math skills and excellent computer skills (relating to word processing, the use of spreadsheets, and data base construction and maintenance). Project Managers must have good organizational, communication, inter-personnel and attention to detail skills.

12.6 Laboratory Director (Technical Director)

12.6.1 Basic Function

The Laboratory Director is responsible for the overall operation and supervision of the ARS International laboratory. The Laboratory Director shall answer to the Vice President for Eastern Operations. The Laboratory Director shall answer to the Quality Assurance Officer(s) on all aspects of Quality Assurance. The Laboratory Director is responsible for conducting operations in the most efficient and economical manner possible commensurate with ensuring continuing accuracy and precision of data produced and maintaining compliance with this Quality Assurance Manual.

12.6.2 Responsibilities and Authority

12.6.2.1 Monitors laboratory testing and reporting activities to determine conformance with authorized policies, procedures, and governing

regulations, and makes appropriate recommendations for correction and improvement as may be necessary.

12.6.2.2 Carries out quality assurance programs, including data validation procedures and techniques, which will enable the laboratory to meet desired quality standards, and advises and assists management in the installation, staffing, and supervision of such programs.

12.6.2.3 Assists in monitoring quality assurance activities of the laboratory to determine conformance with authorized policies and procedures and with sound practice; and makes appropriate recommendations to the Quality Assurance Officer(s) for correction and improvement as may be necessary.

12.6.2.4 Reviews new technology, methods, and equipment and advises management as to such use, with respect to quality aspects.

12.6.2.5 Advises management with regard to quality of purchased equipment, materials, reagents, and chemicals.

12.6.2.6 Performs other related duties as may be necessary

12.6.3 Academic Training, Experience and Skills

12.6.3.1 The Laboratory Director shall have a minimum of a bachelor's degree in chemistry, physics or engineering, with at least 24 college semester credit hours in Chemistry and at least 2 years experience in the radiological analyses of environmental samples. A Master's or Doctoral degree may be substituted for one year of experience.

12.6.3.2 The Laboratory Director must have a minimum of one year laboratory supervisory experience.

12.6.3.3 The Laboratory Director must have excellent math skills and computer skills (relating to word processing, the use of spread sheets, and data base construction and maintenance). The Laboratory Director must have excellent laboratory analytical skills. The Laboratory Director must have good organizational, communication, inter-personnel and attention to detail skills.

12.7 Chemists

12.7.1 Basic Function

Chemists are responsible for the performance of test procedures and the proper operation of analytical test equipment. Chemists shall answer to the Laboratory

Director and to the Quality Assurance Officer(s) on all aspects of Quality Assurance. Chemsits are responsible for carrying out the Quality Assurance Policies and Procedures in the most efficient and economical manner possible commensurate with ensuring continuing accuracy and precision of data produced.

12.7.2 Responsibilities and Authority

12.7.2.1 Perform laboratory testing activities and operates analytical equipment in accordance with authorized policies, procedures, and governing regulations, and makes appropriate recommendations for correction and improvement as may be necessary.

12.7.2.2 Assure that all analytical equipment has been properly calibrated before beginning tests.

12.7.2.3 Assure that all identifying information (including sample identification numbers) have been accurately and legibly transcribed into records or computer data bases.

12.7.2.4 Maintain equipment in working condition, and documents all preventive maintenance and repairs.

12.7.2.5 Carry out quality assurance programs, including data validation procedures and techniques, which will enable the laboratory to meet desired quality standards.

12.7.2.6 Monitor quality assurance activities of the laboratory to determine conformance with authorized policies and procedures and with sound practice; and makes appropriate recommendations to the Quality Assurance Officer(s) for correction and improvement as may be necessary.

12.7.2.7 Advise management with regard to quality of purchased equipment, materials, reagents, and chemicals.

12.7.2.8 Perform such other related duties as may be assigned by the Quality Assurance Officer.

12.7.2.9 Take responsibility for the care and custody of samples once they are received by the laboratory. Personnel should be prepared to testify that applicable samples were in their possession, view, or secured at all times in the laboratory, from the moment received until the time the analyses are complete or the samples disposed.

12.7.3 Academic Training, Experience and Skills

12.7.3.1 Chemists shall have a minimum of a bachelor's degree in science or equivalent.

12.7.3.2 Chemists must have good basic math skills, computer skills, and possess basic laboratory analytical skills. Chemists must have good organizational, communicational, inter-personnel and attention to detail skills.

12.8 Sample Custodian

12.8.1 Basic Function

The sample custodian is responsible for the receipt, tracking, storage and custody of all samples. The sample custodian reports to the Laboratory Director on all matters not pertaining to quality assurance. The sample custodian shall answer to the Quality Assurance Officer(s) on all aspects of Quality Assurance.

12.8.2 Responsibilities and Authority

12.8.2.1 The sample custodian is responsible for the receipt of samples.

12.8.2.2 The sample custodian is responsible for the tracking of all samples received by ARS International The location of a sample at any time must be known.

12.8.2.3 The sample custodian is responsible for the storage of samples and for the logging of samples in and out of storage locations.

12.8.2.4 The sample custodian is responsible for documenting the final disposition of all samples.

12.8.2.5 The sample custodian is responsible for all Chain of Custody (COC) procedures associated with the receipt of samples at ARS International

12.8.2.6 The sample custodian is responsible for preanalyical sample preparation as defined in *ARS-064*.

12.8.3 Academic Training, Experience and Skills

12.8.3.1 Bachelor's degree (or equivalent) in a scientific discipline.

12.8.3.2 The sample custodian must have good basic math skills and computer skills. The sample custodian must have good organizational, communicational, and attention to detail skills.

12.9 Waste Coordinator

12.9.1 Basic Function

The Laboratory Waste Coordinator oversees the handling and disposition of all waste generated by the analytical laboratory. The Waste Coordinator reports to the Laboratory Director on all matters not pertaining to quality Assurance. The sample custodian shall answer to the Quality Assurance Officer(s) on all aspects of Quality Assurance.

12.9.2 Responsibilities and Authority

12.9.2.1 Sample disposition including all labeling and documentation

12.9.2.2 Aqueous laboratory waste neutralization and disposal

12.9.2.3 Holding tank monitoring

12.9.2.4 Air emission monitoring

12.9.2.5 Radiological monitoring to comply with Radiation Protection Plan

12.9.2.6 Operate requisite laboratory equipment and instruments; record data; maintain and make minor adjustments to equipment

12.9.2.7 Comply with laboratory safety standards through proper handling of potentially hazardous chemical and radiological agents and /or biological sources in the workplace

12.9.2.8 Complete training, as required

12.9.2.9 Use proper techniques to avoid cross contamination

12.9.2.10 Monitor inventory levels, order materials and supplies in accordance with established polices and procedures

12.9.2.11 Maintain required laboratory documentation

12.9.2.12 Responsible for implementing and maintaining the ARS International Waste Management Plan

12.9.3 Academic Training, Experience and Skills

12.9.3.1 BA/BS degree in a Physical or Biological Science or equivalent

12.9.3.2 Equivalency consists of one of the following:

12.9.3.2.1 An Associates Degree in a Physical or Biological Science and 4 years laboratory experience or

12.9.3.2.2 8 years of laboratory experience

12.9.3.3 General knowledge of standard laboratory processes and procedures

12.9.3.4 Basic experience using standard analytical equipment (i.e., centrifuge, pipettes, pH meters, laboratory balances, volumetric glassware, etc.)

12.9.3.5 Basic knowledge of waste handling and disposal procedures

12.9.3.6 General knowledge of Microsoft Office applications

12.9.3.7 General knowledge of metric system

12.10 Health, Safety and Environmental (HS&E) Officer

12.10.1 Basic Function

The HS&E Officer manages health, safety and environmental protection programs and standards; implements, directs and coordinates approved programs; assures compliance with local, State and Federal regulatory requirements; directs the activities of all ARS International field personnel.

12.10.2 Responsibilities and Authority

12.10.2.1 The HS&E Officer reports to the Vice-President for Eastern Operations.

12.10.2.2 The HS&E Officer is responsible for implementing and maintaining the ARS International Safety Program and Chemical Hygiene Plan.

12.10.2.3 The HS&E Officer is responsible for implementing and maintaining the ARS International Waste Management Plan.

12.10.2.4 The HS&E Officer is responsible for maintaining Material Safety Data Sheets (MSDS) on hazardous materials used in the workplace.

12.10.2.5 The HS&E Officer is responsible for performing routine safety inspections.

12.10.2.6 The HS&E Officer is responsible for maintaining OSHA required records on accidents.

12.10.2.7 The HS&E Officer is responsible for employee safety training / hazard communication training.

12.10.2.8 The HS&E Officer is responsible for helping to solve workplace safety problems.

12.10.2.9 The HS&E Officer is responsible for maintaining Safety contingency plans (fires, spills, etc.)

12.10.3 Academic Training, Experience and Skills

12.10.3.1 High school diploma with at least five years of related experience addressing health, safety and environmental issues.

12.10.3.2 Excellent verbal and written communication skills.

12.10.3.3 Excellent analytical and organizational skills.

12.11 Field Project Manager

12.11.1 Basic Function

Serve as liaison between Field Operations and other members of the project team including subcontractors. Ensure project requirements are known to the Project Team in a timely manner and obtain project responses to needs of other members of the Project Team. Prepare project-related documentation and perform technical review. Responsible for project scheduling, client interface, purchase orders and scopes of work for project specific items. Document submittals and ensure timely submission of same.

12.11.2 Responsibilities and Authority

12.11.2.1 Create, maintain and generate spreadsheet reports as required and provide to project management and customers

12.11.2.2 Attend project meetings as required.

12.11.2.3 Create daily, weekly and monthly project status reports.

12.11.2.4 Assist with procurement of equipment, parts, supplies as needed.

12.11.2.5 Assist with generating the quality report by collecting data on customer service, timeliness, completion of work orders, etc. Provide report to project management.

12.11.2.6 Monitor and document project tasks and subcontractor compliance to contractual requirements as well as meet QA/QC and safety goals.

12.11.2.7 Complete QA/QC audits of subcontractor reports and photos and document inaccuracies.

12.11.2.8 Physically inspect quality of work performed by subcontractors as required; initiate corrective actions as needed in the field.

12.11.2.9 Research applicable laws, rules, regulations and/or policies and procedures.

12.11.2.10 Use logic to analyze or identify underlying principles, reasons, or facts associated with information or data to draw conclusions.

12.11.2.11 Create and maintain project database(s). Update government data status on a daily basis; complete QA review against ARS records

12.11.3 Academic Training, Experience and Skills

12.11.3.1 High school diploma or GED, technical or vocational school. College degree in Business Management or Engineering preferred. Associate's degree from a recognized college or technical institute with a major study in engineering, hydrology, geology, earth sciences, or environmental studies. Each additional year of approved formal education may be substituted for one year of required work experience.

12.11.3.2 Knowledge of project management (i.e., budgeting, job costing, procurement and contract management).

12.11.3.3 Minimum of 6 months to 1 year experience in project management, quality, and/or project controls.

12.11.3.4 Understanding of quality assurance (QA)/quality control (QC) processes and procedures.

12.11.3.5 Knowledge of radiological contamination control. Knowledgeable in federal regulatory laws, regulations and guidelines including CAA, CERCLA, CWA, DOT, NEPA, NRC, RCRA, SARA, and TSCA.

12.11.3.6 Familiarity with 10 CFR 835, OSHA 1910.120 and other applicable regulatory guidelines within DOD, DOE and NRC for health physics.

12.11.3.7 Federal and state regulator interface including USEPA, USDOT, and NRC.

12.11.3.8 Experience interacting with federal agencies including USACE, DHS, DOD, DOE, USWFS, USFS, and BLM.

12.11.3.9 Experience related to the oil and gas industry.

12.11.3.10 Understanding of NORM contamination and clean-up processes.

12.11.3.11 Knowledge of ALARA.

12.11.3.12 Experience with gamma spectroscopy systems (ISOCS).

12.11.3.13 Knowledge of MARSSIM; ability to design and implement MARSSIM final status surveys.

12.12 Field Technician(s)

12.12.1 Basic Function

Field Technicians, as they pertain to the laboratory's quality systems, are responsible for the performance of sample collection. Field Technicians/Coordinator and shall answer to the Quality Assurance Officer(s) on all aspects of Quality Assurance. Field Technicians are responsible for carrying out the Quality Assurance Policies and Procedures in the most efficient and economical manner possible commensurate with ensuring continuing accuracy and precision of data produced.

12.12.2 Responsibilities and Authority

12.12.2.1 Collects samples in accordance with authorized policies, procedures, and governing regulations, and makes appropriate recommendations for correction and improvement as may be necessary.

12.12.2.2 Assures that all sample identifying information (including sample identification numbers, date and time of sampling) has been accurately recorded and transcribed.

12.12.2.3 Maintains sampling equipment in working condition and uses sampling equipment in a manner which prevents sample cross contamination.

12.12.2.4 Advises management with regard to quality of purchased equipment, materials, reagents, and chemicals required for sampling evolutions.

12.12.3 Academic Training, Experience and Skills

12.12.3.1 Field Sampling Technicians shall have a minimum of a high school diploma and satisfactory completion of a short course or structured in-house equivalent on the collection of samples.

12.12.3.3 Field Sampling Technicians shall have a minimum of six months experience in the collection of samples. The Field Sampling Technician may work under the direct observation of a qualified Sampling Technician while waiting to meet the six month experience requirement.

12.12.3.3 Field Technicians must have good organizational, communicational, and attention to detail skills.

12.13 Systems/Network Administrator(s)

12.13.1 Basic Function

Responsible for installation, maintenance, troubleshooting and upgrading network server, computer hardware, software, LAN/WAN, peripheral equipment and company-wide electronic mail systems, business applications; and security of network system; assesses user training needs and trains users in effective use of applications; makes recommendations regarding hardware and software acquisitions; prepares documentation and provides user assistance to staff; and performs related work as required

12.13.2 Responsibilities and Authority

12.13.2.1 Install, configure and upgrade operating systems and software.

12.13.2.2 Install, configure, assemble and repair computers, monitors, network infrastructure and peripherals such as printers and related hardware.

12.13.2.3 Ensure availability and security of network server and business applications.

12.13.2.4 Perform utility programming and scripting.

12.13.2.5 Perform cost-benefit analysis of proposed business application implementations to include evaluation of hardware and software and make recommendations for business use solutions.

12.13.2.6 Conduct research into current and emerging technologies and issues in support of development efforts.

12.13.2.7 Basic performance tuning and capacity planning skills.

12.13.2.8 Experience with Active Directory and MS Windows systems administration, including installation, upgrade and maintenance.

12.13.2.9 Perform solid network fundamentals, including TCP/IP routing, interface management and service configuration.

12.13.2.10 Configure and maintain network hardware (routers and switches).

12.13.2.11 Perform new system builds.

12.13.2.12 Maintain network server backups and support multiple disks storage systems and tape libraries.

12.13.2.13 Troubleshoots problems with computer systems, including troubleshooting hardware and software, e-mail, network and peripheral equipment problems; makes repairs and corrections where required.

12.13.2.14 Acts as a technical resource in assisting users to resolve problems with equipment and data; implements solutions or notifies outsource providers as required.

12.13.2.15 Makes hardware and software acquisition recommendations including helping users assess needs and providing justification for equipment and services.

12.13.2.16 Performs other duties of a similar nature or level

12.13.3 Academic Training, Experience and Skills

12.13.3.1 BS, Computer Science preferred; 5-7 years experience may be substituted for formal degree.

12.13.3.2 Minimum 3+ years hands-on experience in network administration required. Professional training through industry recognized organizations strongly desired.

12.13.3.3 Experience in Access, SQL, VB and XML

12.13.3.4 Must have in-depth knowledge and experience with Microsoft Windows networking and applications, including but not limited to Server 2003, Exchange 2003, SQL Server, and SMS Server.

12.13.3.5 Experience configuring and maintaining Cisco infrastructure, including routers, switches, and firewalls.

12.13.3.6 Knowledge of TCP/IP protocols configuration and services such as DNS, DHCP, and SMTP.

12.13.3.7 Principles, practices, hardware and software related to the establishment and maintenance of LAN's and WAN's

12.14 President

12.14.1 Basic Function

The President oversees all activities of the corporation including, but not limited to, financial, marketing, business development, and client service activities.

12.14.2 Responsibilities and Authority

12.14.2.1 The President is responsible for maintaining corporate fiduciary duties and for the profitable, ethical, safe, and regulatory compliant operation of the corporation.

12.14.2.2 The President acts as the chief executive officer for the corporation. The President directs the management team and ensures that the business runs effectively, efficiently, and makes a profit.

12.14.2.3 The President acts as a professional role model and public image for the company.

12.14.2.3 The President takes final responsibility for all company actions.

12.14.2.4 The President identifies, develops and directs the implementation of ARS International business strategy.

12.14.2.5 The President plans and directs the activities of the company to achieve stated targets and standards for financial and service performance and legislative adherence.

12.14.2.6 The President recruits, selects and develops managerial team members.

12.14.2.7 The President directs corporate function and performance via the managerial team members.

12.14.2.8 The President maintains and develops organizational culture, values and reputation in its markets and with all staff, customers, suppliers, partners and regulatory/official bodies

12.14.2.9 The President:

-Approves corporate decisions.
-Acts as the approving authority for all contracts.
-Ensures development and implementation of a strategic business plan.
-Maintains the organization's fiscal viability.
-Sets standards and expectations for leadership and other key positions.
-Ensures programs conform to the policies of the Board of Directors.

-Coordinates and conducts weekly manager meetings.
-Keeps managers updated on upcoming deadlines.

12.14.3 Academic Training, Experience and Skills

12.14.3.1 A Bachelor's degree or equivalent

12.14.3.2 The President must have excellent managerial, organizational, communicational, and attention to detail skills.

12.15 Vice President

12.15.1 Basic Function

The Vice President oversees the activities of the Laboratory, IT, Field, and Administration Departments.

12.15.2 Responsibilities and Authority

12.15.2.1 The Vice President reports directly to the President.

12.15.2.2 The Vice President is responsible for the oversight and production of the Laboratory, IT, Field, and Administration Departments.

12.15.2.3 The Vice President acts on behalf of the President on all non-fiduciary matters and assists the President in maintaining his responsibilities and duties.

12.15.2.4 The Vice-President assists the President in the implementation of ARS International business strategy.

12.15.2.5 The Vice-President assists the President in planning and directing the activities of the company to achieve stated targets and standards for financial and service performance and legislative adherence.

12.15.2.6 The Vice-President assists the President in the recruitment, selection and development of managerial team members.

12.15.2.7 The Vice-President directs corporate function and performance via the managerial team members.

12.15.2.8 The Vice-President assists the President in maintaining and developing organizational culture, values and reputation in its markets and with all staff, customers, suppliers, partners and regulatory/official bodies.

12.15.3 Academic Training, Experience and Skills

12.15.3.1 A Bachelor's degree or equivalent.

12.15.3.2 The Vice-President must have excellent managerial, organizational, communicational, and attention to detail skills.

12.16 Chief Financial Officer (CFO)

12.16.1 Basic Function

The CFO directs and oversees all financial activities of the corporation including preparation of current financial reports, summaries and forecasts for future business growth and general economic outlook.

12.16.2 Responsibilities and Authority

12.16.2.1 The CFO reports directly to the Corporate President on all financial matters. The CFO must be aware that in accordance with the Corporate Unrestrictive Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

12.16.2.2 The CFO is responsible for the preparation of all financial reports, including income statements, balance sheets, reports to shareholders, tax returns, and reports for government regulatory agencies.

12.16.2.3 The CFO is responsible for the oversight of accounting departments, budget preparation, payroll, and audit functions. The CFO meets regularly with executive management to keep them informed and to offer direction.

12.16.2.4 The CFO is responsible for preparing review reports to analyze projections of sales and profit against actual figures, budgeted expenses against final totals, and suggests methods of improving the planning process as appropriate.

12.16.2.5 The CFO is responsible for the analyzing company operations to pinpoint opportunities and areas that need to be reorganized, down-sized, or eliminated.

12.16.2.6 The CFO is responsible for conferring with executive management to coordinate and prioritize planning.

12.16.2.7 The CFO is responsible for conducting studies of long-range economic trends and for projecting company prospects for future growth in overall sales and market share, opportunities for acquisitions or expansion into new product areas. The CFO is responsible for estimating requirements for capital, land, buildings, and an increase in the work force.

12.16.2.8 The CFO is responsible for and supervises investment of funds; works with banks and/or investment bankers to raise additional capital as required for expansion.

12.16.3 Academic Training, Experience and Skills

12.16.3.1 Bachelor's degree or equivalent in business administration, accounting, or finance.

12.16.3.2 C.P.A. designation or eligibility to participate in the C.P.A. examination preferred.

12.16.3.3 Knowledge of database and accounting computer application systems to supply the most accurate financial information.

12.16.3.4 At least five years of experience in financial management with increasing responsibilities for multi-faceted direction and planning.

12.16.3.5 Excellent verbal and written communication skills.

12.16.3.6 Excellent analytical and organizational skills.

12.17 Chief Administrative Officer

12.17.1 Basic Function

Responsible for directing all of the administrative functions of the corporation in accordance with industry standards, where applicable, regulatory agencies, as appropriate and company objectives and policies. Provide leadership, management and vision necessary to ensure the company has the proper administrative controls, administrative and reporting procedures, and people systems in place to effectively grow the organization and to ensure financial strength and operating efficiency.

12.17.2 Responsibilities and Authority

12.17.2.1 The Chief Administrative Officer reports directly to the Corporate President on all financial matters. The Chief Administrative Officer must be aware that in accordance with the Corporate Unrestrictive

Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

12.17.2.2 Plan, develop, organize, implement, direct and evaluate the organization's administration function and performance. Areas of authority include administration, contracts, human resources, information technology, and procurement.

12.17.2.3 Participate in the development of the corporation's plans and programs as a tactical partner in evaluating and advising on the impact of long-range planning and regulatory action on the areas of responsibility.

12.17.2.4 Develop credibility for the administration group by providing timely and accurate analyses of budgets, project proposals and business trends in the multiple administrative areas in order to assist the CEO/President and other senior executives in performing their responsibilities.

12.17.2.5 Enhance and/or develop, implement and enforce policies and procedures of the organization by way of systems that will improve the overall operation and effectiveness of the corporation.

12.17.2.6 Establish credibility throughout the organization as an effective developer of solutions to administrative business challenges. This would include the assessment of "out-sourcing" of the various activities and functions if such external support would be the most effective method of providing the proper level of services at the appropriate cost.

12.17.2.7 Provide technical/professional advice and knowledge to others within the various administrative areas and discipline.

12.17.2.8 Continual improvement of the budgeting process for the administrative operation through education of department managers on budgetary issues impacting their budgets and ongoing departmental performance to the budget.

12.17.2.9 In facility management, determine the needs for, assess the viability of internal or external sourcing of, and manage the on-going provision of activities and services for telecommunications and data systems, building maintenance and construction management, mailroom management, printing and distribution of materials and operations for the provision of services in the areas of security, travel reservations,

transportation and fleet management and records management.

12.17.2.10 Act as the company spokesperson for media communication excluding financial, investor relations and legal matters and represent the company in community related activities.

12.17.2.11 Advise, negotiate, manage and administer contracts into which the Corporation may enter. Counsel with the CFO on financial matters associated with the financial viability of entering into such contracts.

12.17.2.12 Oversee the entire Human Resources function and activities but manage all of the specific activities pertaining to the Officers of the Corporation.

12.17.2.13 Evaluate the administrative division structure and team plan for continual improvement of the efficiency and effectiveness of the group as well as providing individuals with professional and personal growth with emphasis on opportunities (where possible) of individuals.

12.17.2.14 Provide day-to-day leadership and management to a service organization that mirrors the adopted mission and core values of the company.

12.17.2.15 Responsible for the measurement and effectiveness of all processes internal and external. Provides timely, accurate and complete reports on the administrative condition of the company.

12.17.2.16 Collaborate with the senior management team to develop and implement plans for the infrastructure of systems, processes, and personnel designed to accommodate the rapid growth objectives of the organization.

12.17.2.17 Motivate and lead a high performance team; attract, recruit and retain required members of the executive team not currently in place; provide mentoring as a cornerstone to the management career development program.

12.17.2.18 Act as lead "client-care officer" through direct contact with every client and partner.

12.17.2.19 Foster a commitment to excellence, success-oriented, accountable environment within the company.

12.17.3 Academic Training, Experience and Skills

12.17.3.1 Masters degree or equivalent; or ten to fifteen years' related experience and/or training; or equivalent combination of education and experience in several of the administrative areas and at the highest level of a Corporation.

12.17.3.2 Experienced leader and administrative executive with appropriate industry experience.

12.17.3.3 Energetic, forward-thinking and creative individual with high ethical standards and an appropriate professional image.

12.17.3.4 Strategic visionary with sound technical skills, analytical ability, good judgment and strong operational focus.

12.17.3.5 Extremely well organized and self-directed individual who is "politically savvy" and a team player.

12.17.3.6 Intelligent and articulate individual who can relate to people at all levels of an organization and possesses excellent communication skills.

12.17.3.7 Educator who is trustworthy and willing to share information and serve as a mentor.

12.17.3.8 Excellent negotiator who is experienced in contracts.

12.17.3.9 Detailed knowledge of organization's operations, organizational procedures, and personnel.

12.17.3.10 Excellent calendar management skills, including the coordination of executive meetings.

12.17.3.11 Experience assisting management with the creation of PowerPoint presentations.

12.17.3.12 Strong knowledge of MS Office, including Word, Excel, PowerPoint and Outlook.

12.17.3.13 Experience scheduling travel arrangements for management.

12.18 Procurement Officer

Procurement Officer Responsibilities and Authority is currently part of the Facilities Administrator job (see Section 12.20 for Facilities Administrator).

12.18.1 Basic Function

Places purchase orders for materials, supplies and equipment as needed in accordance with approved procurement procedures. Tracks inventory levels and reorders as needed. Researches suppliers to obtain the best prices and best merchandise, as well as quickest available turnaround for deliveries. Stays in communication with all departments to determine purchasing needs. Provides reports to Accounting Department.

12.18.2 Responsibilities and Authority

12.18.2.1 The Procurement Officer reports directly to the Chief Administrative Officer. The Procurement Officer must be aware that in accordance with the Corporate Unrestrictive Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures. The Procurement Officer is responsible for ensuring that the quality systems requirements regarding procurement of quality materials and equipment are followed at all times.

12.18.2.2 The Procurement officer is responsible for communicating with all departments to determine purchasing needs.

12.18.2.3 The Procurement officer is responsible for communicating with providers to determine purchasing prices, shipping procedures, merchandise lines and all other purchasing procedures.

12.18.2.4 The Procurement officer is responsible for communicating with Accounting Department to determine budgetary allowances and needs.

12.18.2.5 The Procurement officer is responsible for the placing and tracking of purchase orders.

12.18.2.6 The Procurement officer is responsible for tracking the delivery of purchases, backorders, substitutions, and all other related transactions

12.18.2.7 The Procurement officer is responsible for keeping records of all transactions.

12.18.2.8 The Procurement officer is responsible for tracking inventory levels of office supplies to determine re-ordering needs.

12.19 HR Director

12.19.1 Basic Function

The Human Resource Director develops and maintains an effective office staff through selection, training, compensation, motivation and review. The Human Resource Director assists management in the recruitment and interviewing of employees, and advises management on hiring decisions in accordance with policies and requirements that have been established in conjunction with executive management.

12.19.2 Responsibilities and Authority

12.19.2.1 The Human Resource Director reports to the President and/or the Vice President.

12.19.2.2 The Human Resource Director is responsible for the recruitment placement and termination of employees as required by the various ARS International departments.

12.19.2.3 The Human Resource Director is responsible for providing instruction to all levels of employees with regards to established corporate practices and benefits (e.g. new hire orientation), legal requirements (e.g. safety, sexual harassment), personal or career enhancement opportunities, or work improvement methods (e.g. team building, conflict resolution).

12.19.2.4 The Human Resource Director is responsible for advising departmental management on affirmative action requirements, classification issues, performance appraisals, and employee relations issues.

12.19.2.5 The Human Resource Director is responsible for maintaining a liaison with Executive Management and other appropriate departments to respond to personnel problems, issues, and special requests and to facilitate personnel actions.

12.19.2.6 The Human Resource Director is responsible for advising and assisting management and staff in the handling of employee relations issues, complaints and/or grievances and determination of appropriate disciplinary actions.

12.19.3 Academic Training, Experience and Skills

12.19.3.1 High school diploma.

12.19.3.2 Five years of related experience is required.

12.19.3.3 The Human Resource Director must have excellent, organizational, communicational, and attention to detail skills.

12.20 Facilities Administrator

12.20.1 Basic Function

Responsible for the managing facilities, grounds, and equipment. Plan, budget and schedule facility maintenance and improvements including estimates on equipment, labor materials and other related costs. Maintain the procurement system. Maintain and update asset management system.

12.20.2 Responsibilities and Authority

12.20.1.1 The Facilities Administrator reports to and receives daily direction from the Chief Administrative Officer. The Facilities Administrator must be aware that in accordance with the Corporate Unrestrictive Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

12.20.2.2 Oversee, maintain and update the asset management system.

12.20.2.3 Perform quarterly and annual fixed asset inventory.

12.20.2.4 Oversee the coordination of building space allocation and layout and facility expansion.

12.20.2.5 Plan budget and schedule facility modifications, including cost estimates.

12.20.2.6 Initiate and maintain planned maintenance programs for a variety of office equipment.

12.20.2.7 Manage the procurement and receiving functions

12.20.2.8 Responsible for maintaining the preventive maintenance of facility equipment, including HVAC, etc..

12.20.2.9 Oversee cleaning and maintenance of facility.

12.20.2.10 Monitor grounds maintenance to include replacement of plants, trees, etc

12.20.2.11 Contract with and supervise all outside vendor contractors

12.20.2.12 Processes account applications and maintenance actions

12.20.2.13 Monitors approval of accounts to maintain an appropriate degree of control over vendor relationships.

12.20.3 Academic Training, Experience and Skills

12.20.3.1 High school diploma; college degree preferred.

12.20.3.2 Specialized training in facility maintenance, procurement systems preferred.

12.20.3.3 Detailed knowledge of organization's operations and organizational procedures

12.20.3.4 Understanding of contracts

12.20.3.5 Experience in procurement and asset management

12.20.3.6 Experience with maintenance trades

12.20.3.7 Mechanical aptitude and a working knowledge of electrical, plumbing and mechanical systems

12.20.3.8 Minimum of 5 - 7 years experience in building maintenance and contracts/subcontracts management

12.21 Accounting Manager

12.21.1 Basic Function

Direct work efforts of accounting staff. Create and implement accounting policies and procedures. Compile corporate financial information, process journal entries into various accounts, and reconcile reports and financial data.

12.21.2 Responsibilities and Authority

12.21.2.1 The Accounting Manager Reports to the CFO. The Accounting Manager must be aware that in accordance with the Corporate Unrestrictive Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

12.21.2.2 Responsible for the development of policies, systems, special financial studies, etc

12.21.2.3 General responsibility for implementing and monitoring the company accounting procedures.

12.21.2.4 Prepare financial reports, including income statements, balance sheets, tax returns and reports for government regulatory agencies.

12.21.2.5 Manage the accounting department, budget preparation, and audit functions. Assign and audit the work of the accounting department.

12.21.2.6 Prepare and review reports, analyze projections of revenue and profit against actual figures, budgets and expenses against final totals and suggest methods of improving the planning process as needed.

12.21.2.7 Create, maintain and generate reports required and provide information to Executive management.

12.21.2.8 Attend project meetings as required.

12.21.2.9 Prepare journal entries to reconciles general ledger and subsidiary accounts.

12.21.2.10 Distribute monthly revenue and expenditure reports to department managers.

12.21.2.11 Make wire transfers and journal funding transfers.

12.21.2.12 Review and approve reimbursement billings and receivables.

12.21.2.13 Prepare audit schedules for external auditors and act as a liaison between the company and auditors.

12.21.2.14 Prepare annual and mid-year budgets.

12.21.2.15 Provide training in the use of the company's computerized financial system and assist departmental personnel with budget questions, proper expenditure coding, document processing and other accounting related activities.

12.21.2.16 Meet regularly with executive management to keep them informed and to offer direction.

12.21.2.17 Perform other duties of a similar nature or level.

12.21.3 Academic Training, Experience and Skills

12.21.3.1 BA/BS degree in Accounting; MS degree in Accounting preferred.

12.21.3.2 C.P.A. designation, or eligibility to participate in the C.P.A. examination, preferred.

12.21.3.3 Minimum of three (3) years experience in Accounting; graduate level education may substitute for experience.

12.21.3.4 Comprehensive knowledge of accounting principles generally accepted in the U.S.

12.21.3.5 Knowledge of database and accounting computer application systems.

12.21.3.6 Experience in financial management with increasing responsibilities for multi-faceted direction and planning.

12.21.3.7 Preparing financial and/or auditor statements, schedules and reports.

12.21.3.8 At least two years experience in payroll preparation and general ledger accounting

12.21.3.9 Knowledge of database and accounting computer application systems.

12.21.3.10 The Accounting Manager must have good organizational, communicational, and attention to detail skills.

12.22 Accounting Assistant(s)

12.22.1 Basic Function

The accounting assistant performs accounting assignments involving accounts receivable and accounts payable.

12.22.2 Responsibilities and Authority

12.22.2.1 Accounting assistants report directly to the Accounting Manager. Accounting assistants must be aware that in accordance with the Corporate Unrestrictive Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

12.22.2.2 The accounting assistant is responsible for assisting the Accounting Manager in preparing payroll and maintaining payroll records.

12.22.2.3 The accounting assistant is responsible for assisting the Accounting Manager in preparing and maintaining accounts receivable and accounts payable records.

12.22.2.4 The accounting assistant is responsible for assisting the Accounting Manager in preparing and reconciling of balance ledgers and bank statements.

12.22.2.5 The accounting assistant is responsible for assisting the Accounting Manager in the consolidation of monthly revenue and expense figures to produce monthly financial statements.

12.22.3 Academic Training, Experience and Skills

12.22.3.1 High school diploma.

12.22.3.2 At least one year experience in general ledger accounting

12.22.3.3 Basic knowledge of database and accounting computer application systems.

12.22.3.4 Accounting Assistants must have good organizational, communicational, and attention to detail skills.

12.23 Receptionist

12.23.1 Basic Function

Promptly answer all incoming calls with proper telephone etiquette and forward the call to the appropriate ARS International department or person. Copy and distribute all incoming and outgoing facsimiles. Sort, copy, mail and file outgoing reports and correspondence as required.

12.23.2 Responsibilities and Authority

12.23.2.1 The Receptionist reports directly to the Officer Manager.

12.23.2.2 The Receptionist is responsible for operating and promptly answering a multi-line telephone system with proper telephone etiquette; responsible for projecting a professional, credible, pleasant and sincere attitude over the telephone.

12.23.2.3 The Receptionist is responsible for taking messages and forwarding them to the appropriate personnel in a timely manner.

12.23.2.4 The Receptionist is responsible to assist the sending and receiving of incoming facsimiles and forwarding the facsimiles to the appropriate personnel.

12.23.2.5 The Receptionist is responsible for the sorting, copying, mailing and filing of outgoing reports and correspondence as required.

12.23.2.6 The Receptionist is responsible for the scanning of reports and other documents as directed by the Facilities Administrator.

12.23.3 Academic Training, Experience and Skills

12.23.3.1 High school diploma.

12.23.3.2 No experience is necessary, however, the Receptionist must be computer literate, have good communication skills, the ability to operate a multi-line telephone system, facsimile machine and scanner, and the ability to multi-task.

12.24 Maintenance Personnel

12.24.1 This position is currently out sourced to an outside company

12.25 Administrative Assistant

12.25.1 Basic Function
The Administrative Assistant provides administrative support to a designated manager or class of managers.

12.25.2 Responsibilities and Authority

12.25.2.1 The Administrative Assistant reports directly to the Facilities Administrator.

12.25.2.2 The Administrative Assistant is responsible for typing, transcription, copying and scanning duties as required.

12.25.2.3 The Administrative Assistant is responsible for composing correspondence as directed by the designated manager.

12.25.2.4 The Administrative Assistant is responsible for the planning and scheduling of meetings and appointments; organizing and maintaining paper and electronic files; and disseminating information by using the telephone, mail services, Web sites, and e-mail.

12.25.2.5 The Administrative Assistant is responsible for storing, retrieving, and integrating information for dissemination from a manager to applicable staff and clients.

12.25.2.6 The Administrative Assistant is responsible for arranging conference calls and scheduling meetings as directed by the applicable manager.

12.25.2.7 The Administrative Assistant is responsible for operating standard office equipment efficiently including:

-multi-line telephone system
-facsimile machine
-photocopy machine
-postage meter
-calculator
-computer/printer

12.25.3 Academic Training, Experience and Skills

12.25.3.1 High school diploma.

12.25.3.2 One year of related experience is preferred. Administrative assistants should be proficient in Microsoft Word and good at spelling, punctuation, grammar, and oral communication. Administrative assistants must have good interpersonal skills and be capable of exercising discretion, good judgment, organizational abilities, and initiative.

12.26 Accounting Clerk

12.26.1 Basic Function

Input payables/receivables into accounting system. Reconcile cash and make bank deposits. File vendor invoices/payments.

12.26.2 Responsibilities and Authority

12.26.2.1 The Accounting Clerk must be aware that in accordance with the Corporate Unrestrictive Quality Performance Policy, ARS International personnel are free to pursue and initiate quality actions and procedures in order to maintain the highest possible QA/QC standards without regards to commercial, financial or other undue pressures.

12.26.2.2 Match, batch, code and enter invoices.

12.26.2.3 Enter, post and reconcile batches.

12.26.2.4 Research and resolve accounts payable or accounts receivable issues with customers of vendors.

12.26.2.5 Update and reconcile the sub-ledger to the general ledger.

12.26.2.6 Maintain cash applications, account reconciliations and chargebacks.

12.26.2.7 Prepare and make bank cash deposits.

12.26.2.8 Review credit card charges and reconcile to expense reports/monthly statement.

12.26.2.9 File invoices, checks, etc. as appropriate.

12.26.3 Academic Training, Experience and Skills

12.26.3.1 High school diploma

12.26.3.2 Minimum 6 months to 1 year experience in accounting environment.

12.26.3.3 Minimum experience with accounts payable, accounts receivable, and bank reconciliations.

12.26.3.4 Some knowledge of general ledger accounts.

12.26.3.5 Proficient in using Microsoft Office (Word, Excel).

12.26.3.6 Ability to interface successfully with a variety of people including management, general staff, clients.

12.26.3.7 Excellent organizational skills are a must.

12.26.3.8 Demonstrate ability and temperament to work with sensitive information.

12.26.3.9 Demonstrate interpersonal skills and proficiency in business vocabulary to effectively represent the company to outside parties.

12.26.3.10 Demonstrate attention to detail.

13 DATA INTEGRITY

13.1 The ARS International Data Integrity system includes:

13.1.1 Data Integrity training

13.1.2 Signed data integrity documentation for all laboratory employees

13.1.3 In-depth, periodic monitoring of data integrity

13.1.4 Data integrity procedure documentation

13.2 Data integrity procedures shall be signed and dated by senior management.

13.3 Data integrity procedures and associated implementation records shall be maintained in accordance with *ARS-049 Document Control and Records Management* and shall be made available to assessors for review.

13.4 Management shall provide and assure confidentiality and a receptive environment in which all employees may privately discuss ethical issues or report items of ethical concern. Laboratory management shall be informed when the confidential reporting of data integrity issues warrant the need for further detailed investigation.

13.5 Senior managers shall acknowledge their support of the data integrity procedures by:

13.5.1 Upholding the spirit and intent of the organization's data integrity procedures

13.5.2 Effectively implementing the specific requirements of the data integrity procedures

13.6 Data Integrity training is discussed in the Laboratory Training Program section of this Quality Assurance Manual.

13.7 Procedures for the protection of electronic data including, but not limited to integrity and confidentiality of data entry and collection, data storage, data transmission and data processing are discussed in the Good Automated Laboratory Practices section of this Quality Assurance Manual and in ARS Procedure *IT-14 Entering, Processing, maintaining, Reporting, Transmitting, Storage and Integrity of LIMS Raw Data*.

13.8 Computers and automated equipment shall be maintained to ensure proper functioning and shall be provided with the environmental and operating conditions necessary to maintain the integrity of environmental test and calibration data. Environmental and operating conditions for computers are discussed in the Good Automated Laboratory Practices section and the Physical Facilities section of this Quality Assurance Manual.

13.9 The laboratory shall establish and implement appropriate procedures for the maintenance and security of data including the prevention of unauthorized access to, and the unauthorized amendment of, computer records. Security of computer data is addressed in the Good Automated Laboratory Practices section of this Quality Assurance Manual and in ARS Procedure *IT-22 LIMS Security*.

14 GOOD AUTOMATED LABORATORY PRACTICES

14.1 Introduction and Purpose

14.1.1 The purpose of this section is to provide requirements for maintaining a good automated laboratory. Specific guidance and procedures can be found in the following procedures:

IT-01 Shutdown Procedures for the Domain Controller and Network Servers
IT-02 Startup Procedures for the Domain Controller and Network Servers
IT-03 Adding and Removing Users from a Windows 2003 Domain
IT-04 Virus Protection on Servers and Desktop PC's
IT-05 Daily / Weekly Network Backups
IT-06 Employee Use of Workstations, Network and LIMS
IT-07 Software Testing and Verification
IT-08 Software Development
IT-09 Emergency Disaster Recovery Plan
IT-10 LIMS Raw Data Verification
IT-11 LIMS Raw Data Modification
IT-12 Software Version Control
IT-13 Software Change Control
IT-14 Entering, Processing, Maintaining, Reporting, Transmitting, Storage and Integrity of LIMS Raw Data
IT-15 LIMS Software Testing and Quality Assurance
IT-16 Testing, Inspecting and Maintaining the LIMS
IT-17 Creating, Verifying and Modifying Electronic Data Deliverables
IT-18 Resolving Discrepancies Between Electronic Data Deliverables and Hard Copy Reports
IT-19 Retention of LIMS Raw Data, Documentation and Records
IT-20 Software Historical File Maintenance
IT-21 Changes to LIMS Hardware and Communication Components
IT-22 LIMS Security
IT-23 Canon DR-9080C User Guide
IT-24 Mapping a Network Drive

14.1.2 This "Good Automated Laboratory Practices" (GALP) section uses the acronym LIMS, laboratory information management system, to describe the automated laboratory systems that collect and manage data. GALP applies to all computer systems, not just LIMS.

14.1.3 The ability to effect changes to original observations or measurements is the factor in determining whether the automated laboratory system is a LIMS. If data entering automated laboratory systems can be manipulated or changed in any way by the action of a person prior to being recorded, then that automated laboratory system is a LIMS.

14.1.4 GALP shall be used by ARS International to ensure the reliability of data. GALP includes traceability, accountability, standardized procedures, adequate resources, and the availability of documentation of conformance to the applicable requirements (including setting acceptance criteria where appropriate).

14.1.5 GALP shall be used by the laboratory to ensure the reliability of data. GALP includes traceability, accountability, standardized procedures, adequate resources, and the availability of documentation of conformance to the requirements (including setting acceptance criteria where appropriate).

14.2 GALP Laboratory Management

14.2.1 When electronic data are collected, analyzed, processed or maintained, the Laboratory management shall:

14.2.1.1 Ensure that personnel clearly understand the functions they are to perform.

14.2.1.2 Ensure that quality assurance staff members monitor computer activities.

14.2.1.3 Ensure that personnel, resources and facilities are adequate and available.

14.2.1.4 Receive reports of audits of LIMS and computer systems and ensure that corrective actions are promptly taken in response to any deficiencies.

14.2.1.5 Approve the SOPs setting forth the methods that ensure electronic data integrity, ensure that any deviations from SOPs and applicable GALP provisions are appropriately documented and that corrective actions are taken and documented, and approve subsequent changes to SOPs.

14.3 GALP Personnel

14.3.1 The laboratory shall ensure that all computer support staff and users:

14.3.2 Have adequate education, training and experience to perform assigned function.

14.3.3 Have a current summary of their training, experience and job description, including their knowledge relevant to LIMS design and operation, maintained at the facility.

14.3.4 Are of sufficient number for timely and proper operation of the computer systems.

14.4 GALP Quality Assurance

14.4.1The Quality Assurance Officer(s) or his/her designee shall:

14.4.1.1 Audit the computer systems at intervals adequate to ensure the integrity of the electronic data and prepare audit reports. Reports shall include a description of the operation audited, the dates of the audit, the person performing the audit, findings and problems observed, action recommended and taken to resolve existing problems, and any scheduled dates for re-audit. QA staff shall report to the laboratory management any problems that may affect data integrity.

14.4.1.2 Determine that no deviations from approved GALP SOPs were made without proper authorization and adequate documentation.

14.4.1.3 Ensure that the responsibilities and procedures applicable to QA, the records kept by QA, and the method of indexing such records are properly documented and maintained.

14.4.1.4 Establish non-conformance and corrective action procedures for hardware and software failures.

15 CALCULATIONS AND STATISTICAL METHODS

Calculations and Statistical Methods and are covered in detail in ARS Procedure *ARS-060 Analytical Calculations*. The Analytical Calculations procedure lists a number of statistical tools and techniques available to the laboratory worker. These tools and techniques can be used to gain more information about data produced by testing and analytical procedures. The information may be used to make predictions or come to conclusions about the nature and validity of the data. The procedure also addresses manual calculations, including manual integrations, as they pertain to the ARS International laboratory testing activities.

16 INTERLABORATORY PROFICIENCY TESTING

16.1 At a minimum, the ARS International laboratory shall participate in the following Interlaboratory Comparison Studies:

16.1.1 Mixed Analyte Performance Evaluation Program (MAPEP), U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho.

16.1.2 Environmental Resource Associates, Inc. (ERA) Performance Evaluation Program or other programs of a similar nature.

16.2 The results of the proficiency test sample analysis (interlaboratory comparison sample) shall be used by the laboratory to evaluate the ability of the laboratory to produce accurate data.

16.3 The laboratory's management and all analysts shall ensure that all Proficiency Examination (PE) samples are handled (i.e., managed, analyzed, and reported) in the same manner as real environmental samples utilizing the same staff, methods as used

for routine analysis of that analyte, procedures, equipment, facilities, and frequency of analysis.

16.4 A corrective action process will be initiated when PE sample results fall outside the established control limits.

16.5 The laboratory shall not send any PE sample, or portion of a PE sample, to another laboratory for any analysis for which the laboratory seeks accreditation or is accredited.

16.6 The laboratory shall not knowingly receive any PE sample or portion of a PE sample from another laboratory for any analysis for which the sending laboratory seeks accreditation or is accredited.

16.7 The laboratory staff and management shall not communicate with any individual at another laboratory (including intralaboratory communication) concerning the PE sample.

16.8 The laboratory management and staff shall not attempt to obtain the assigned value of any PE sample from the PE provider before the laboratory submits the PE results.

16.9 The laboratory shall maintain copies of all written, printed and electronic records resulting from the analysis of any PE sample for 5 years or for as long as is required by the applicable regulatory program, whichever is greater.

17 TEST METHODS AND STANDARD OPERATING PROCEDURES

17.1 Standard Operating Procedures (SOP's)

17.1.1 The laboratory shall maintain standard operating procedures that accurately reflect all phases of current laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods.

17.1.2 These documents may be equipment manuals provided by the manufacturer, or internally written documents.

17.1.3 The test methods may be copies of published methods as long as any changes or selected options in the methods are documented and included in the methods manual.

17.1.4 Standard Operating Procedures may be incorporated into this Quality Assurance Manual.

17.1.5 Each SOP shall clearly indicate the effective date of the document, the revision

number and the signature(s) of the approving authority.

17.1.6 Copies of all SOP's shall be accessible to all personnel.

17.1.7 The SOP's shall be organized according to *ARS-061-Preparation and Management of Procedures and Plans*

17.2 Method Selection and Validation

17.2.1 The laboratory shall ensure that it uses the latest valid edition of a standard (test method) unless it is inappropriate or not possible to do so. When necessary, the test method may be supplemented with additional details to ensure consistent application.

17.2.2 Laboratory-developed methods or methods adopted by the laboratory shall only be used if they are appropriate for the intended use and if they have been validated.

17.2.3 The laboratory shall validate non-standard methods, laboratory designed / laboratory developed methods, standard methods used outside their intended scope, and amplifications and modifications of standard methods to confirm that the methods are fit for the intended use. Method validation shall be performed following *ARS-035 Analytical Method Verification*.

Analytical Test Methods

Isotope	Analytical Method	Counting Method
Americium (Am) 241, 243	EPA 907.0 / HASL-300 / EML / APHA	Alpha Spectroscopy
Americium (Am) 241	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Americium (Am) 241	Eichrom Column	Alpha Spectroscopy
Americium (Am), Total Alpha	EPA 907.0 / HASL-300 / EML / APHA	Low Bkgd. α/β Counting
Americium (Am), Total	Eichrom Column	Alpha Spectroscopy
Antimony (Sb) 124, 125	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Barium (Ba) 133	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Beryllium (Be) 7	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Bismuth (Bi) 207, 212, 214	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Cadmium (Cd) 109, 113M	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Carbon, C-14	EML	Liquid Scintillation
Cerium (Ce) 139, 141, 144	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Cerium (Ce), Total	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Cesium (Cs) 134, 137	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Cesium (Cs) 134, 137	EPA 901.0 / 7500-Cs B	Low Bkgd. β Counting
Chromium (Cr) 51	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Cobalt (Co) 57, 58, 60	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Curium (Cm) 242, 244	EPA 907.0 / EML / APHA	Alpha Spectroscopy
Europium (Eu) 152, 154	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Gamma Spectroscopy	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Gross Alpha / Gross Beta	EPA 900.0 / HASL-300 / 7110 B / EML / APHA	Low Bkgd. α/β Counting
Gross Alpha / Gross Beta	EPA 9310	Low Bkgd. α/β Counting
Gross Gamma	EPA 900.0 / HASL-300 / 7110 B / EML / APHA	Gamma Scintillation
Iodine (I) 125, 131	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Iodine (I) 131	EPA 902.0 / 7500-I B	Low Bkgd. β Counting
Iron (Fe) 59	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Iridium (Ir) 192	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Krypton (Kr) 85	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Lead (Pb) 210, 212, 214	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Lead (Pb) 210	EML / APHA	Low Bkgd. β Counting
Lead (Pb) 210	Eichrom Column	Low Bkgd. β Counting
Leak Tests	EPA 900.0 / HASL-300 / 7110 B / EML / APHA	Low Bkgd. α/β Counting
Manganese (Mn) 54	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Neptunium (Np) 237	EPA 907.0 / HASL-300 / EML / APHA	Alpha Spectroscopy

Analytical Test Methods Continued

Isotope	Analytical Method	Counting Method
Neptunium (Np) 237	Eichrom Column	Alpha Spectroscopy
Neptunium (Np), Total Alpha	EPA 907.0 / EML / APHA	Low Bkgd. α Counting
Neptunium (Np), Total	Eichrom Column	Low Bkgd. α Counting
Niobium (Nb) 94, 95	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Plutonium (Pu) 238, 239/240, 242	EPA 907.0 / EML / APHA	Alpha Spectroscopy
Plutonium (Pu) 238, 239/240, 242	Eichrom Column	Alpha Spectroscopy
Plutonium (Pu), Total Alpha	EPA 907.0 / EML / APHA	Low Bkgd. α Counting
Plutonium (Pu), Total	Eichrom Column	Low Bkgd. α/β Counting
Polonium (Po) 210	HASL-300 / EML / APHA	Alpha Spectroscopy
Potassium (K) 40	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Radium (Ra) 223, 224, 226, 228	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Radium (Ra) 226	EPA 903.1 / HASL-300 / 7500 Ra C / EML / APHA	Alpha Scintillation
Radium (Ra) 228	EPA 904.0 / HASL-300 / 7500 Ra D / EML / APHA	Low Bkgd. α/β Counting
Radium (Ra) 228	EPA 9320	Low Bkgd. α/β Counting
Radium (Ra), Total Alpha	EPA 903.0 / HASL-300 / 7500 Ra B / EML / APHA	Low Bkgd. α/β Counting
Radium (Ra), Total Alpha	EPA 9315	Low Bkgd. α/β Counting
Radon (Rn) 222	EPA / DA	Alpha Scintillation
Radon (Rn) 222	EPA	Liquid Scintillation
Scandium (Sc) 46	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Strontium (Sr) 89, 90	EPA 905.0 / HASL-300 / 7500 Sr B / EML APHA	Low Bkgd. α/β Counting
Thallium (Tl) 208, 210	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Thorium (Th) 228, 229, 230, 232	EPA 907.0 / HASL-300 / EML / APHA	Alpha Spectroscopy
Thorium (Th) 228, 229, 230, 232	Eichrom Column	Alpha Spectroscopy
Thorium (Th), Total	EPA 907.0 / HASL-300 / EML / APHA	Low Bkgd. α/β Counting
Thorium (Th), Total	Eichrom Column	Low Bkgd. α/β Counting
Tritium (H_3)	EPA 906.0 / HASL-300 / 7500 H_3 B / EML / APHA	Liquid Scintillation
Uranium (U) 232, 234, 235, 238	EPA 907.0 / HASL-300 / EML / APHA	Alpha Spectroscopy
Uranium (U) 232, 234, 235, 238	Eichrom Column	Alpha Spectroscopy
Uranium (U) 235, 238	EPA 901.1 / HASL-300 / 7120 B / EML / APHA	Gamma Spectroscopy
Uranium (U), Total Alpha	EPA 907.0 / HASL-300 / EML / APHA	Low Bkgd. α/β Counting
Uranium (U), Total Alpha	EPA 908.0	Low Bkgd. α/β Counting
Uranium (U), Total	KPA (ASTM D-5174-97)	Kinetic Phosphorescence
Uranium (U), Total	Eichrom Column	Low Bkgd. α/β Counting

18. LABORATORY TRAINING PROGRAM

The quality assurance department in conjunction with management shall ensure the competence of all personnel who operate specific equipment, perform environmental tests and/or calibrations, evaluate results, and sign test reports and calibration certificates.

Appropriate supervision shall be provided when using personnel that are undergoing training. Lines of authority in the laboratory shall be proportioned such that adequate supervision is ensured.

The training program shall be relevant to the present and anticipated task of the laboratory.

18.1. Training Frequency and Matrix

18.1.1. The Quality Assurance department shall maintain a training matrix adequate to meet required NELAC, DOE QSAS, DOD QSM, ANSI NQA-1, regulatory and/or client training requirements. The training matrix shall list required training topics by job description and define the frequency of the training. The training matrix shall be available for reference for all employees.

18.1.2. Analyst training shall be considered up to date if:

18.1.2.1. An employee training file contains a certification that technical personnel have read, understood and agreed to perform the most recent version of the test method (the approved method or standard operating procedure as defined by the laboratory document control system)

18.1.2.2. An employee record contains documentation of continued proficiency by at least one of the following once per year:

18.1.2.2.1. Acceptable performance of a blind sample (single blind to the analyst);
18.1.2.2.2. Another demonstration of capability (DOC);
18.1.2.2.3. Successful analysis of a blind performance sample on a similar test method using the same technology;
18.1.2.2.4. At least four consecutive laboratory control samples with acceptable levels of precision and accuracy; or
18.1.2.2.5. If “18.1.2.2.1” to “18.1.2.2.4” cannot be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.

18.2. Ethics and Data Integrity Training

18.2.1. Ethics and Data integrity training shall be provided as a formal part of new employee training and shall be provided on an annual basis for all current employees.

18.2.2. The topics covered during the ethics and data integrity training shall be documented in writing and provided to all trainees.

18.2.3. Key topics covered during the training shall include the ARS International organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues, and record keeping.

18.2.4. Specific examples of breaches of ethical behavior shall be discussed during the training including improper data manipulations, adjustments of instrument time clocks, and in appropriate changes in concentrations of standards.

18.2.5. The training shall include discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

18.2.6. Ethics and data integrity training shall emphasis the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient.

18.2.7. The training shall include client confidentiality and conflict of interest issues.

18.2.8. Employees shall be required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment or civil/ criminal prosecution.

18.2.9. Initial data integrity training and the annual refresher training shall have a signature attendance sheet or other form of documentation that demonstrates all staff have participated and understood their obligations related to data integrity.

18.3. Radiation Awareness Training

18.3.1. Laboratory personnel shall be trained in the requirements of LAC 33:XV, Chapter 10, Article 1012 prior to entering a Restricted Area or working with radioactive materials. At a minimum, initial training instruction shall include the following:

18.3.1.1. All individuals shall be kept informed of the storage, transfer, or use of sources of radiation in such portions of their work area.

18.3.1.2. All individuals shall be instructed in the health protection problems associated with exposure to such radioactive material or radiation (including the biological risks to an embryo or fetus), in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed (when applicable).

18.3.1.3. All individuals shall be instructed in, and instructed to observe to the extent within the worker's control, the applicable provisions of the Louisiana Radiation Protection Regulations and the ARS International Radioactive Material License under which they are working.

18.3.1.4. All individuals shall be instructed of the responsibility to report promptly to ARS International Management any condition that may constitute, lead to, or cause a violation of applicable Louisiana Radiation Protection Regulations and the ARS International Radioactive Material License, or which may cause unnecessary exposure to radiation or radioactive material.

18.3.1.5. All individuals shall be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material. An example of such an occurrence would be a spill or fire involving radioactive material.

18.3.1.6. All individuals who have worn dosimetry for purposes of personnel dose monitoring, shall be advised as to the radiation exposure reports that workers shall be furnished pursuant to the Louisiana Radiation Protection Regulations.

18.3.2. The extent of the instructions contained in subsections "18.3.1.1" through "18.3.1.1" above shall be commensurate with the potential radiological health protection problems in the work area.

18.4. Radiation Worker Training

18.4.1. Laboratory personnel shall be trained in the requirements of LAC 33:XV, Chapter 14, Appendix A prior to performing surveys of radioactive materials. The instruction shall contain a practical and written examination. Laboratory personnel must obtain a score of at least 80% on the written examination before they will be allowed to perform surveys. As a minimum, initial training instruction shall include the following:

18.4.2. Fundamentals of Radiation Safety

18.4.2.1. Characteristics of radiation
18.4.2.2. Units of radiation dose and quantity of radioactivity
18.4.2.3. Levels of radiation from sources of radiation
18.4.2.4. Methods of minimizing radiation dose:
18.4.2.4.1. working time;
18.4.2.4.2. working distance;
18.4.2.4.3. shielding;
18.4.2.4.4. respiratory precautions;
18.4.2.4.5. use of anti-contamination clothing.

18.4.3. Radiation Detection Instrumentation to be Used

18.4.3.1. Use of radiation survey instruments,
18.4.3.1.1. operation;
18.4.3.1.2. calibration;
18.4.3.1.3. limitations.
18.4.3.2. Survey techniques,
18.4.3.3. Use of personnel monitoring equipment.

18.5. Quality Assurance and Quality Control Training

18.5.1. Personnel shall be instructed in the applicable procedures utilized as part of the ARS International Quality Assurance Program and in the applicable requirements of the ARS International Quality Assurance Manual prior to performing laboratory analysis. The Laboratory Director shall determine which Quality Assurance procedures and portions of the Quality Assurance Manual are applicable. Method training and QA indoctrination shall be documented in training files.

18.5.2. The training may consist of personnel reviewing the Quality Assurance Procedures and Quality Assurance Manual and passing a verbal exam of the procedures and manual administered by the Laboratory Director , Quality Assurance Officer(s), or their designee. The person administering the exam shall ensure that the examinee has thorough and complete knowledge and understanding of the applicable material. The Laboratory Director and Quality Assurance Officer(s) shall designate in writing those individuals which may administer verbal examinations. The designated individuals as a minimum must be qualified on the procedure or material on which they are administering the exam.

18.5.3. Demonstration of Capability requirements, see section 19 of *ARS-001 Laboratory Quality Assurance Manual*.

18.6. Safety Training

18.6.1. Personnel shall be instructed in the safety procedures utilized by the ARS International laboratory. Training as a minimum shall include instruction in Chemical Hazard Communication and the provisions of *HSE-004 Chemical Hygiene Plan*.

18.6.2. The safety training may consist of personnel reviewing *HSE-004 Chemical Hygiene Plan* and Chemical Hazard Communication plans and passing a verbal exam of the material administered by the Laboratory Director, the Quality Assurance Officer(s), or their designee. The person administering the exam shall ensure that the examinee has thorough and complete knowledge and understanding of the applicable material.

18.7. Waste Management Training

18.7.1. Personnel shall be instructed in the waste management procedures utilized by the ARS International laboratory. Training as a minimum shall include instruction in *HSE-005 Waste Handling*.

18.7.2. The waste management training may consist of personnel reviewing the *HSE-005 Waste Handling* passing a verbal exam of the material administered by the Laboratory Director, Quality Assurance Officer(s), or their designee. The person administering the exam shall ensure that the examinee has thorough and complete knowledge and understanding of the applicable material.

18.8. Technical Skills and Analytical Methods Training

18.8.1. Personnel shall be instructed in the technical skills required and utilized by the ARS International laboratory and in the analytical methods performed. Training as a minimum shall include instruction in the analytical methodologies the person will be utilizing and in the specific technical skills required to perform the specific analytical method.

18.8.2. The technical skills and analytical methods training may consist of personnel reviewing the appropriate ARS International Analytical Procedure and passing both a verbal exam and practical performance exam of the procedure administered by the Laboratory Director, Quality Assurance Officer(s), or their designee. The person administering the exam shall ensure that the examinee has thorough and complete knowledge, understanding and skills to properly perform the applicable procedure.

18.9. Records of Training

18.9.1. Records of indoctrination and training may be maintained in the form of:

18.9.1.1. Attendance sheets;
18.9.1.2. Training logs:
18.9.1.3. Personnel training records; and
18.9.1.4. A description of the training and indoctrination.
18.9.1.5. Graded Test from Computer Based Training

18.9.2. Records of training shall contain evidence, as applicable, that each employee has read, understood and is using the latest version of the laboratory's quality documentation that relates to his or her job responsibilities.

19. DEMONSTRATION OF CAPABILITY

19.1 Procedure for Demonstration of Capability

The Quality Assurance Officer(s) in conjunction with Laboratory Management shall ensure that all technical laboratory staff has a demonstrated capability in the activities for which they are responsible. Demonstration of capability records and/or completion of appropriate training may be used to meet this requirement. Demonstration of capability records shall be maintained for each laboratory test method an individual is qualified to perform.

19.1.1 A demonstration of capability (DOC) must be made prior to using any test method, and any time there is a change in instrument type, personnel or test method. A continuing demonstration of method performance shall be required at least annually thereafter. In cases where the laboratory analyzes samples using a test method that has been in use by the laboratory before July 1999, and there have been no significant changes in instrument type, personnel or test method, the continuing demonstration of method performance and the analyst's documentation of continued proficiency shall be acceptable. The laboratory shall have records on file to demonstrate that an initial demonstration of capability is not required.

19.1.2 In general, this demonstration does not test the performance of the method in real world samples, but in the applicable and available clean matrix (a sample of a matrix in which no target analytes or interferences are present at concentrations that impact the results of a specific test method), e.g., water solids, biological tissue and air. In addition, for analytes which do not lend themselves to spiking, the demonstration of capability may be performed using quality control samples.

19.1.3 All demonstrations of capability shall be documented through the use of the Certification Statement form contained in this section. The completed forms shall be retained by the Quality Assurance Department and made available upon request.

19.1.4 All associated supporting data necessary to reproduce the analytical results

summarized in the Certification Statement shall be retained by the Quality Assurance Department.

19.1.5 The following steps, which are adapted from the EPA test methods published in 40 CFR Part 136, Appendix A, shall be performed if required by a mandatory test method or regulation. Note: For analytes for which spiking is not an option and for which quality control samples are not readily available, approaches other than the 40 CFR approach maybe used to perform this demonstration. It is the responsibility of the laboratory to document that other approaches to DOC are adequate. LCS's and or PE samples maybe used for DOC.

19.1.6 QC sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

19.1.7 At least four aliquots shall be prepared and analyzed according to the test method either concurrently or over a period of days.

19.1.8 Using all of the results, the mean recovery is calculated in the appropriate reporting units (such as pCi/L or pCi/g) and the standard deviations of the population sample (n-1) (in the same units) for each parameter of interest. When it is not possible to determine mean and standard deviations, such as for presence/absence testing and logarithmic values, the laboratory must assess performance against established and documented criteria.

19.1.9 Compare the calculated results to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). Default acceptance criteria shall be an analytical result within $\pm 2\sigma$ of the true value, Replicate Error Ratio within the -1 to +1 range, and the standard deviation of the sample population (n-1) within $\pm 2\sigma$ of the true value. If all parameters meet the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.1.10 When one or more of the tested parameters fail at least one of the acceptance criteria, an noncomformance report must be completed according to *ARS-013 Nonconformance Reporting and Corrective Action Program*, and the test must be repeated for all parameters that failed to meet the criteria. Repeated failure, however, confirms a general problem with the measurement system.

19.2 Certification Statements

19.2.1 A "Personnel Demonstration of Capability" certification statement may be used to document the completion of each demonstration of capability.

19.2.2 A copy of the certification statement shall be retained for each affected employee

for a minimum of five years.

Personnel Demonstration of Capability - Certification Statement

Date:_____
ARS International
2609 North River Road
Port Allen, LA 70767

Analyst Name:_____
Matrix:_____
Method Number:_____
Parameters Measured:_____

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method, which is use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method was performed by the analyst identified on this certification.

3. A copy of the test method and the laboratory specific SOP's are available for all personnel on-site.

4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory (*Note* [1]).

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

Laboratory Manager's Printed Name	Signature	Date
Quality Assurance Officer's Printed Name	Signature	Date

Note [1]*:*

True:	Consistent with supporting data.
Accurate:	Based on good laboratory practices consistent with sound scientific principles/practices.
Complete:	Includes the results of all supporting performance testing.
Self-Explanatory:	Data properly labeled and stored so that the results are clear and require no additional explanation.

20 DEPARTURE FROM PROCEDURES AND POLICES

20.1 Departure from Analytical Procedures

20.1.1 ARS International shall use acceptable test methods approved by the Louisiana Department of Environmental Quality (LADEQ), NELAC, DOE and/or the DOD when performing analysis. Acceptable methods are defined as methods cited in Title 40 of the Code of Federal Regulations (40 CFR) and subsequent changes published in the Federal Register, other published methods from such sources as the Environmental Protection Agency (EPA), HASL-300, *Standard Methods for the Examination of Water and Wastewater*, American Standards for Testing and Measurement (ASTM), National Institute for Occupational Safety and Health (NIOSH), EPA's Test Methods for Evaluating Solid Waste (SW-846), United States Geological Survey (USGS), and other alternate test procedures approved for nationwide use, as well as any method approved by the LADEQ.

20.1.2 Any variance or departure from an approved analytical test method or test procedure must first be approved by written confirmation with the applicable client or accrediting agency. A variance or departure is defined as "any deviation from an approved method that has the potential for affecting the analytical results from a test procedure".

20.1.3 Departures or deviations from environmental tests and calibration methods shall only occur if the departure or deviation has been documented, technically justified, authorized, and accepted by the client

20.1.4 ARS International shall report any deviations, departures, additions to, or exclusions from an acceptable test method and any other information relevant to the test method to the client in the report narrative.

20.2 Departure from Quality Assurance Procedures

20.2.1 Departures from quality assurance procedures shall be initiated and performed in accordance with this Quality Assurance Manual. Any departure from an ARS International approved quality assurance procedure must first be approved by ARS International management. A quality assurance departure is defined as "any departure or deviation from an approved quality assurance procedure that has the potential for affecting the quality assurance of a test procedure or test result".

20.2.2 Departures from quality assurance procedures shall be initiated by completing the appropriate sections of the Procedure Request/Approval form. An example of a Procedure Request/Approval form can be found at the end of this section. To indicate a departure or deviation from a procedure, the deviation block on the

Procedure Request/Approval form should be checked. An expiration date for the deviation or departure should also be entered on the form if applicable.

20.2.3 Deviations and departures shall at a minimum be approved by at least two members of the ARS International Management Staff knowledgeable in the areas affected by the procedure. At least one of these members shall be the ARS International Laboratory Director or ARS International Quality Assurance Officer(s), however, the ARS International Laboratory Director or Quality Assurance Officer(s) shall not be the same person who initiated the deviation. All controlled procedure copies shall be updated with approved changes within seven days of final approval.

Page ___ of ___

PROCEDURE REQUEST/APPROVAL PAGE

(To Be Used For Changes, Revisions, Deviations, Deletions, and New and Temporary Procedures)

Procedure Number: _____

Procedure Title: _____

Complete A, B, C, D and E

A. New Procedure: ☐ Yes ☐ No

B. Change Number: _____ (From QA Officer Change Log) ☐ N/A

Type of Change: ☐ Permanent ☐ Temporary, Expiration Date: _____

Deviation: ☐ Yes ☐ No Deviation Exp. Date _____

C. Revision Number: _____ ☐ N/A

D. Deletion: ☐ Yes ☐ No ☐ N/A

E. Temporary Procedure: ☐ Yes ☐ No Expiration Date: _____

DESCRIPTION OF CHANGE, DEVIATION, REVISION, OR DELETION:_____

_____

_____

_____

REASON FOR CHANGE, DEVIATION, REVISION, OR DELETION:_____

_____

_____

_____

APPROVALS

Author/Originator: _____ Date: _____

Technical Reviewer: _____ Date: _____

Quality Assurance Officer(s): _____ Date: _____

President/Vice President: _____ Date: _____

21 QUALITY ASSURANCE DISCREPANCIES, NONCONFORMING WORK AND CORRECTIVE ACTIONS

Quality Assurance Discrepancies, Nonconforming Work and Corrective Actions are discussed in detail in Procedure *ARS-013 Nonconformance Reporting and Corrective Action Program*. The purpose of the SOP is to specify a system to identify, investigate, control and document nonconformances; to notify applicable organizations and affected clients of deficiencies; and to provide a process for the development and implementation of corrective measures when warranted. The Nonconformance and Corrective Action Program provides a means for tracking and trending lessons learned to prevent reoccurrence of nonconformances.

21.1 Preventive Action

21.1.1 Preventive action shall be a pro-active process to identify opportunities for improvement rather than a reaction to the identification of problems or complaints. The laboratory shall seek to identify needed technical or quality system improvements and potential sources of nonconformance.

21.1.2 When preventive action is required, action plans shall be developed, implemented and monitored to reduce the likelihood of the occurrence of such non-conformances and to take advantage of the opportunities for improvement.

21.1.3 Preventive action procedures shall include the initiation of such actions and application of controls to ensure that they are effective.

22 ANALYSIS REPORTS AND WORKSHEETS

Analysis reports are discussed in detail in Procedure *ARS-059 Review, Validation, and Reporting of* Radiochemistry Data and Results. Worksheets are discussed in Procedure *ARS-049 Document Control and Record Management*.

22.1 Formula and Significant Figures

22.1.1 Final results of each test shall be calculated using formulas specified in *ARS-060 Analytical Calculations*. Where special requirements or non-routine work requires use of a formula that is not documented in *ARS-060 Analytical Calculations*, formulas used shall be subjected to a documented review by an independent reviewer prior to releasing the results in question.

22.1.2 The use of leading zeros for numbers less than one (1) is required (i.e. all numbers less than one must have a zero to the left of the decimal point).

22.1.3 Reporting units must accompany all results that are not dimensionless.

22.1.4 Results may be reported in standard decimal, or in scientific notation format, depending on the client request and the magnitude of the result.

22.1.5 Results reported from the ARS International LIMS system may be rounded using the significant figure and rounding routine below:

22.1.5.1 Rounding

Results are rounded as follows: The final digit of each reported value is rounded to the appropriate number of significant figures (see below). If the digit 5, 6, 7, 8 or 9 is dropped, increase the preceding digit by one unit. If the digit 0, 1, 2, 3, or 4 is dropped, do not alter the preceding digit.

23 CONTROL OF RECORDS

Control of records is discussed in detail in *ARS-049 Document Control and Record Management*.

24 RECORDS RETENTION AND DISPOSITION

Records retention and disposition is discussed in detail in *ARS-049 Document Control and Record Management*.

25 LOGBOOKS AND LOGBOOK MAINTENANCE

Logbooks and Logbook Maintenance are discussed in detail in *ARS-049 Document Control and Record Management*.

26 CLIENT CONFIDENTIALITY AND PROPRIETARY RIGHTS

ARS International, recognizes the importance of maintaining client confidentiality associated with laboratory samples, analysis and results. All personnel at ARS International are required to sign a confidentiality statement as a condition of employment and are instructed as to the importance of client confidentiality, proprietary rights and national security. These statements shall be maintained on file at the ARS International corporate office. Information pertaining to laboratory samples, analysis and results shall not be communicated, in either a written or verbal form, to any other entity other than the client of concern without the affected client's prior permission.

27 CLIENT SERVICE

27.1 Mission Statement of ARS International

ARS International realizes that our clients are our most valuable asset. The goal of ARS International is to provide our clients with the highest level of QUALITY, EXPERTISE and SERVICE available in the industry today at the best achievable price without compromising INTEGRITY and CONFIDENTIALITY.

27.2 Service

27.2.1 Service to the clients of ARS International must be maintained at the highest

professional level achievable at all times. Without our clients ARS International would not exist.

27.2.2 Employees of ARS International shall treat all clients with professionalism, courtesy and respect. There shall be no discrimination in service between clients. Employees of ARS International shall at all times strive to achieve the goals stated in the ARS International Mission Statement.

27.2.3 The ARS International laboratory shall afford clients or their representative's the opportunity to clarify the client's request and to monitor the laboratory's performance in relation to the client's work performed.

28 CUSTOMER COMPLAINTS

28.1 Customer Complaint Procedure

28.1.1 Negative complaints and comments received from customers, government agencies or other sources outside the ARS International laboratory shall be documented and turned over to the Laboratory Director for review within one working day of the date the comment or complaint was received. Negative complaints or comments shall be documented on the "ARS International Customer Complaint Form" An example of the ARS International Customer Complaint Form can be found at the end of this section. Verbal notification of the complaint or comment shall be made to the Laboratory Director or Quality Assurance Officer by the individual receiving the complaint as soon as possible. The Laboratory Director shall advise the individuals concerned as to the nature of the complaint.

28.1.2 The Laboratory Director shall review the complaint or comment and recommend corrective actions as necessary. The ARS International Customer Complaint Form shall then be forwarded within two working days to the Quality Assurance Officer(s) for review. The Quality Assurance Officer(s) shall investigate the reason for the complaint or comment and recommend further corrective actions as necessary. The Quality Assurance Officer(s) shall then forward the ARS International Customer Complaint Form to the ARS International President or Vice President for final review within two working days of receiving the form.

28.1.3 The ARS International President or Vice President shall review the complaint or comment and shall approve or disapprove of corrective actions recommended by the Laboratory Director and Quality Assurance Officer(s). The ARS International President or Vice President may recommend further corrective actions as necessary. The ARS International President or Vice President shall determine if the customer is to be advised of the corrective action.

ARS International Customer Complaint Form

Customer: _____ Phone Number: _____

Person Receiving Complaint, Comment, or Suggestion: _____

Check One: ☐ Complaint ☐ Comment ☐ Suggestion

Nature of Complaint, Comment, or Suggestion: _____
_____
_____
_____
_____

Recommended Corrective Actions, Laboratory Director: _____
_____
_____
_____

Laboratory Director Signature: _____ Date: _____

Recommended Corrective Actions, Quality Assurance Officer(s): _____
_____
_____
_____
_____

QA Officer Signature: _____ Date: _____

Final Approved Corrective Actions, ARS International President / Vice President: _____
_____
_____
_____

President / Vice President Signature: _____ Date: _____

Is the customer to be advised of the corrective action (President / Vice President Determination);

☐ Yes ☐ No

Person assigned to advise the customer (President / Vice President Determination).

_____

29 REVIEW OF REQUESTS, TENDERS AND CONTRACTS

Review of requests, tenders and contracts are discussed in detail in *ARS-037 Review of Requests, Tenders and Contracts*.

30 SUBCONTRACTING OF ENVIRONMENTAL TESTS AND CALIBRATIONS

Subcontracting of environmental tests and calibrations are discussed in detail in *ARS-063 Subcontracting Environmental Tests and Calibrations*.

31 PURCHASING SERVICES AND SUPPLIES

Purchasing of services and supplies is discussed in detail in *ARS-045 Procurement Control*.

32 SAMPLE COLLECTION

32.1 General Requirements

32.1.1 The applicable sampling plan as well as the sampling procedure shall be available at the location where sampling is undertaken.

32.1.2 Sampling plans, whenever reasonable, shall be based on appropriate statistical methods.

32.1.3 The sampling process must address any factors which must be controlled to ensure the validity of the environmental test.

32.1.4 Deviations, additions or exclusions requested by a client from a documented sampling procedure shall be recorded in detail. The deviations, additions or exclusions shall be included in all documents containing the environmental test results. Deviations, additions or exclusions shall be communicated to all appropriate personnel.

32.1.5 The laboratory shall record data and operations relevant to sampling that forms part of the environmental test that is to be undertaken. These records shall include:

32.1.5.1 The sampling procedure used,

32.1.5.2 The identification of the sampler,

32.1.5.3 Environmental conditions (if relevant),

32.1.5.4 Diagrams or other equivalent means to identify the sampling location as necessary and,

32.1.5.5 If appropriate, the statistics the sampling procedures are based upon.

32.2 Sample Containers

Polyethylene, polyvinyl chloride (PVC), Teflon containers or zip-lock type plastic bags are recommended for collecting radioactive samples because these containers are less adsorbent than glass or metal containers. Since radioactive elements are often present in extremely low quantities, a large fraction of the elements may be lost by adsorption on container walls or glassware surfaces during analysis. This loss may, in turn, cause a loss of radioactivity and possibly contaminate subsequent samples due to reuse of inadequately cleaned containers. Glass bottles are also more susceptible to breakage during handling than plastic containers. When a specific type of container is requested by a client, ARS International shall use that container.

32.3 Sample Preservation

Aqueous samples requiring preservation shall be preserved at the time of collection to a pH of <2. Nitric acid or hydrochloric acid may be used to achieve the desired acidification. There are no refrigeration requirements for radiological samples.

32.4 Sample Holding Times

32.4.1 The holding time for radiological samples, excluding radon, is 180 days from the date of collection or no more than five half-lives when the duration of the five half-lives is less than 180 days. The holding time for samples requiring radon analysis is 72 hours from the time of collection.

32.4.2 The holding time interval is defined to begin at the time and date that the sample was collected. Holding times are calculated in days or hours, according to the time units used in the holding time requirements. That is, if the specified holding time is given in hours, then the analysis must be completed before the end of the last hour of the holding time when calculated from the sampling time. When the holding time is given in days, the analysis must be complete before the end of the day on which the holding time would expire as calculated from the sampling day. The analysis holding time is calculated from the time of sample collection to the time of completion of all analytical runs, and includes dilutions and any required re-analysis.

32.5 Sample Collection Devices

32.5.1 Sample material may be gathered by using shovels, augers, trowels, coring devices, bailers or other types of sample gathering equipment. Sample gathering equipment shall be cleaned of interferants before and after each sample is taken. Deionized water shall be used for cleaning evolutions. Clean paper towels or rags may also be used to clean debris and sample material from sampling equipment. Sampling equipment should always be rinsed after wiping with

paper towels or rags.

32.5.2 An equipment blank shall be collected of any cleaning or rinse water when the sampling tool has been used to sample material expected or known to exceed a regulatory release limit.

32.6 Field Sampling and Sub Sampling Procedure

32.6.1 Soils

32.6.1.1 Soil samples shall be collected in the upper 15 centimeters of soil. If soil sampling is to be performed as part of a release survey, samples should also be taken from the 15 cm to 30 cm layer of soil depth.

32.6.1.2 Soil shall be removed using a shovel, auger, trowel, coring device or other similar instrument. Sampling devices shall be cleaned between samples to prevent sample cross contamination. A minimum of one quart or one pound of soil should be collected. Protective gloves should always be worn when sampling soil.

32.6.1.3 Soil samples shall be placed into individual containers. The containers shall be sealed to prevent soil leakage or spillage. Containers used shall be durable enough to withstand normal handling and transport conditions without a loss of integrity. Examples of suitable containers often used are plastic wide mouth bottles or zip-lock bags.

32.6.1.4 At a minimum, a sample I.D. number, location the sample was taken from, date and time the sample was taken, and the initials or printed name of the person taking the sample, shall be indicated on each sample container and on the COC.

32.6.2 Sand, Sludge, Slurry, and Liquid Samples

32.6.2.1 Sample locations shall be selected to be representative of the material being assessed. Samples from different containers may be combined, only if the original source of the material was the same. If a container holds materials which have separated under the influence of gravity (e.g. paraffin, sludge, water and sand), each phase must be sampled separately. The intention of this approach is to minimize the amount of NORM waste which must be disposed of by separately managing different phases of the material.

32.6.2.2 Samples of materials with a liquid consistency shall be placed into a non-breakable plastic or metal container and sealed tight. A minimum of one gallon of liquid sample material should be collected. Aqueous samples shall be preserved at the time of collection to a pH of <2.

32.6.2.3 Samples with a more viscous consistency (slurries, sludge, etc.) should also be placed into a non-breakable plastic or metal container and sealed tight. A minimum of one quart of sample material should be collected.

32.6.2.4 At a minimum, gloves should be worn when collecting sand, slurry, sludge, or liquid samples.

32.6.2.5 At a minimum, a sample I.D. number, location the sample was taken from, date and time the sample was taken, and the initials or printed name of the person taking the sample, shall be indicated on each sample container and COC.

32.6.3 Radon Emanation Field Sampling

32.6.3.1 Use an activated charcoal testing canister. Remove the retaining ring and charcoal retaining pad from the bottom of the testing container.

32.6.3.2 Open the container holding the activated charcoal. Immediately place and evenly distribute the activated charcoal in the bottom of the radon testing container. Replace the charcoal retaining pad and retaining ring in the bottom of the testing container. Note the time and date the charcoal was placed in the testing container.

32.6.3.3 Place the charcoal testing canister on the material to be assayed. Leave the testing container in place for a minimum of 24 hours.

32.6.3.4 Remove the retaining ring and charcoal retaining pad from the bottom of the testing container. Place the charcoal from the testing container in plastic container. Seal the container. Note the time and date the charcoal was placed in the container.

32.6.3.5 At a minimum, a sample I.D. number, location the sample was taken from, date and time the charcoal was placed in the testing canister and removed from the canister, and the initials or printed name of the person taking the sample shall be indicated on each sample container.

33 SAMPLE RECEIPT AND ACCEPTANCE AND TRACKING, STORAGE AND DISPOSAL

Sample receipt and acceptance are discussed in detail in *ARS-062 Sample Receiving*.

34 CHAIN OF CUSTODY (COC)

34.1 General Chain of Custody Requirements

34.1.1 There are two levels of sample handling: 1) sample tracking and 2) legal Chain of Custody (COC) protocols, which are used for evidentiary or legal purposes. The ARS International laboratory shall utilize legal COC protocols when a client specifies that a sample will be used for evidentiary purposes.

34.1.2 A log of names, initials and signatures for all individuals who are responsible for signing or initialing any laboratory record shall be maintained by the Quality Assurance Officer(s).

34.2 Legal/Evidentiary Custody

The use of legal COC protocols may be required by some State or federal programs. The following protocols shall be incorporated when legal COC is implemented by the organization.

34.3 Basic Requirements

34.3.1 The legal COC records shall establish an intact, continuous record of the physical possession, storage and disposal of sample containers, collected samples, sample aliquots, and sample extract or digestates. The COC record shall account for all time periods associated with the samples. For ease of discussion, the above mentioned items shall be referred to as samples.

34.3.2 A sample is in someone's custody if:

34.3.2.1 It is in ones actual physical possession

34.3.2.2 It is in ones view, after being in ones physical possession

34.3.2.3 It is in ones physical possession and then locked or sealed so that no one can tamper with it; and/or

34.3.2.4 It is kept in a secured area, restricted to authorized personnel only.

34.3.3 The COC record shall identify all individuals who physically handled individual samples.

34.3.4 In order to simplify record keeping, the number of people who physically handle the sample should be minimized.

34.3.5 A designated sample custodian be appointed to shall be responsible for receiving, storing and distributing samples.

34.3.6 Legal COC shall begin at the point established by the Federal or State oversight

program. This may begin at the point that cleaned sample containers are provided by the laboratory or the time sample collection occurs.

34.3.7 The COC forms shall remain with the samples during transport or shipment.

34.3.8 If shipping containers and/or individual sample containers are submitted with sample custody seals and any seals are not intact, the custodian shall note this on the sample discrepancy form.

34.3.9 Mailed packages should be registered with return receipt requested. If packages are sent by common carrier, receipts should be retained as part of the permanent COC documentation.

34.3.10 Once received by the laboratory, laboratory personnel are responsible for the care and custody of the sample and must be prepared to testify that the sample was in their possession and within view or secured in the laboratory at all times, from the moment it was received form the custodian until the time that the analyses are completed or the time of sample disposal.

34.3.11 ARS International shall utilize an Internal Chain of Custody(ICOC) to establish an intact, continuous record of the physical possession, storage, and disposal of sample containers, collected samples, sample aliquots, and sample extracts or digestates. The ICOC shall begin at the time of sample receipt, or at any other point established by the applicable federal or state oversight program. The ICOC shall account for all time periods associated with the samples and act as a record identifying all individuals who physically handled individual samples. The ICOC is maintained through a barcoding system in LIMS.

34.4 Required Information in Custody Records

34.4.1 Tracking records shall include, by direct entry or linkage to other records:

34.4.1.1 Time of day and calendar date of each transfer or handling;

34.4.1.2 Signatures of all personnel who physically handle the samples;

34.4.1.3 All information necessary to produce unequivocal, accurate records that document the laboratory activities associated with receipt, preparation, analysis and reporting;

34.4.2 A Chain of Custody shall be utilized by the laboratory when samples, sample aliquots, extracts or digestates are transferred to a third party for analysis.

34.4.3 Chain of Custody records shall contain the time of day and calendar date of each transfer or handling procedure and the signatures of all personnel who physically

handled the sample(s).

34.4.4 An ARS International chain of custody form shall be completed for all samples received without a client's chain of custody form. The ARS International employee accepting receipt of the samples shall initiate the chain of custody form and sign for accepting the samples. ARS International personnel collecting field samples shall initiate a Chain of Custody at the time of sample collection or when the sample is turned over to the laboratory for analysis.

35 SAMPLE STORAGE AND DISPOSAL

35.1 Sample Storage

35.1.1 The laboratory shall maintain an appropriate facility to avoid sample deterioration, contamination, or damage during storage, handling, preparation and testing. The laboratory will maintain an indexed sample storage system that facilitates sample retrieval. The laboratory shall follow any relevant instructions provided by the client with the sample. Where items have to be stored or conditioned under specific environmental conditions, these conditions shall be maintained, monitored and recorded. It should be noted that there are no refrigeration or temperature requirements for the storage of samples requiring radiological analysis. When applicable, samples shall be stored according to conditions specified by specific preservation protocols.

35.1.2 Samples shall be stored away from all standards, reagents, food and other potentially contaminating sources. Samples shall be stored in such a manner as to prevent cross contamination.

35.1.3 Sample fractions, extracts, leachates and other sample preparation products shall also be stored and kept away from all standards, reagents, food and other potentially contaminating sources. Samples shall be stored in such a manner as to prevent cross contamination. Unused portions of samples, together with all identifying labels, shall be returned to Sample Storage everyday at close of business. The unused portion of the sample shall be retained in a secure storage location until permission to destroy of dispose of the sample material is received by the Laboratory Director.

35.1.4 Where a sample or portion of the sample is to be held secure (for example, for reasons of record, safety or value, or to enable check calibrations or tests to be performed later), the laboratory shall maintain storage and security arrangements that protect the condition and integrity of the secured items or portions concerned. The laboratory shall maintain control and document access to all legal samples and sub-samples.

35.1.5 Samples shall be stored in a designated sample storage location posted "Caution: Restricted Area, Radioactive Material". Sample storage areas with exposure rates exceeding 5,000 microroentgens per hour (µR/hr) 30 centimeters from the samples, shall additionally be posted "Caution: Radiation Area". The postings shall be conspicuous in nature and shall bear the conventional radiation tri-foil symbol. The background color of the postings shall be yellow. The radiation tri-foil symbol and wording shall be of the colors purple, magenta, or black.

35.1.6 The shelf life for all sample types requiring radionuclide analysis, other than radon, is 180 days. Samples shall not be analyzed for radionuclides after a holding period of six months, unless directed by the client. Samples analyzed after the six month self life shall be annotated as such in the sample file and final report.

35.1.7 Samples with gamma exposure rates greater than 5,000 µR/hr or with individual radioisotope activity levels greater than one micro curie per gram shall be segregated from those samples with lesser gamma exposure rates and activity levels.

35.2 Sample Return, Disposal and Shipment

35.2.1 *HSE-005 Waste Handling Procedure* contains specific requirements for disposal of samples, digestates, leachates, extracts and other sample preparation products.

35.2.2 The laboratory shall maintain records that indicate the date of disposal, the nature of disposal (e.g., sample depleted, disposed in a hazardous waste facility or licensed facility, returned to the client), and name of the individual who performed the task.

35.2.3 Samples received by ARS International may be returned to the client, at the discretion of the Laboratory Director or Radiation Safety Officer, within 30 days of the completion of the sample analysis, unless specifically requested otherwise by the client. Client specific sample retention requirements shall be documented. The ARS International employee returning the samples shall complete the "Date Returned" section of the Sample Tracking Log. Samples shall be prepared for shipment in such a manner as to prevent leakage of the sample material during conditions normally incident to transport.

35.2.4 Sample material which ARS International is not required to return to the client (i.e., leak tests, air samples and unused portions of liquid samples which do not qualify as radioactive material per Louisiana Department of

Environmental Quality, Radiation Protection Regulations) shall be maintained for a period of 30 days from the date the final analysis report is supplied to the client. Sample material which is not required to be return to the client may be disposed after the 30 day holding period or according to contractual disposal criteria client specific sample disposal information shall be documented.

35.2.5 Samples that are involved in litigation actions shall only be disposed with the concurrence of the affected legal authority, the sample data user and/or the submitter of the sample. The laboratory shall record and maintain for a minimum of five years all correspondence between all parties concerning the final disposition of the physical sample.

35.2.6 Samples, which meet the Department of Transportation's definition of radioactive material, shall be shipped under the direction of the Radiation Safety Officer.

36 PREVENTION OF SAMPLE CROSS CONTAMINATION

36.1 Sample Contamination Prevention Methods

Sample cross contamination shall be prevented by:

36.1.1 The labeling of sample containers with Sample I.D. numbers and File Tracking numbers. Labeling sample containers with Sample I.D. numbers and File Tracking numbers is discussed in *ARS-062 Sample Receiving*.

36.1.2 The labeling of Planchets, Petri dishes, columns, centrifuge tubes and beakers with the abbreviated batch I.D. number as listed (BXX-XXXXX-XX). The batch I.D. on the Petri dish should always match the batch I.D. on the Planchet inside it. This labeling is critical and both the Chemist and the Countroom Technical should always review these Idenifications before the batch is delivered to the batch is counted.

36.1.3 Opening only one sample container at a time.

36.1.4 Opening and utilizing only one reagent or chemical at a time.

36.1.5 Utilizing disposable pipette tips and replacing the pipette tip after each use with a new tip.

36.1.6 Proper rinsing of glassware using reagent grade de-ionized water. Reference the section of this Quality Assurance Manual titled “Glassware Cleaning (Including Planchet Preparation)” for glassware rinsing and cleaning procedures.

36.1.7 Storing samples and maintaining sample security in accordance with the section of this Quality Assurance Manual titled "Sample Receiving and Shipping"

36.1.8 Maintaining good housekeeping practices in the laboratory.

36.1.9 Storing prepared planchets in a manner that preserves their integrity until they are counted.

36.1.10 Equipment which is used serially for sample preparation will be cleaned thoroughly between samples (example being a grinder).

36.1.11 Whenever Gamma Spectrscopy analysis requires low level detection, a new Marinelli geometry will be used.

37 SAMPLE AND REAGENT SPILLAGE AND BREAKAGE

Sample and reagent spillage and breakage are discussed in detail in *HSE-004 Chemical Hygiene Plan*.

38 REFERENCE STOCK SOLUTIONS, REAGENTS AND INTERMEDIATE DILUTIONS

Refer to *ARS-038 Radioactive Reference Standard Solutions and Records*

39 QUALITY CONTROL SAMPLES

Quality Control Samples are discussed in detail in *ARS-014 Operational Quality Assurance*.

40 ANALYSIS SYSTEMS CONTROL CHARTS

40.1 General

40.1.1 Control charts provide a useful tool in assessing QC efforts through graphical displays of a parameter(s) and variability over time. Control charts are established to monitor trends, warning, or out-of-control situations as they happen. A parameter plotted is related to sample testing, either directly in terms of concentration or indirectly in terms of derived information such as concentration mean (arithmetic) or range of concentration.

40.1.2 Quality control data shall be recorded and monitored in such a way that trends are detectable. Statistical techniques shall be applied when reviewing the quality control data results, where practicable. The monitoring process shall be planned and reviewed.

40.1.3 Quality control data monitoring shall include, but is not limited to, the

following:

40.1.3.1 Regular use of certified reference materials and/or internal quality control using secondary reference materials;

40.1.3.2 Participation in interlaboratory comparison proficiency testing programs;

40.1.3.3 Replicate tests or calibrations using the same or different methods;

40.1.3.4 Retesting or recalibration of retained samples;

40.1.3.5 Correlation of results for different characteristics of a sample (for example, total uranium should be greater than or equal to uranium-235).

40.1.4 Quality control measures shall be assessed and evaluated on an on-going basis.

40.1.5 Quality control acceptance criteria shall be used to determine the usability of data.

40.1.6 ARS International shall use the applicable acceptance/rejection criteria established by NELAP and/or DOE where no method, client specific requirements, or regulatory criteria exist.

40.1.7 When it is not apparent as to whether a mandated method or regulation QC acceptance/rejection criteria is more stringent, the regulation criteria shall be used.

40.1.8 Control charts (with the exception of gamma spectroscopy analysis) should be maintained for the following;

40.1.8.1 Counting instrument backgrounds.

40.1.8.2 Analytical blanks for each type of analysis performed.

40.1.8.3 Percent LCS spike recoveries, as appropriate, for each analyte.

40.1.8.4 Percent tracer/carrier recoveries, as appropriate, for each analyte.

40.1.8.5 Replicate samples.

40.1.8.6 Counting instrument calibration verification checks.

40.1.9 The following gamma spectroscopy specific control charts should be maintained;

40.1.9.1 Gamma spectroscopy backgrounds.

40.1.9.2 Full Width Half Max (FWHM).

40.1.9.3 Full Width Tenth Max (FWTM).

40.1.9.4 Relative Peak Shift.

40.1.9.5 Total activity (of LCS samples)

40.1.9.6 Blanks

40.1.10 Unless otherwise noted, control chart ranges at a minimum shall include ±1, ±2 and ±3 standard deviations. After a minimum of 20 results have been obtained for each particular analysis and matrix, the mean result and its standard deviation will be tabulated. The control chart consists of a graph of the mean value line with upper and lower warning control lines. The warning limit is set at ±2 standard deviations of the mean and the out-of-control limits at ±3 standard deviations of the mean. This charting will be performed for each procedure and matrix type. Means and standard deviations will be recalculated quarterly or when a minimum of twenty (20) data points have been obtained. A new graph will be generated reflecting any changes in the mean value, warning limits and out-of-control limits lines. The database for determining control limits will be based on the data collected during the last 3 months up to 100 data points. From this data, control limits will be set for the following quarter.

40.1.11 The laboratory shall use the following method and default parameters in the event that twenty (20) data points have not been obtained to calculate the mean and standard deviations:

Mean	=	Perform five separate counts of a reference standard or blank and determine the mean of the results.
1σ	=	±12% of the determined mean value of the reference standard or blank, as appropriate.
2σ	=	±25% of the determined mean value of the reference standard or blank, as appropriate.
3σ	=	±35% of the determined mean value of the reference standard or blank, as appropriate.

40.1.12 For duplicate analyses, a control chart is generated using at least 20 duplicate results of a single matrix. The RER shall be plotted.

40.1.13 Although control charts are useful tools for determining accuracy and precision in laboratory results, they should not be the only nor should a single point on the control chart be the sole criteria used to evaluate any individual sample result. Control charts must be evaluated not only with respect to individual values but also with respect to patterns and trends. Therefore, recoveries and RER results should be plotted as soon as they are calculated.

40.2 Required Data

40.2.1 All control charts will contain the following information at a minimum. Units are required as applicable. All instrumentation that generates its own control charts must include the below information.

40.2.2 All axes labeled

40.2.3 Instrument I.D. and/or serial number

40.2.4 One, two, and three sigma values as well as the normal expected values

40.2.5 Applicable units as necessary.

40.3 Control Charts Maintenance

40.3.1 All control charts shall be maintained by the Quality Assurance Manager. Control charts shall either be documented on appropriate graph paper or computer generated.

40.4 Evaluating Control Charts

40.4.1 Control charts shall be assessed on a timely and on-going basis. A Gaussian distribution will provide 5 percent outliers from 2 standard deviations. Quality control results (of unknown material) outside of this range must be reviewed by the appropriate supervisor. Depending upon correlation of other data points, this data may still be acceptable. Data points outside of 3 standard deviations require corrective action referencing the sample batch related to the out-of-control QC. A group of seven QC data points that occur sequentially above or below the calculated mean indicate the need for corrective action.

40.4.2 With warning limits set at two standard deviations of the mean, one result in 20 may fall outside the warning limit by statistical chance. This should not be of particular concern unless two successive points appear outside of the warning limits. This situation should then be considered a potential out-of-control event. A single point outside of three standard deviations or three points outside two standard deviations per twenty sample set constitutes a potential out-of-control situation and requires investigation and correction, as required.

40.4.3 Trends indicate slow changes in the procedure which could lead to an out-of-control situation unless corrected. The following criteria indicate the presence of trends:

40.4.3.1 Measurement outside ± 3 sigma; - stops analysis

40.4.3.2 8 most recent consecutive points on one side of mean;

40.4.3.3 4 of 5 most recent points > 1 sigma;

40.4.3.4 7 most recent points trending in one direction

40.4.3.5 15 most recent points inside 1 sigma;

40.4.3.6 8 most recent points outside 1 sigma

40.4.4 Any trends identified will be documented and monitored and evaluated to determine whether there is an unacceptable impact to ongoing measurements. When a trend is identified that could negatively impact the quality of ongoing measurements, the procedure must be examined for possible causes and appropriate corrective measures taken.

40.4.5 Upper and lower acceptability limits are set at ±3 standard deviations from the mean. These limits must be as, or more stringent than individual method requirements. Any data point falling outside the limits will require remedial action. This remedial action may include re-analyzing all samples and QC involved or may involve data validation. If the data is valid despite this data point falling outside control limits, a QC Sample Non-Conformance Report should be generated and included in the project file and QC Summary. An example of a QC Sample Non-Conformance Report is contained at the end of the “Data Quality Objectives” section of this Quality Assurance Manual. The QC Sample Non-Conformance Report should state the following:

40.4.5.1 What data point fell outside of the control limits.

40.4.5.2 What corrective or investigative action was taken.

40.4.5.3 A clear explanation of the validity of the data and how this deviation affects that data validity.

40.4.6 The original QC Sample Non-Conformance report shall be maintained by the QA/QC Department. Copies of the report should be filed in the job folder and the applicable analytical section.

40.5 Accuracy and Precision Control Charts

40.5.1 Although control charts are useful tolls for determining accuracy and precision in laboratory results, they should not be the only nor should a single point on the control chart be the sole criteria used to evaluate any individual sample result. Control charts must be evaluated not only with respect to individual values but also with respect to patterns and trends. Therefore, spike recovery and RER, DER (Normalized Absolute Difference), or RPD (Relative Percent Difference) results as appropriate should be plotted as soon as they are calculated.

41 ANALYTICAL COUNTING EQUIPMENT OPERATION AND CALIBRATION

Analytical Counting Equipment Operation and Calibration are discussed in detail in the following procedures:

ARS-014 Operational Quality Assurance
ARS-044 Segregation of Out-of-Tolerance Instruments
ARS-050 Operation of the Tennelec LB-4100 Alpha/Beta Counting System
ARS-051 Operation of the Ortec Alpha Spectroscopy System
ARS-052 Operation of the Packard 3170 Liquid Scintillation Counting System
ARS-053 Operation of the Canberra Alpha Spectroscopy System
ARS-056 Operation of the LB5100W Alpha/Beta Counting System
ARS-057 Operation of the Apex Gamma Spectroscopy System
ARS-058 Operation of the Ortec Gamma Spectroscopy System

42 SUPPORT (NON-COUNTING) EQUIPMENT CALIBRATION AND MAINTENANCE

42.1 General Maintenance Requirements

42.1.1 Records of general maintenance for equipment described in this section shall be recorded in a log book. General maintenance includes the cleaning of equipment other than glassware, replacement of batteries, cables and

other maintenance items of a general nature. The equipment maintenance log books shall be maintained by the Quality Assurance Department. Records of general maintenance shall be maintained for a minimum of five years. Each log shall include as a minimum:

42.1.1.1 The name of the item of equipment.

42.1.1.2 The manufacturer's name, type identification and serial number.

42.1.1.3 The date received and the date placed in service.

42.1.1.4 The condition of equipment when placed in service (new, used, or reconditioned).

42.1.1.5 The current location.

42.1.1.6 The location of the manufacturer's instruction manual (if available).

42.1.1.7 The details of maintenance.

42.1.2 Maintenance log books shall be maintained on all instrumentation or measuring devices. Each log book shall include, in addition to the information required above;

42.1.2.1 calibration frequency

42.1.2.2 standards used for calibration

42.1.2.3 calibration history

42.1.2.4 the authorized calibration personnel or institute; and

42.1.2.5 records of all maintenance performed.

42.1.3 In the case of measuring equipment, calibration records shall also be maintained for a minimum of five years.

42.1.4 Analytical equipment shall be calibrated or verified at least annually, using NIST traceable references when available, over the entire range of use.

42.2 Portable Battery Powered Radiation and Contamination Survey Equipment

42.2.1 Portable battery powered radiation and contamination survey equipment used in the laboratory includes, but is not limited to, the following;

42.2.1.1 Ludlum Model 3 Scintillation Detectors with Ludlum 44-2 probe

42.2.1.2 Ludlum Model 2 Geiger Mueller Detectors with Ludlum 44-9 probes

42.2.1.3 Ludlum Model 3 Detectors with mid-range 44-38 Geiger Mueller probes

42.2.1.4 Ludlum Model 2223 Scalers/Rate meters with Ludlum 43-89 probes

42.2.2 Other similar types of portable battery powered radiation and contamination survey equipment may also be used and are also subject to the conditions of this procedure.

42.2.3 Each portable radiation and contamination survey instrument shall be calibrated:

42.2.3.1 At intervals not to exceed one year, any time the instrument is found to respond inconsistently to a known source or shows any indication of physical damage, and after each instrument servicing other than battery replacement;

42.2.3.2 At energies and radiation levels appropriate for use; and

42.2.3.3 So that accuracy within plus or minus 20% of the true radiation level can be demonstrated on each scale.

42.2.4 Records of portable radiation and contamination survey instrument calibrations shall be maintained for a period of not less than five years.

42.2.5 Preoperational checks shall be performed on all battery powered portable radiation and contamination survey instruments before and after use and any time an employee believes an instrument may not be operating correctly. Preoperational checks on survey instruments assigned to the laboratory may be performed at the beginning of the day or at the end of the day. Preoperational checks shall be performed at least monthly on all battery powered portable radiation and contamination survey instruments which have not been used. The results of preoperational checks shall be recorded in a hardbound book.

42.2.6 Preoperational checks consist of a physical integrity, battery, response and calibration check. Preoperational checks shall be performed as follows:

42.2.6.1 Physical Check: Inspect the instrument to ensure the instrument is

physically sound.

42.2.6.1.1 Items to verify include:

42.2.6.1.2 Frayed, torn cables

42.2.6.1.3 Corroded or stuck connectors

42.2.6.1.4 Cracked meter faces

42.2.6.1.5 Bent or loose deflection needles

42.2.6.1.6 Loose or misaligned selector switch

42.2.6.1.7 Cracked casing

42.2.6.1.8 Torn Mylar of detector face

42.2.7 Calibration Check: Verify that the meter is within calibration limits by checking the calibration sticker attached to the instrument's housing. Ensure the instrument is calibrated in accordance with state requirements. Instruments are required to be calibrated every 12 months.

42.2.8 Battery Check: Turn the selector switch on the instrument to the BAT position for a minimum of 5 seconds and verify on the meter face that the battery is functional. The meter needle should measure within the BAT TEST region. Batteries should be replaced if the needle does not deflect to above the lower BAT TEST line or if the needle is not stable.

42.2.9 Response Check: Perform a response check prior to use as follows:

42.3 Ludlum Model 3 with 44-2 probe or equivalent instrumentation:

42.3.1 Place a check source with a known value against the end face of the probe. Turn the scale selector switch to an appropriate scale so that the indicating needle does not peg high or low, and so that a comprehensive instrument reading can be obtained. Note the meter reading. Values for the response check must be within 20% of a known value for the particular meter and source being used.

42.3.2 Known values for a specific instrument shall be determined as soon as possible after meter calibration. A response source shall be held against the end face of the probe and the meter reading noted. This reading shall be

used to determine the ± 20% range. The same response source shall then be used for all future response checks. The initial meter reading of a known source for all battery powered portable survey instruments used by the ARS International laboratory shall be documented in the Equipment Maintenance Log.

42.4 Ludlum Model 2 with a 44-9 probe or equivalent instrumentation:

42.4.1 Place a check source with a known value within ½" of the Mylar window of the probe. Turn the scale selector switch to an appropriate scale so that the indicating needle does not peg high or low, and so that a comprehensive instrument reading can be obtained. Note the meter reading in counts per minute (cpm). Values for the response check must be within 20% of a known value for the particular meter and source being used.

42.4.2 Known values for a specific instrument shall be determined as soon as possible after meter calibration. A response source shall be held against the end face of the probe and the meter reading noted. This reading shall be used to determine the ± 20% range. The same response source shall then be used for all future response checks. The initial meter reading of a known source for all battery powered portable survey instruments used by the laboratory shall be documented in the Equipment Maintenance Log.

42.5 Portable Air Sampling Equipment

42.5.1 Portable air sampling equipment used in the laboratory includes, but is not limited to, the LV-1 Air Sampler

42.5.2 Other similar types of portable air sampling equipment may also be used and are also subject to the conditions of this procedure.

42.5.3 Each portable air sampling instrument shall be calibrated at intervals not to exceed one year and any time the instrument is found to show any indication of physical damage which may affect the accuracy of the measured flow rate through the instrument.

42.5.4 Records of portable air sampling equipment calibrations shall be maintained for a period of not less than five years.

42.5.5 Prior to using portable air sampling equipment, the operator shall ascertain that the instrument is in calibration.

42.6 Semi-Portable Counter Scalers

42.6.1 Semi-portable counter scalers used by the ARS International laboratory include, but are not limited to, the following;

42.6.1.1 Ludlum Model 2200 with a Ludlum Model 44-10 Scintillation probe

42.6.1.2 Ludlum Model 2200 with a Ludlum Model 182 Scintillation probe

42.6.1.3 Ludlum Model 2000 with a Ludlum Model 44-10 Scintillation probe

42.6.1.4 Ludlum Model 2000 with a Ludlum Model 182 Scintillation probe

42.6.2 Other similar types of semi-portable counter scalers may also be used and are also subject to the conditions of this procedure.

42.6.3 The electronics of each semi-portable counter scaler shall be calibrated at intervals not to exceed one year and any time the instrument is found to respond inconsistently to a known source or shows any indication of physical damage.

42.6.4 A Chi-square reliability check shall be performed on semi-portable counting systems annually.

42.6.5 Background count rates and reference source checks shall be performed daily when in use. The performance of daily count rates and reference source checks shall be logged in a hard bound book. Average background count rate and average reference source count rate shall be performed as a minimum every six months for all in-use on semi-portable counting systems.

42.6.6 Records of semi-portable counter scaler calibrations, Chi-square reliability checks, background count rates, and reference source count rates shall be maintained for a period of not less than five years.

42.7 Balances

See *ARS-041 Analytical Balance Calibration Check* for balance requirements.

42.8 Thermometers

42.8.1 All liquid-in-glass type thermometers used in conjunction with the laboratory shall have their calibration verified against a NIST traceable thermometer at intervals not to exceed one year, or any time there is indication that the thermometers may not be reading accurately. All dial-type thermometers used in conjunction with the laboratory shall have their calibration verified against a NIST traceable thermometer at least quarterly, or any time there is indication that the thermometers may not be reading

accurately.

42.8.2 Thermometers may be calibrated in house using the following procedure.

42.8.2.1 Place the thermometer whose calibration is being verified in an ice bath with a NIST traceable thermometer and allow the indicated temperatures on the thermometers to stabilize. Indicated thermometer temperature should be within ±1% of the NIST traceable thermometer temperature.

42.8.2.2 Place the thermometer whose calibration is being verified in an bath of boiling water with a NIST traceable thermometer and allow the indicated temperatures on the thermometers to stabilize. Indicated thermometer temperature should be within ±1% of the NIST traceable thermometer temperature.

42.8.2.3 Documentation of thermometer calibrations shall be maintained for at least five years. An example of a thermometer calibration form can be found at the end of this section.

42.8.3 Thermometers which are unable to read within ±1% of the NIST traceable thermometer temperature shall not be used in conjunction with the laboratory.

42.8.4 Electronic thermometers and thermistors shall be calibrated at intervals not to exceed one year, or any time there is indication that the thermometers may not be reading accurately. Calibration of electronic thermometers and thermistors may be performed in house by tracking the temperature of the electronic thermometer or thermistor against a calibrated NIST traceable liquid-in-glass type thermometer. Electronic thermometers or thermistors which are unable to track and read within ±1% of a calibrated liquid-in-glass type thermometer shall not be used in conjunction with the laboratory.

42.8.5 Thermometers shall be labeled when calibrated and a correction factor, if any, recorded.

42.9 Pipettes

Pipette maintenance calibration shall be performed according to *ARS-042 Use and Maintenance of Mechanical Pipettors*

42.10 Ovens

42.10.1 The temperature of ovens shall be monitored daily when used for

analysis requiring specific temperature controls using a NIST traceable thermometer. Monitoring of temperature may be accomplished by the use of liquid-in-glass type thermometers, dial-type thermometers, electronic thermometers or thermistors.

42.10.2 Thermometers used to control and monitor oven temperature shall be graduated in increments no larger than 1°C. Records shall be maintained of the oven temperature at the start, during, and at the end of heating evolutions of a sample aliquot when specific temperature controls are required.

42.10.3 The temperature of muffle furnaces shall be monitored when used for analysis requiring specific temperature controls. Devices used to measure the temperature of muffle furnaces shall be graduated in increments no larger than 50°F or 25°C. Records shall be maintained of the muffle furnace temperature at the start, during, and at the end of heating evolutions of a sample aliquot when specific temperature controls are required.

42.11 Radiological Count Room Temperature/Pressure/Humidity Monitors

42.11.1 The temperature, pressure and humidity of the environment inside radiological counting rooms shall be monitored and recorded daily in a log book. Pressure and humidity monitors shall have their calibration verified at intervals not to exceed 12 months.

42.12 Calibration Labels

Each item of equipment, including reference materials, shall be labeled, marked or otherwise identified to indicate its calibration status.

42.13 Records

Records of equipment calibration and maintenance shall be maintained in accordance with *ARS-049 Document Control and Records Management*.

THERMOMETER CALIBRATION

Thermometer Serial Number: _____

Thermometer Range (Indicate ^{0}F or ^{0}C): _____

Thermometer Type: ☐ Liquid-In-Glass ☐ Dial ☐ Electronic ☐ Other: _____

NIST Traceable Thermometer Serial Number: _____

NIST Traceable Thermometer Range (Indicate ^{0}F or ^{0}C): _____

NIST Traceable Thermometer Calibration Date: _____

Thermometer Temperature in Ice (Indicate ^{0}F or ^{0}C): _____

Thermometer Temperature in Boiling Water (Indicate ^{0}F or ^{0}C): _____

Other Temperature Measurements (At Least one Measurement Required)

Monitor Being Calibrated (Indicate ^{0}F or ^{0}C)	NIST Thermometer (Indicate ^{0}F or ^{0}C)
_____	_____
_____	_____
_____	_____

Thermometer being calibrated must indicate within ± 1% of the true temperature.

Calibration Completed By: _____ Date: _____
Signature

Laboratory Director Review: _____ Date: _____
Signature

QA Officer Review: _____ Date: _____
Signature

Pipette Calibration Form

Date:_____
Pipette I.D. Number Calibrated:_____
Weight Scale I.D. Used: _____
Temperature: _____

Person Performing Calibration: _____
Maximum Volume of Pipette:_____
Calibration Date of Weight Scale:_____

For pipettes of 5 - 40 µl volume:
Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 5 µl of deionized water: _____

The weight of the Planchet with 5 µl of deionized water minus the weight of the empty Planchet should be between 0.004 and 0.006 grams.

Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 20 µl of deionized water: _____

The weight of the Planchet with 20 µl of deionized water minus the weight of the empty Planchet should be between 0.019 and 0.021 grams.

Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 40 µl of deionized water: _____

The weight of the Planchet with 40 µl of deionized water minus the weight of the empty Planchet should be between 0.038 and 0.042 grams.

For pipettes equal to or less than 5 ml volume:
Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 1 ml of deionized water: _____

The weight of the Planchet with 1 ml of deionized water minus the weight of the empty Planchet should be between 0.99 and 1.01 grams.

Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 3 ml of deionized water: _____

The weight of the Planchet with 3 ml of deionized water minus the weight of the empty Planchet should be between 2.97 and 3.03 grams.

Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 5 ml of deionized water: _____

The weight of the Planchet with 5 ml of deionized water minus the weight of the empty Planchet should be between 4.95 and 5.05 grams.

For pipettes greater than 5 ml volume but less than 10 ml volume:
Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 2 ml of deionized water: _____

The weight of the Planchet with 2 ml of deionized water minus the weight of the empty Planchet should be between 1.98 and 2.02 grams.

Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 5 ml of deionized water: _____

The weight of the Planchet with 5 ml of deionized water minus the weight of the empty Planchet should be between 4.95 and 5.05 grams.

Weight of empty Planchet (If Planchet was tarred enter 0):_____
Weight of Planchet and 10 ml of deionized water: _____

The weight of the Planchet with 10 ml of deionized water minus the weight of the empty Planchet should be between 9.90 and 10.10 grams.

43 MEASUREMENT TRACEABILITY – GENERAL REQUIREMENTS

Measurement traceability for the Analytical Laboratory is covered in detail in *ARS-014 Operational Quality Assurance*

44 PREVENTIVE MAINTENANCE

44.1 Refer to *ARS-048 Preventive Maintenance*

45 REAGENT AND DEIONIZED WATER PRODUCTION

45.1Water Quality

45.1.1 Four categories of water quality are recognized by the ARS International laboratory. These categories are Type I water, Type II water and Type III water as defined in ASTM D1193-06 "Standard Specification for Reagent Water.

Reagent Water Specifications		
Water Type	**Resistivity megohm-cm at 25^0 C**	**Conductivity µmho/cm at 25^0 C**
Type I	>18.0	<0.1
Type II	>1.0	<0.05
Type III	>4.0	0.25

1. Type I water is used in test methods requiring an absolute minimum interference and bias and maximum precision. Type I water is prepared by distillation of Type II water.

2. Type II water is used by the ARS International laboratory for radiological analysis and for the final rinsing of glassware. Type II water is prepared by the ARS International laboratory by passing feed water through a mixed-bed deionizer. The control criteria for Type II water shall result in water of sufficient purity that, upon analysis, no detectable analyte concentration is obtained for each analysis in which the water is used. Type II water, having a minimum resistivity of 1 megohm-cm at 25^0 C (in line), is also prepared by passing feed water through a mixed-bed deionizer.

3. Type III water can be used for glassware washing, preliminary rinsing of glassware, and as feed water for production of higher grade waters.

45.1.2 The pH of Type I or Type II water cannot be measured accurately without contaminating the water. Type I water cannot be stored without significant degradation. Type I water should be produced continuously and used immediately after processing. Reagent grade and Type II water may be stored, but keep storage to a minimum and provide quality consistent with the intended use. Store all types of water in materials and containers that will protect the water from contamination.

45.2 Water Quality Measurements

45.2.1 Daily water quality checks shall be performed on all working days using the resistivity meter on the deionized water supply. Records of water quality measurements shall be maintained in log books designated for that purpose. Corrective actions to be taken for non-compliant and non-routine events are described in the "Corrective Action for Out-of-Spec Water" section of this SOP and should be documented and evaluated in accordance with *ARS-013 Nonconformance Reporting and Corrective Action Program*.

45.3 Corrective Action for Out-of-Spec Water

45.3.1 The pre-filter to the mixed-bed deionizer shall be cleaned or replaced when the deionizer is incapable of producing Type II water. The ion exchange resin bed of the mixed-bed deionizer shall be replaced in the event that cleaning or replacement of the pre-filter does not result in the production of Type II water.

45.4 Preventive Maintenance of the Mixed-Bed Deionizer

45.4.1 The resistivity (megohm-cm at 25^0 C, in line) and conductivity (µmho/cm at 25^0 C) of the water output of the mix-bed deionizer shall be monitored daily when in use. Deionizer pre-filter and/or the resin beds shall be cleaned or replaced when the water quality output is within 10% of the Type II water quality limits.

46 GLASSWARE CLEANING AND PLANCHET PREPARATION

46.1Glassware utilized by the ARS International laboratory shall be cleaned as follows:

46.1.1 Rinse all used glassware* off with tap water and place glassware in a dishwasher.

46.1.2 Add one scoop of detergent to the dishwasher and start a wash cycle.

46.1.3 Remove the clean glassware from the dishwasher and place the glassware

in a sink.

46.1.4 Place a stopper in the sink drain and add 280ml of Citrinox cleaner.

46.1.5 Fill the sink approximately half full with tap water and let the glassware soak for at least one hour.

46.1.6 Remove the glassware from the Citrinox soak and rinse with deionized water.

46.1.7 Let the glassware air dry or wipe dry with a clean paper towel.

46.1.8 The glassware should be visually inspected for cracks and leftover residue.

46.1.9 Discard glassware with visual cracks. Rinse glassware with acetone, dry and store in appropriate cabinet.

46.1.10 Sample glassware and containers shall be designated disposable or cleaned according to recommended procedures that are listed in the individual Analytical Materials Specifications.

***Note**: *Do NOT mix the environmental or NORM glassware with the DOE glassware in the cleaning process. Glassware designated for use with high activity samples should be kept separate from glassware used for low level environmental activity samples.*

46.2 KPA Glassware

46.2.1 For all low-level uranium KPA analysis, prior to initial use, all new glassware with the exception of cuvettes shall be soaked in hot 8 molar nitric acid for at least two hours and then in room temperature 8 molar nitric acid overnight.

46.3 Planchet Preparation

46.3.1 Planchets shall be rinsed with Type II water to remove interfering residues or contamination before use. Planchets shall be stored in a manner that preserves their integrity and prevents contamination until they are used.

47 POLLUTION PREVENTION AND WASTE MINIMIZATION

Pollution preventions and waste minimization are discussed in detail in *HSE-005 Waste Handling Procedure*.

48 WASTE MANAGEMENT

Waste management is discussed in detail in *HSE-005 Waste Handling Procedure*.

49 AUDITS AND SURVEILLANCES

49.1 General Requirements

49.1.1 A schedule shall be developed by the Quality Assurance Officer(s) listing the audits and surveillance to be performed for the year.

49.1.2 Specific audits and surveillance shall be scheduled to be performed during a given calendar quarter. The audit and surveillance program shall address all elements of the quality system, including environmental testing and/or calibration activities. The assigned audit or surveillance may be conducted anytime during the calendar quarter. The "Audit and Surveillance Schedule" can be found at the end of this section.

49.1.3 It is the responsibility of the Quality Assurance Officer(s) to plan and organize audits and surveillances as required by the schedule and as requested by management.

49.1.4 An audit related to data integrity with respect to any evidence of inappropriate actions or vulnerabilities shall also be conducted on an as needed basis.

49.1.5 Audits and surveillances shall be carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited. Personnel shall not audit their own activities.

49.1.6 The person assigned the audit or surveillance shall conduct a thorough review of the applicable procedure before conducting the audit or surveillance. Findings and observations shall be documented by the person conducting the audit or surveillance on an "Audit and Surveillance" form or an equivalent form of documentation (e.g., a report). An example of an Audit and Surveillance Form can be found at the end of this section. Completed Audit and Surveillance forms shall be forwarded to the Quality Assurance Officer(s) for review. Findings shall be evaluated and corrected in accordance with *ARS-013 Nonconformance Reporting and Corrective Action Program*.

49.1.7 An annual audit and review of this Quality Assurance Manual and the Quality Assurance Program shall be performed by the Quality Assurance Officer(s).

49.1.8 Discovery of potential issues shall be handled in a confidential manner

until such time as a follow up evaluation, full investigation, or other appropriate actions have been completed and the issues clarified. Applicable potential issues shall be handled in accordance with *ARS-013 Nonconformance Reporting and Corrective Action Program*.

49.1.9 Corrective action shall be taken in a timely manner when audit findings cast doubt on the effectiveness of operations or on the correctness or validity of the laboratory's environmental test or calibration results. Corrective actions shall be in accordance with *ARS-013 Nonconformance Reporting and Corrective Action Program*.

49.1.10 The Laboratory Director shall determine if clients need to be notified in writing when audit findings indicate that laboratory test results may have been affected.

49.1.11 Clients shall be notified promptly, in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report, calibration certificate or amendment to a report or certificate. The written notification shall be mailed within five working days of the discovery of event(s) that cast doubt on the validity of test results.

49.1.12 Documentation shall be maintained of all audits and surveillances, associated findings, and any corrective actions taken. All audits, surveillances and investigations that result in a finding of inappropriate activity shall be documented. Documentation shall include any disciplinary actions involved, corrective actions taken, and all appropriate notifications to clients. Documentation of audits, surveillances and investigations shall be maintained for a minimum of five years.

49.1.13 Laboratory management shall ensure that corrective actions are discharged within the agreed time frame as indicated on the NCR, CAR, or appropriate SOP.

49.1.14 Follow-up audit activities shall verify the implementation and effectiveness of any corrective action taken.

49.2 Laboratory Operations

The areas included in the Laboratory Operations are as followed:

49.2.1 Laboratory Contamination Control
49.2.2 QC Samples
49.2.3 PE Sample Reports
49.2.4 Analysis Systems Control Charts

49.2.5 Equipment Maintenance/Calibration Program
49.2.6 Sample Receiving, Shipping and Storage
49.2.7 Radioactive Material License
49.2.8 Laboratory SOPs
49.2.9 Data Integrity

49.3Laboratory Programs

The areas included in the Laboratory Programs are as followed:

49.3.1 Document Preparation and Control
49.3.2 Records Retention
49.3.3 Radioactive Source Control
49.3.4 Nonconformance Reports and Corrective Action Plans
49.3.5 Hazardous Waste Disposal/Pollution Preventive
49.3.6 Laboratory Training
49.3.7 Dosimetry Monitoring
49.3.8 Customer Complaints
49.3.9 LIMS

49.4Audit Process

49.4.1 Auditor should prepare for the audit by reading the procedures associated with the given area, printing necessary forms for audit, and preparing a list of questions for the interview section, if needed.

49.4.2 The auditor should perform the audit through interviews, observations, and investigations.

49.4.3 If during the interview process a concern arises, the auditor should continue to question the issue until they understand the issue completely and should record all information provided on the Audit and Surveillance Form.

49.4.4 Debrief appropriate individuals once audit is completed.

49.4.5 Return all completed forms and documentation to Quality Assurance department.

Audit and Surveillance Schedule

Operations and Programs	Audit/Surveillance	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Document Preparation and Control	Audit		X		
Records Retention	Audit		X		
Laboratory Contamination Control	Audit and Surveillance Note 1			X	
QC Samples	Audit and Surveillance Note 1			X	
PE Sample Reports	Audit		X		X
Analysis Systems Control Charts	Audit	X			
Equipment Maintenance/Calibration Program	Audit and Surveillance Note 1	X			
Radioactive Source Control	Audit		X		
Sample Receiving, Shipping and Storage	Audit and Surveillance Note 1			X	
Non-Conformance Reports and Corrective Action Plans	Audit and Surveillance Note 1			X	
Hazardous Waste Disposal / Pollution Prevention	Audit				X
Laboratory Training	Audit			X	
Dosimetry Monitoring	Audit				X
Customer Complaints	Audit				X
Radioactive Material License	Audit				X
Laboratory SOPs	Audit	X			
LIM's (Good Automated Laboratory Practices)	Audit	X			
Data Integrity	Audit		X		

Note[1]: Both an audit and surveillance shall be conducted together at the prescribed frequency.

Audit and Surveillance Form

Page 1 of ____

Person Audited: _____ Date Audited: _____

Program or Procedure Audited: _____

Person(s) Contacted:_____
(Printed Name)

FINDING(S):_____

_____

_____

_____

_____

_____

_____

OBSERVATION(S):_____

_____

_____

_____

_____

_____

CORRECTIVE ACTION:_____

_____

_____

_____

Signature Person Conducting Audit:_____ Date:_____

Person Performing Audit:_____
(Printed Name)

NCR/CAR #:_____ Responsible Person(s) Executing CAR:_____

Signature Quality Assurance Officer:_____ Date:_____

50 RADIOACTIVE REFERENCE SOURCE CONTROL

Control of Radioactive Reference Sources is discussed in detail in *RSP-001 Laboratory Radiation Safety Plan*.

51 LABORATORY RADIATION AND CONTAMINATION CONTROL

Laboratory Radiation and Contamination Control is discussed in detail in *RSP-001 Laboratory Radiation Safety Plan*.

52 PROCEDURE DEVELOPMENT, REVIEW, APPROVAL AND CONTROL

Procedure Development, Review, Approval and Control are discussed in detail in the following procedures:

ARS-049 Document Control
ARS-061 Preparation and Management of Procedures and Plans

53 FRAUD PREVENTION

53.1 Laboratory management shall practice fraud prevention and detection on an on-going basis. The following list serves as examples of practices that management may utilize as part of the fraud prevention and detection program.

53.2 Internal proficiency testing (single blinds and double-blinds),

53.3 Post analysis of electronic data and magnetic tape audits, as applicable,

53.4 Effective reward programs to improve employee vigilance and co-monitoring,

53.5 Separate standard operating procedures,

53.6 Identification of appropriate and inappropriate laboratory and instrument manipulation practices.

APPENDIX "A"

REFERENCES

APPENDIX "A" - REFERENCES

ARS Radioactive Material License, LA-7153-N01
ARS Radiological Safety Plan
ARS Safety Manual
ARS Good Automated Laboratory Practices SOP
NELAC (National Environmental Laboratory Accreditation Conference) Quality Systems
NELAC (National Environmental Laboratory Accreditation Conference) Proficiency Testing
EPA 2185 - Good Automated Laboratory Practices
DOE – Quality Systems for Analytical Services, Current Revision
DOD – Quality Systems Manual, Current Revision
Louisiana Administrative Code, Title 33, Part I, Subpart 3
Louisiana Administrative Code, Title 33, Part XV
Code of Federal Regulations, Title 10, Parts 19 and 20
Code of Federal Regulations, Title 49, Parts 170 through 178
U.S. Nuclear Regulatory Commission Regulatory Guide 4.15 (Quality Assurance for Radiological Monitoring Programs (Normal Operations)-Effluent Streams and the Environment)
ASTM D3856-06 Standard Guide for Good Laboratory Practices in Laboratories Engaged in Sampling & Analysis
MARLAP – Multi-Agency Radiological Laboratory Analytical Protocols Manual (EPA 402-B-04)
ANSI NQA-1 2000 Quality Assurance Requirements for Nuclear Facility Applications with Addenda

APPENDIX "B"

GLOSSARY OF TERMS

Appendix "B" - Glossary of Terms

Accuracy	The extent to which the results of a calculation or measurement approach the true value of the calculated or measured quantities, and are free of errors.
AEA	Atomic Energy Act and amendments.
Aliquot	A representative sample of a larger quantity.
Alpha Scintillation Detector	An analytical instrument used to detect and quantify individual scintillations when emitted alpha particles strike a phosphor during the process of radioactive decay.
Alpha Spectrometry	A type of spectroscopy that discriminates among alpha particles emitted during radioactive decay according to their energy level, and which is used to identify and quantify different alpha-emitting radionuclides in a sample.
Analysis	A process used to measure one or more attributes of a sample in a clearly defined controlled systematic manner. Often requires treating a sample chemically or physically before measurement.
Analyte	The particular chemical or radiochemical specifies to be identified and/or quantified.
Analytical	A term describing the precise identification and quantification of target compounds, ions or radionuclides present in a sample.
Analytical Holding Time	Analytical holding time refers to the time elapsed between sample collection or preparation (as specified by the analytical procedure) and laboratory analysis.
Analytical Sample	An aliquot of various media (liquid, solid, or gaseous) which is submitted to a Subcontract Laboratory for the detection and quantification of specific target compounds, ions or radionuclides.
Analytical Uncertainty	The analytical uncertainty values (in 1 sigma) and DLC's for radiochemical parameters. See Uncertainty.
ASTM	American Society of Testing Materials

ASTM Class A Glassware	Glassware that conforms to the ASTM Class A standard for containers used in the preparation and analysis of standards, reagents and samples for LANL under the SOW.
ASTM Type I,II	For the purposes of this SOW, ASTM Type I water is water having Water conductivity less than 0.06 µmho/cm or resistivity greater than 16.67 MΩ·cm. ASTM Type II water is water having conductivity less than 1 µmho/cm or resisitivity greater than 1 MΩ·cm. The applicable ASTM standard is D 1193-77.
Background Counts	The somewhat steady level of radiation present in all natural environments, which produces an instrument noise recorded as individual disintegrations or counts.
Batch	A group of samples, which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, than each group of 20 samples or less will all be handled as a separate batch.
Bias	The deviation due to matrix effects of the measured value (xs-xu) from a known spiked amount. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike). Thus, the bias (B) due to matrix effects based on a matrix spike is calculated as: $B= (xs-xu)-K$ Where: xs=measured value for spiked sample, xu=measured value for unspiked sample, and K =known value of the spike in the sample Using the following equation yields percent recovery (%R). $\%R=100\ (xs-xu)/K$
Calibration	A process used to identify the relationship between true, or reference, analyte concentration, or other variable and the response of the measurement instrument, chemical analysis method, or other measurement system.
Calibration Blank	A calibration standard prepared to contain negligible or immeasurable amounts of analytes. It is used to establish the zero concentration point for analytical measurement calibration.

Calibration Standard	A sample prepared to contain known amounts of the analytes of interest and other constituents required for the analysis.
Carrier	A compound with similar chemical and physical properties that is used to introduce a specific radioactive tracer into a sample. Without the use of carriers, the small amounts of radioactive tracers used in analyses would tend to stick to the surface of glassware, syringes and other analytical equipment.
Carryover Contamination	Target analytes that are introduced during Subcontract Laboratory handling and analysis from a previous analytical sample or Subcontract Laboratory standard, and which were not present in the original sample.
CAS Number	Chemical Abstract Services number which uniquely identifies a chemical substance.
CCV	Continuing Calibration Verification. An analytical sample included in the analyses of a batch to verify that the process or measurement is still in calibration.
Certified Standard	A certified standard is a material that is guaranteed to meet specified conditions of purity, concentration or weight for a defined time period by its manufacturer. The material must be accompanied by a certificate of analysis.
Chain of Custody (COC)	An unbroken, documented trail of accountability designed to ensure that the physical integrity of samples, data and records remains uncompromised.
Chemical	Any naturally occurring or man made substance characterized by a definite molecular composition, including molecules that contain radionuclides.
Chemical Analysis	The term chemical analysis refers to all general inorganic, organic and radiochemical analyses.
CLP	USEPA Contract Laboratory Program. (CLP)
COC seal	The chain of custody seal is a specifically designed piece of tape attached to the lid and sides of a sample container is such a manner that the sample can not be opened without destroying this tape. An intact COC seal suggests that no sample tampering has occurred during transit of the sample from the client to the laboratory.
Conductivity	Conductivity is the measurement of the current that can pass through a sample solution and is proportional to the total concentration of ionizied salts.

Control Limits	Control limits specify the parameters within which all analyses must be performed.
Controlled Document	Controlled documents are those subject to special preparation, distribution, and tracking protocols. The document control protocols ensure that persons in possession of documents are known, so that complete incorporation of revisions or implementation of new versions can be verified against the list of document holders.
Corrective Action Report (CAR)	Documentation of required steps taken to correct and out of control situation. A CAR is issued when any of the following occurs: • Significant Condition Adverse to Quality/Safety. • Client Complaints. • Recurrent deficiencies identified by NCRs
Correlation Coefficient	Correlation coefficient is a number or function indicating the degree of correlation (positive or negative) between two sets of data or between two random variables and is equal to their covariance divided by the product of their standard deviations.
Curie (Ci)	A unit of radioactivity defined as that quantity of any radioactive nuclide that has an activity of 3.7x1010 disintegrations per second.
Daily Requirements	Daily requirements for checking refrigerators, balances and the like apply only to business days. Daily requirements for instrument calibration and standards preparation refer only to days when the instruments are used.
Data Qualifiers	General inorganic chemistry and radiochemistry data qualifiers available for use by the ARS International Laboratory are listed in LANL SOW Section 4.1.9. The use of these data qualifiers is required on the Analysis Results form, the electronic data deliverable, and the QC data deliverable.
Deionized Water (DI)	Deionized water (DI) has all ions removed by an ion exchange process.
Digestate	A digestate is a sample medium treated by a digestion process to release or remove specific target analytes for subsequent analyses.
Digestion	The process of releasing or removing target analytes from a sample so that they may be quantified in subsequent tests.

Dilution	Dilution is the process of reducing the concentration of target analytes by the adding of solvent (usually water).
Distillation	Distillation is the process of purifying a liquid by successive evaporation and condensations, which leave non-volatile impurities behind.
DLC	DLC is the acronym for decision level concentration. When calculated according to the equation in this QA Manual, the DLC gives the level at which there is five percent probability of reporting a false positive for a sample containing no analyte. The DLC is calculated sample specifically using variable values from the actual analytical conditions.
DOD	Department of Defense
DOE	Department of Energy
DQO	Data Quality Objectives. The qualitative and quantitative goals that are developed before sampling begins that clarify the investigative objectives and identify the type, quantity and quality of data needed to support decisions.
Dried	Dried refers to a treatment where a solid is heated a temperature sufficiently high to remove the free water present, but also low enough to avoid chemical changes in the material being treated.
Dry Weight Basis	Dry weight is the weight of a solid or semisolid material after the free water content has been removed by drying. Analytical results are reported on a dry weight basis (e.g., mg/kg or µg/kg) unless otherwise specified.
Duplicate Analysis	An analysis performed on a pair of identical prepared sub samples of the same sample.
Duplicate Measurement	One of a pair of measurements performed on a prepared sample under identical conditions.
Duplicate Sample	A duplicate sample is a split taken by the sampling team and submitted as a sample for the purpose of assessing both sampling and analytical precision.
EDD	EDD is the acronym for electronic data deliverable. This is the computer file containing analytical results and associated information. The value of each data element in the electronic data deliverable (EDD) shall be identical or equivalent to the value of the corresponding data element in all hardcopy

	forms provided by the laboratory. The result reported for any given element shall be the same wherever that data element is used.
EPA	Environmental Protection Agency. EPA is the federal agency that is responsible for enforcing environmental laws.
Error	Any discrepancy between a computed, observed or measured quantity and the expected or theoretically correct value of that quantity.
Field Blank	A blank sample (either prepared in the field or carried to the sampling site), is a sample exposed to sampling conditions (e.g., bottle caps removed, preservatives added, etc.) and sent to the laboratory for analysis in the same manner in which environmental samples analyzed. It is used to identify the presence of contamination potentially added during the sampling process. See also trip blank.
Field Duplicate	An independent sample which is collected as close as possible to the same point in space and time as the original sample. It is useful in documenting the precision of the sampling process.
Field Matrix Spike	A known amount of a field sample to which a known amount of the target analyte has been added. Used to compute the proportion of added analyte that is recovered upon analysis.
Field Reagent Blank	See Field Blank
Field Sample	Field samples are those collected to characterize environmental media as opposed to field quality control samples.
Field Split	A field sample that has been divided in the field into equally representative portions, also called a split sample.
Finding	A non-compliance that requires correction
Gamma Radiation	A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require dense shielding, such as concrete, steel or lead to be blocked.
Gamma Spectroscopy	A form of spectroscopy in which gamma rays are sorted according to their energy levels and are then used to identify and quantify the presence of gamma-emitting radionuclides in a sample.

Good Automated Practice	Good Automated Laboratory Practice covers the use of automated Laboratory calculation routines and the handling of information stored in modern laboratory databases and is used as defined by the EPA for chemical analysis laboratories.
Grab Sample	A specimen collected by a single application of a field sampling procedure to a target population.
Half-Life	The time required for one-half of the radioactive atoms initially present in a sample to decay. Each radionuclide has a characteristic half-life ranging from a fraction of a second to thousands of years.
Handling	Work performed by the laboratory in the process of unpacking, preparing, analyzing and disposing of a sample.
Holding Time	The maximum elapse of time that one can expect to store a sample without unacceptable changes in analyte concentrations. Holding times apply under prescribed storage conditions and deviations in storage conditions may affect the holding time. Extraction holding time refers to the time elapsed from sample collection time to sample preparation time. Analytical holding time refers to the time elapsed between sample collection or preparation (as specified by the analytical procedure) and laboratory analysis.
Homogenized	A homogenized sample has been blended into a uniform mixture and reduced in particle size to reduce so that particles are uniformly small and evenly distributed.
Incomplete Reports and Errors	Incomplete reports and errors refer to those identified by comparison with historical data, or if QC data are either missing or outside the control limits, or if the data are unusable for any reason.
Initial Calibration	The process used to establish the relationship between instrument response and analyte concentration at several analyte concentration values to demonstrate that an instrument is capable of acceptable analytical performance.
Instrument Blank	An analyte-free matrix used to determine if any contamination of the instrument will be detected in samples.
Instrument Calibration	See “initial calibration” and “CCV” (continuing calibration verification)

Interference	A chemical or physical entity whose influence results in a decrease or increase in the response of an analytical method or other measurement system relative to the response obtained in the absence of the entity.
Inter-Laboratory Comparison Studies	Performance evaluation studies conducted by various government and private agencies.
Intermediate Dilution	An intermediate dilution is a dilution of some stock solution that requires further dilution before use in instrument calibration or quality control sample preparation. Intermediate dilutions are not used to calibrate instruments in undiluted form.
Internal Standard	An internal standard is a spike added to a sample and is used to determine the percent recovery during sample preparation and instrument efficiency during analysis. Internal standards recommended by the EPA method are required unless approval prior sample analysis was received from the appropriate client. For methods where internal standards are recommended but the specific compounds are not specified, the laboratory shall choose one or more internal standards similar in analytical behavior to the compounds of interest, and not expected to be found in the samples. In the latter case, the choice of an internal standard must be approved by the client prior to sample analysis.
KPA	Kinetic phosphorescence analysis for total uranium. KPA has been found to be unreliable due to strong susceptibility to interferences from constituents commonly found in LANL samples.
Laboratory Duplicate	The portions of a sample taken from the same sample container, Sample prepared for analysis an analyzed independently but under identical conditions. Each duplicate sample is expected to be equally representative of the original sample.
LCS	Laboratory Control Sample. A known matrix spiked with compounds representative of the target analytes. This is used to document laboratory performance.
Leachate	A liquid that has percolated through waste, soil, rock or other material and has mobilized chemical species in the process.
Leaching	The separation or dissolving out of soluble constituents from a solid material or matrix by the natural action of percolating water or chemicals.

Leading Zeros	Leading zeros are placed after a decimal point and before the numbers (greater or less than zero) representing an analytical result.
Less Than	Numerical result that includes all values below a defined value. Mathematical "less than" signs shall not be used in reporting analytical results.
LIMS	The Laboratory Information Management System of the Subcontract Laboratory.
LQAP	The Laboratory quality assurance plan (LQAP) for each laboratory.
MAPEP	The Mixed Analyte Performance Evaluation Program is operated by the U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho.
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols
Matrix	The component or substrate (e.g. surface water, drinking water, soil and sludge) that contains analyte of interest.
Matrix Duplicate	An intra-laboratory (within the laboratory) split sample which is used to document the precision of a method in a given sample matrix.
Matrix Spike Analysis	This is a measure of the ability of a method or process to adequately recover analytes or to establish a bias.
Matrix Spike Duplicates (MSD)	An aliquot of sample spiked with a known concentration of target analytes. The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.
MDC	MDC is the acronym for minimum detectable concentration. The MDC provides general information about the sensitivity of analytical techniques in radiochemistry based upon assumed nominal conditions.
Mesh	Mesh refers to the size of the openings or pores in a sieve or screen through which solid samples are passed in preparation for analysis. The preparation method may specify the mesh sizes (pore diameters) that must be used.
Method	A body of procedures and techniques for systematically performing an activity.

Method Blank	An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.
Method Blank Subtraction	Method blank subtraction shall be done only in liquid scintillation counting and not in other radiochemistry analytical methods. Result for the other counting techniques shall be corrected for instrument background only, and shall not be blank subtracted.
Mixed Waste	Waste that contains both hazardous waste (as defined by RCRA and its amendments) and radioactive wastes [as defined by the Atomic Energy Act (AEA) and its amendments]
NIST Traceable Standards	National Institute for Science and Technology (NIST) traceable standards are those provided by this agency or used to calibrate standards used by the Laboratory, and which must be used where specified in this SOW.
Nonconformance Report (NCR)	Report issued when the quality and usability of items, services or processes does not meet applicable requirements for operational activities performed by ARS.
Null value	A null value is a zero or a non-detect value for an analyte. The Subcontract Laboratory is not required to supply data element values that are not identified in the list of required data elements provided in the EDD requirements. For those data elements not required by LANL, the data element tag must be present in the EDD, but the value may be a null value.
Observation	Food for Thought
Optional Compounds	Optional compounds are those not routinely required in instrument calibration or the reporting of analytical results.
Out of Control	A condition in which a measured quality control parameter does not meet the specified or acceptable criteria for that parameter.
PE Samples	Performance evaluation (PE) samples are samples with known constituent concentrations that are periodically submitted to test Subcontract Laboratory analytical and reporting performance.

Percent Moisture	The percent moisture refers to the portion (percentage) of a soil or sludge sample that may be removed by drying the sample under controlled conditions. Percent moisture measurements shall be made and reported for all LANL soil samples, and unless otherwise specified, soil sample results for all analyses shall be reported on a dry weight basis.
Performance-based Methods	Performance-based methods are based on the achievement of desired detection limits in cases where industry standard methods do not address particular analytes and may be utilized with prior approval from the LANL SMO.
pH	The negative logarithm of the hydrogen ion activity.
PPBV	Parts per billion by volume.
Precision	A concept used to describe dispersion of measurements with respect to a measure of location or central tendency. Precision may be represented by the inverse of the standard deviation of a set of measurements. The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV).
Preparation	Preparation is the action or process of making samples ready for analysis and may involve extractions, dilutions and other laboratory treatments. Sample preparation shall be conducted according to the specifications of the analytical procedures listed in this QA Manual.
Preparation Blank	A preparation blank (PB) consists of DI water and the appropriate reagents and is included in each batch of samples requiring digestion or distillation.
Prepared Sample	A sample treated in such a manner as to render it amenable to analysis. May include chemical or physical treatments.
Primary Contact Person	The primary contact person is the individual assigned by the laboratory to act as the contact point for all work related to this SOW.
Qualifier	A qualifier is a letter code indicating, on a gross scale, a verifiable or potential data deficiency. Qualifier flags are assigned to data based on the outcome of data validation checks.
Quality Control	A Quality Control (QC) sample provides information useful for sample

(QC)	adjusting, controlling or verifying the continuing acceptability of sampling and/or analytical activities in progress.
Radioactive materials	A current radioactive materials license that is appropriate to the license materials the laboratory anticipates receiving under this contract is required for all laboratories. If the radioactive materials license has expired, the Subcontract Laboratory shall have a letter of timely renewal on file. Photocopies of new or updated licenses shall be provided to the LANL SMO with the next quarterly progress report.
Radioactive Tracer	A radioactive tracer is a radioactive material added to, or introduced to a sample for the purpose of monitoring chemical or physical loses of target analytes. The tracer is assumed to behave in the same manner as that of the target analytes.
RCRA	Resource Conservation and Recovery Act and amendments.
Reagent	Reagents are chemicals of known purity that are used in analytical methods. This term does not apply to materials used to calibrate instruments or to perform quality control activities. Such materials are called standards.
Reagent Blank	See Method Blank
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents, which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Reagent Water	Water that has been generated by any method which would achieve the performance specification for ASTM Type II water. For organic analyses, see definition of organic free reagent water.
Record	Record is the term applied to information that results from performance under a contract. Records must be maintained in such a way as to ensure that they can be provided or retrieved in their entirety on demand or otherwise supplied as a deliverable under this subcontract.
Reference Material	A material containing known quantities of target analytes in solution or in a homogenous matrix. It is used to document bias of the analytical process.
Relative Percent Difference	The relative percent difference (RPD) is the measure of precision used for all general inorganic constituents.

Relative Precision	Relative precision is precision measured relative to a particular value and is expressed as the relative standard deviation (RSD). See "Precision" in this Glossary.
Replicate	A replicate sample is a sample split taken by the Subcontract Laboratory and prepared separately from the original sample for the purpose of assessing analytical precision. See also Duplicate Sample.
Replicate Error Ratio	The replicate error ratio (RER) is used to determine replicate precision for radiochemical results.
Reporting Limit	The reporting limit is the limit reported for those analytes that are not detected in a sample. The reporting limits are derived by the laboratory as described in each method.
Representativeness	Is the degree to which data accurately and precisely represent a characteristic of a population or an environment condition.
Routine Analysis	A routine analysis is defined as including the categories of inorganics, metals, organics, radiochemistry and high explosives described in a particular contract or SOW.
Routine Data	Routine data validation describes the process of reviewing analytical data relative to quantitative acceptance criteria. The objective of routine data validation is to 1) estimate technical quality of the data relative to minimum national standards adopted by LANL, and 2) indicate to data users the technical quality at a gross level by assigning qualifier flags to the data whose quality indicators do not meet the acceptance criteria.
Sample	See field sample.
Sample custody	Sample custody is transferred to the Subcontract Laboratory at the time of sample receipt, after which the Subcontract Laboratory is responsible for maintenance of unbroken chain of custody (COC). By definition, a sample is in custody if it is 1) in one's possession, 2) in view, or 3) in a controlled access area.
Sample Matrix	The sample matrix in chemical analysis refers to that portion of a sample which is exclusive of the analytes of interest (e.g., soil and water components). Together the matrix and analytes of interest form the sample.
Sample Preparation	Sample preparation shall be conducted according to the specifications of the analytical procedures.

Serial Dilution	Serial dilutions are made by performing a series of dilutions of an aliquot taken from a stock solution for a target analyte. The first dilution of the original stock solution serves as the stock solution for the second dilution and the second dilution serves as the stock solution for the third dilution and so on.
Sigma	A sigma value is the statistical term equivalent to one standard deviation.
Significant Error	An error when an analyte is detected in a sample where it is not present, or when an analyte is present at a concentration above the instrument detection limit but is reported as undetected by the Subcontract Laboratory.
Significant Figures	Significant figures are the digits of a number beginning with the digit farthest to the left that is not zero and ending with the last digit farthest to the right that is not zero or is exactly zero. The LQAP shall specify the Subcontract Laboratory policy regarding the number of significant figures to be used in reporting analytical results. A maximum of three significant figures shall be used to report the final analytical result.
Significant Result/ Value	A significant result or value is where the reported value for an analyte is greater than of the background value by one to three standard deviations as specified in the methods referenced in this QA Manual.
SOP	SOP is the acronym for standard operating procedure. SOPs are documents prepared by the Subcontract Laboratory as controlled documents that describe the step-by-step activities in the Laboratory.
Spiked Sample	A spiked sample is a sample that has a known amount of target analyte added to it.
Split Samples	Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of sample are impossible to obtain, field duplicate samples should be taken for matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra- and inter-laboratory precision.
Standard Addition	The practice of adding known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.

Standard Curve	A plot of concentration of known analytes versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument.
Standard Deviation	The standard deviation is a measurement of the dispersion of a frequency distribution that is the square root of the arithmetic mean of the squares of the deviation of each of the class frequencies from the arithmetic mean of the frequency distribution.
Standards	Standards are any material intended for, possibly as a dilution, in instrument calibration or to perform quality control activities.
Stock Solution	A stock solution is a high-concentration standard. Stock solutions are not used to calibrate instruments or as quality control samples, but rather are diluted to produce the standards used to calibrate or prepare quality control samples.
Storage	Storage means the keeping of samples on the Subcontract Laboratory's premises until they are analyzed and properly disposed. For each type of analysis, the specified EPA method for sample storage shall be followed. The LQAP shall also describe procedures for the storage of samples. Laboratories shall have an SOP that requires daily temperature monitoring (on all business days) for refrigerated sample storage areas and the corrective action that will be initiated if a measurement falls outside the range 4°C$\pm$ 2°C. The laboratory shall maintain logbooks for sample storage refrigeration units in which the daily temperature checks are recorded. The laboratory shall retain and store all LANL samples associated with a specific delivery order for a period of 90 days after issuing the analytical report for that delivery order.
Target Analyte	A chemical or parameter, the concentration, mass or magnitude of which is designed to be quantified by use of a particular test method.
Tracer	A tracer is a substance, usually a radioactive isotope, added to a sample to determine the efficiency of a chemical extraction, reaction or analysis. Recovery guidelines for tracer results shall be 40 to 105 percent.
Turn Around Time	Turn around time refers to the period between receipt of samples by the laboratory and receipt of the analytical report for those samples by the LANL

	SMO. The next business day after receipt date of samples is day 1 in counting turn around time.
Ultimate Disposal	The final disposal of hazardous substances and does not include temporary storage or other temporary measures of managing hazardous wastes.
Uncertainty	Uncertainty refers to the range of values (expressed as plus or minus the measured value) that include the theoretical or true value of an analyte with a specific degree of confidence. Radiochemical analytical results shall be accompanied by sample-specific uncertainty bounds that reflect the 67 percent confidence level (1 sigma). The uncertainty bounds shall include not only the measurement counting error, but also a technique-specific error term that includes uncertainty values for each contributing measurement process, and a sample-specific contribution reflecting specific chemical recoveries, detectors used, etc. All radiochemical result uncertainties shall incorporate terms for technique-related and sample specific measurement errors.
Water Content	Water content is the amount of water in an unsaturated medium, expressed as the ratio of the weight of water in a sample to the weight of the oven-dried sample, often expressed as a percent. (See percent moisture)
Working Standards	Working standards are those used to calibrate instruments and are prepared from or calibrated against certified standards.
Worksheet	The term worksheet refers to any form used to describe the work in a particular analytical batch. Worksheets may present the data acquired or be a cover sheet for those data.
Worksheet Review	Worksheet review is a process for assessing the degree of compliance with laboratory and client requirements in the analysis documentation.

APPENDIX "C"

DOCUMENT FLOW OUTLINE

Appendix "C" - Document Flow Outline

Sample(s) Acceptance and COC verified in accordance with QA Manual

⇓

Samples logged into laboratory system and sample file created in accordance with QA Manual

⇓

Sample preparation in accordance with QA Manual and Analytical SOP

⇓

QC sample analysis completed, QC sample work sheet completed, Technical Review

⇓

Applicable analytical data placed in Sample File

⇓

Data Reduction process in accordance with ARS QA Manual

⇓

Data Validation process in accordance with ARS QA Manual, QA Department Review

⇓

Analytical Report Generation

⇓

Analytical Report Review, QA Department Review

⇓

Analytical report submittal to client

APPENDIX "D"

Data Quality Objectives for Various Analysis and Analytes

APENDIX "D" Data Quality Objectives for Various Analysis and Analytes

ARS International has established Data Quality Objectives for various analysis and analytes. The tables on the following pages list these objectives. Both RER values (for precision determination) and recovery values (for accuracy determination) are listed. Target values for Minimum Detectable Concentration (MDC) are also given.

Data Quality Objectives for Liquid Analysis [1] - Method Specific

Analyte	MDC pCi/L	Percent Recovery (%)	Typical Recovery (%)	Precision RER	Error ±2σ	Volume Basis (ml)	Count Time Basis (hr)
Pu-239/240	<0.05	50 - 105	75	-1 to +1	<10%	200	24
Pu-238	<0.05	50 - 105	75	-1 to +1	<10%	200	24
U-238	<0.05	50 - 105	85	-1 to +1	<10%	200	24
U-235	<0.05	50 - 105	85	-1 to +1	<10%	200	24
U-234	<0.05	50 - 105	85	-1 to +1	<10%	200	24
Th-232	<0.05	50 - 105	65	-1 to +1	<10%	200	24
Th-230	<0.05	50 - 105	65	-1 to +1	<10%	200	24
Th-228	<0.05	50 - 105	65	-1 to +1	<10%	200	24
Ra-228	<0.5	50 - 105	85	-1 to +1	<10%	500	2
Ra-226	<0.25	50 - 105	100	-1 to +1	<10%	500	1
Gross Radium Alpha	<0.5	50 - 105	75	-1 to +1	<10%	500	2
Gross Alpha	<0.5	50 - 105	100	-1 to +1	<10%	200	15
Gross Beta	<0.8	50 - 105	100	-1 to +1	<10%	200	15
Total Uranium	<0.5	50 - 105	85	-1 to +1	<10%	500	2
Total Uranium mg/l	<0.0004	50 - 105	85	-1 to +1	<10%	1	2
Sr-90	<0.30	50 - 105	72	-1 to +1	<10%	500	15
Gamma Spectroscopy (Natural, Fission, Activation)	<0.5	N/A	N/A	-1 to +1	<10%	2000	4

1 Methods Used: EPA Drinking Water Series, Standard Methods for the Examination of Water and Waste Water, HASL-300, ASTM, ANSI, USGS, Eichrom Resin Columns, EPA SW846.

Data Quality Objectives for Solid Analysis [1] - Method Specific							
Analyte	**MDC pCi/g**	**Percent Recovery (%)**	**Typical Recovery (%)**	**Precision RER**	**Error ±2σ**	**Mass Basis (g)**	**Count Time Basis (hr)**
Pu-239/240	<0.05	50 - 105	65	-1 to +1	<10%	1	24
Pu-238	<0.05	50 - 105	65	-1 to +1	<10%	1	24
U-238	<0.1	50 - 105	65	-1 to +1	<10%	1	24
U-235	<0.1	50 - 105	65	-1 to +1	<10%	1	24
U-234	<0.1	50 - 105	65	-1 to +1	<10%	1	24
Th-232	<0.1	50 - 105	65	-1 to +1	<10%	1	24
Th-230	<0.1	50 - 105	65	-1 to +1	<10%	1	24
Th-228	<0.1	50 - 105	65	-1 to +1	<10%	1	24
Gross Radium Alpha	<0.5	50 - 105	75	-1 to +1	<10%	1	2
Gross Alpha	<1	50 - 105	100	-1 to +1	<10%	0.1	15
Gross Beta	<1	50 - 105	100	-1 to +1	<10%	0.1	15
Total Uranium	<0.5	50 - 105	85	-1 to +1	<10%	1	2
Total Uranium mg/l	<0.0004	50 - 105	85	-1 to +1	<10%	1	2
Sr-90	<0.5	50 - 105	72	-1 to +1	<10%	1	15
Gamma Spectroscopy (Natural, Fission, Activation)	<0.5	N/A	N/A	-1 to +1	<10%	800-2000	4

[1]Methods Used: EPA Drinking Water Series, Standard Methods for the Examination of Water and Waste Water, HASL-300, ASTM, ANSI, USGS, Eichrom Resin Columns, EPA SW846.

Target *A Priori* MDC's

The tables below give target minimum detectable concentration values for radionuclide analyses by analytical technique and matrix. The ARS International laboratory shall adjust analytical conditions to meet the target MDC's. For DOE gamma spectroscopy, Cs-137 and Co-60 shall be reported for every sample. Analytical conditions shall be adjusted to meet the specified MDC's for those radionuclides. The analytical conditions chosen will determine the MDC's for other reported nuclides. Method Detection Limit Studies (e.g., quantization limits or range of applicability) shall be performed by the laboratory for all analysis performed.

Gamma Spectroscopy Radionuclides - Minimum Detectable Concentrations (MDC) by Matrix					
Radionuclide	Water (pCi/L)	Solid (pCi/g)	Air Filter (pCi/sample)	Urine (pCi/L)	Vegetation (pCi/g)
K-40	NA	NA	NA	NA	NA
Co-60	150.00	0.50	200.00	2000.00	5.00
Ru-106	NA	NA	NA	NA	NA
Sb-125	NA	NA	NA	NA	NA
Cs-134	NA	NA	NA	NA	NA
Cs-137	15.00	0.10	20.00	200.00	0.50
Eu-152	NA	NA	NA	NA	NA
Eu-154	NA	NA	NA	NA	NA
Eu-155	NA	NA	NA	NA	NA
Tl-208	NA	NA	NA	NA	NA
Bi-211	NA	NA	NA	NA	NA
Bi-214	NA	NA	NA	NA	NA
Pb-212	NA	NA	NA	NA	NA
Pb-214	NA	NA	NA	NA	NA
Th-227	NA	NA	NA	NA	NA
Th-234	NA	NA	NA	NA	NA
Pa-233	NA	NA	NA	NA	NA
U-235	NA	NA	NA	NA	NA
Am-241	NA	1.00	NA	NA	NA

Alpha Spectrometry Radionuclides - Minimum Detectable Concentrations (MDC) by Matrix						
Radionuclide	Water (pCi/L)	Solid (pCi/g)	Air Filter (pCi/sample)	Urine (pCi/L)	Vegetation (pCi/g)	Feces Ash (pCi/g)
Am-241	0.05	0.05	0.06	0.06	0.006	0.04
Cm-244	0.05	0.05	0.06	0.06	0.006	0.04
Np-237	0.05	0.05	0.06	0.06	0.006	0.04
Po-210	1	0.5	1	1	0.5	0.5
Pu-238	0.05	0.05	0.06	0.06	0.006	0.04
Pu-239/240	0.05	0.05	0.06	0.06	0.006	0.04
Ra-226	1	0.5	1	1	0.5	0.5
Th-228	0.1	0.1	0.1	0.1	0.1	0.1
Th-230	0.1	0.1	0.1	0.1	0.1	0.1
Th-232	0.1	0.1	0.1	0.1	0.1	0.1
U-234	0.1	0.1	0.1	0.1	0.01	0.1
U-235	0.1	0.1	0.1	0.1	0.01	0.1
U-238	0.1	0.1	0.1	0.1	0.01	0.1

Gas Proportional Counting Radionuclides - Minimum Detectable Concentrations (MDC) by Matrix				
Radionuclide	Water (pCi/L)	Solid (pCi/g)	Air Filter (pCi/sample)	Vegetation (pCi/g)
Gross Alpha	3	3	2	3
Gross Beta	4	1	2	1
Sr-90	1	0.5	2	0.5
Pb-210	1	5	2	5
Po-210	1	1	2	1
Ra-226	1	1	2	1
Ra-228	0.5	0.5	1	0.5
Tc-99	1	5	10	5

Liquid Scintillation Counting Radionuclides - Minimum Detectable Concentrations (MDC) by Matrix				
Radionuclide	Water (pCi/L)	Solid (pCi/g)	Air Filter (pCi/sample)	Swipe (pCi/100cm^2)
H-3	250	250 [a] (pCi/L)	10	10
C-14	500	10	20	20
Tc-99m	5	10	20	20
Pb-210	1.0	5	10	10
Rn-222	200	200		

[a] For H-3 the specified solid MDC applies to the extracted water.

TESTAMERICA LABORATORIES

LABORATORY QUALITY ASSURANCE PLAN

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THE LEADER IN ENVIRONMENTAL TESTING

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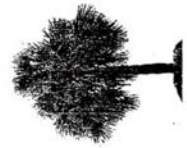


FLORIDA DEPARTMENT OF HEALTH

State of Florida
Department of Health, Bureau of Laboratories
This is to certify that
E87689

TESTAMERICA ST. LOUIS
13715 RIDER TRAIL NORTH
EARTH CITY, MO 63045

has complied with Florida Administrative Code 64E-1,
for the examination of Environmental samples in the following categories

DRINKING WATER - GROUP II UNREGULATED CONTAMINANTS, DRINKING WATER - OTHER REGULATED CONTAMINANTS, DRINKING WATER - RADIOCHEMISTRY, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - RADIOCHEMISTRY, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - RADIOCHEMISTRY, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

EFFECTIVE July 24, 2009 THROUGH June 30, 2010

[redacted]

Chief, Bureau of Laboratories
Florida Department of Health
DH Form 1697, 7/04
NON-TRANSFERABLE E87689-19-07/24/2009
Supersedes all previously issued certificates

Appendix No.	Title
4	Glossary / Acronyms
5	Laboratory Certifications, Accreditations, Validations
6	Calculations
7	TestAmerica St. Louis SOP List

SOPs AND POLICIES REFERRED TO IN THE QA MANUAL

SOP/Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-005	Calibration Curves (General)
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CA-L-S-001	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CA-L-P-001	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-004	Controlled Purchases Policy

For a list of Laboratory SOPs See Appendix 7

SECTION 3

INTRODUCTION
(NELAC 5.1 - 5.3)

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica St. Louis's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with the U.S. Department of Energy, Quality Systems for Analytical Services (QSAS, current revision), U.S. Department of Defense Quality Systems Manual for Environmental Laboratories, 2003 The National Environmental Laboratory Accreditation Conference (NELAC) standards and ISO/IEC Guide 17025 (2005). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP), the various accreditation and certification programs listed in Appendix 6. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations. The relevant QSAS, QSM and NELAC sections are included in the heading of each QAM section.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- EPA SW-846, *Test Methods for the Evaluation of Solid Waste, 3rd Edition,* September 1986; Update I, July 1992; Update II, September 1994; and Update III, December 1996.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th and 21st Edition.
- *U.S. Department of Energy* Order 414.1c, *Quality Assurance*
- *U.S. Department of Energy Quality Systems for Analytical Services;* Revision 2.4, October 2008
- *U.S. Department of Defense Quality Systems Manual;* Version 4.1, April 2009
- 10CFR 50 Appendix B
- Nuclear Regulatory Commission (NRC) quality assurance requirements.
- Toxic Substances Control Act (TSCA).
- ASME NQA-1-2000 Quality Assurance Requirements for Nuclear Facility Applications (for nuclear-related activities)
- 10CFR 21

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations.

The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 4 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters. The Program also contains guidelines on maintaining documentation of analytical process, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all requests to provide analyses are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested water, air, industrial waste, and soil methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Appendix 4. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director, Technical Directors and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

This manual is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to SOP ST-QA-0035, "Preparation and Management of Standard Operating Procedures".

Updates and changes to the laboratory QAM follow the same procedure as changes and updates to laboratory SOPs.

SECTION 4

ORGANIZATION AND MANAGEMENT
(NELAC 5.4.1)

4.1 OVERVIEW

TestAmerica St. Louis is a local operating unit of TestAmerica Laboratories, Inc. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. TestAmerica St. Louis has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, Corporate Quality Assurance, etc.) The TestAmerica St. Louis laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate and TestAmerica St. Louis is presented in Figure 4-1. This Quality Assurance Manual is applicable only to:

TestAmerica St. Louis
13715 Rider Trail North
Earth City, Missouri 63045
23-2637347
MO00054

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program. More extensive job descriptions are maintained by laboratory management.

4.2.1 Quality Assurance Program

The responsibility for quality lies with every employee of the laboratory. All employees have access to the QAM, are trained to this manual and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's St. Louis location.

4.2.2 Laboratory Director

The St. Louis Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to his/her respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- The Laboratory Director is responsible for maintaining positive operating margin to the company at the laboratory level and for meeting and exceeding the annual budget.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Supervises all laboratory personnel and provides guidance and direction as needed.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Responsible for ensuring compliance and integration of facility operation with corporate and regulatory policies and procedures.
- Ensures that appropriate corrective actions are taken to address issues identified by external and internal audits.
- The Laboratory Director has signatory authority for the QAM, policies, SOPs and contracts (as defined by TestAmerica policy).

4.2.3 QA Manager

The Quality Assurance Manager is responsible for developing, implementing, maintaining and improving the laboratory quality system. The QA manager reports to the laboratory director and has access to corporate QA for advice and resources. This position is able to evaluate data objectively and perform assessments without outside (managerial) influence.

Responsibilities include but are not limited to:

- Providing Quality Systems training to all new personnel and ensuring that all personnel understand their contributions to the quality system
- Evaluate the effectiveness of training
- maintaining a Quality Assurance Manual (QAM), arranging and managing PT samples, and performing systems, data, special, and external audits with both clients and regulatory officials.
- Oversees the maintenance of QC records, maintains certifications, approves, develops, and maintains Standard Operating Procedures (SOPs), submits monthly QA Reports, evaluates corrective actions and assists in reviewing new work as needed.
- Ensures communication at all levels in the lab regarding the effectiveness of the quality system
- Has the final authority to accept or reject data, and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data.
- Be available to any employee to resolve data quality or ethical issues.
- Be independent of laboratory operations.
- Has signatory authority for the QAM, SOPs and policies pertaining to QA/QC.
- QA Manager or designee reviews control charts.

4.2.4 Technical Director

The Technical Director(s) report(s) directly to the Laboratory Director. The scope of responsibility ranges from the new hire process and existing technology through the on going training and development programs for existing analysts and second and third generation instrumentation.

Specific responsibilities include:

- Assists in coordinating, writing and reviewing SOPs.
- May assist in the review of proposals
- Solves day to day technical issues, provides technical training and guidance to staff, project managers, and clients.
- Investigates technical issues identified by QA, and directs evaluation of new methods.

4.2.5 Manager of Project Management/Customer Service Manager

In addition to filling the requirements of Project Manager for key accounts, he/she fulfills supervisory duties and responsibilities. As Manager, he supervises the Project Management staff, sets standards for and monitors productivity, manages the assignment of accounts and the daily workload and tracks and maintains information for various revenue reports. With the QC Manager, he determines acceptable corrective actions for the nonconformance occurring within his group, develops and reviews standard operating procedures for the group.

Additional responsibilities include:

- Has signatory authority for final reports.
- Training of the Project Management staff
- Notify supervisors of incoming projects and sample delivery schedules
- Coordinate requests for sample containers and sample pick-up/deliveries

4.2.6 Project Manager

- Coordinates and manages customers' projects through all phases of laboratory operations, ensuring fulfillment of TestAmerica's commitment to client requirements, error-free work, and on-time delivery.
- Responsible to ensure that clients get timely responses to status inquiries, resolutions to problems and the agreed upon deliverables
- Discusses with clients any project related problems, resolves service issues and coordinates technical details with the lab staff
- Responsible for staff familiarization with specific quotes, sample log-in review and final report accuracy and completeness
- Maintains communications with clients and Account Executives and serves as a liaison between clients and laboratory operations to meet client's needs.
- Works closely with business unit personnel to manage quotations and change orders for existing scopes of work.
- Generates narratives outlining project observations, QC excursions, and laboratory

comments.
- Has signatory authority for final reports.

4.2.7 Department Manager/Supervisor
The Department Manager/Supervisor is responsible for the overall operations of a specific laboratory area.

These responsibilities include but are not limited to:

- Meeting client satisfaction goals, managing the human resources within the department, and ensuring health and safety and quality assurance plan compliance.
- Serves as a technical resource to department employees, as well as Project Managers, sales personnel, and clients.
- Make recommendations to laboratory management in regard to process improvements.
- Ensure analysts in their department adhere to applicable SOPs and the QAM.

4.2.8 Chemist/Analyst
- Laboratory analysts are responsible for the generation of data by preparing and analyzing samples according to written SOPs and client requirements.
- They are responsible for understanding the requirements in the LQM and the SOPs associated with their specific function.
- Perform the initial technical review of sample preparation information, calculations, qualitative identifications and raw data with the authority to stop, accept, or reject data based on compliance with sell-defined QC criteria.
- The laboratory analyst also provides prompt documentation and notification to the Group Leader of problems or anomalies detected.
- Monitor, calibrate, and maintain standard laboratory equipment such as refrigerators, ovens, water systems, and pipettes, and instrumentation, as necessary.

4.2.9 Environmental Health and Safety Coordinator
- The Environmental Health and Safety Coordinator is responsible for administering the EH&S program that provides a safe, healthy working environment for all employees and the environment.
- Monitors all areas for unsafe conditions, acts, and potential hazards. Enforces environmental, health, and safety policies and procedures. Maintains regulatory compliance with local, state, and federal laws.
- Makes safety and health recommendations to laboratory management in conjunction with the facility safety committee.
- Develops and maintains the facility's health and safety and waste disposal procedures.
- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Material Safety Data Sheet (MSDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.

- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is "reasonable" and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica's medical consultants.

4.2.10 Radiation Safety Officer (RSO)

- Under the direction of the Laboratory Director, implements the radiation protection program that, as a minimum, provides compliance with pertinent regulatory requirements, license provisions, and the Radiation Protection Program.
- Maintains direct access to the Laboratory Director on matters relating to radiological protection.
- Maintains sufficient organizational independence to review and evaluate activities involving the use of radioactive materials.
- Provides Authorized Users and radiation workers with the instruments, protective devices, dosimetry, training, and other items needed to perform their work in accordance with the radiological protection program elements.
- Maintains original copies of all St. Louis licenses/permits, including attachments and amendments, for radioactive materials.
- Directs program to monitor and control radioactive materials throughout the laboratory
- Conducts radiation safety training
- Maintains inventory of standards, tracers, and radiological samples
- Manages segregated area for storing radioactive and mixed wastes

4.3 DEPUTIES

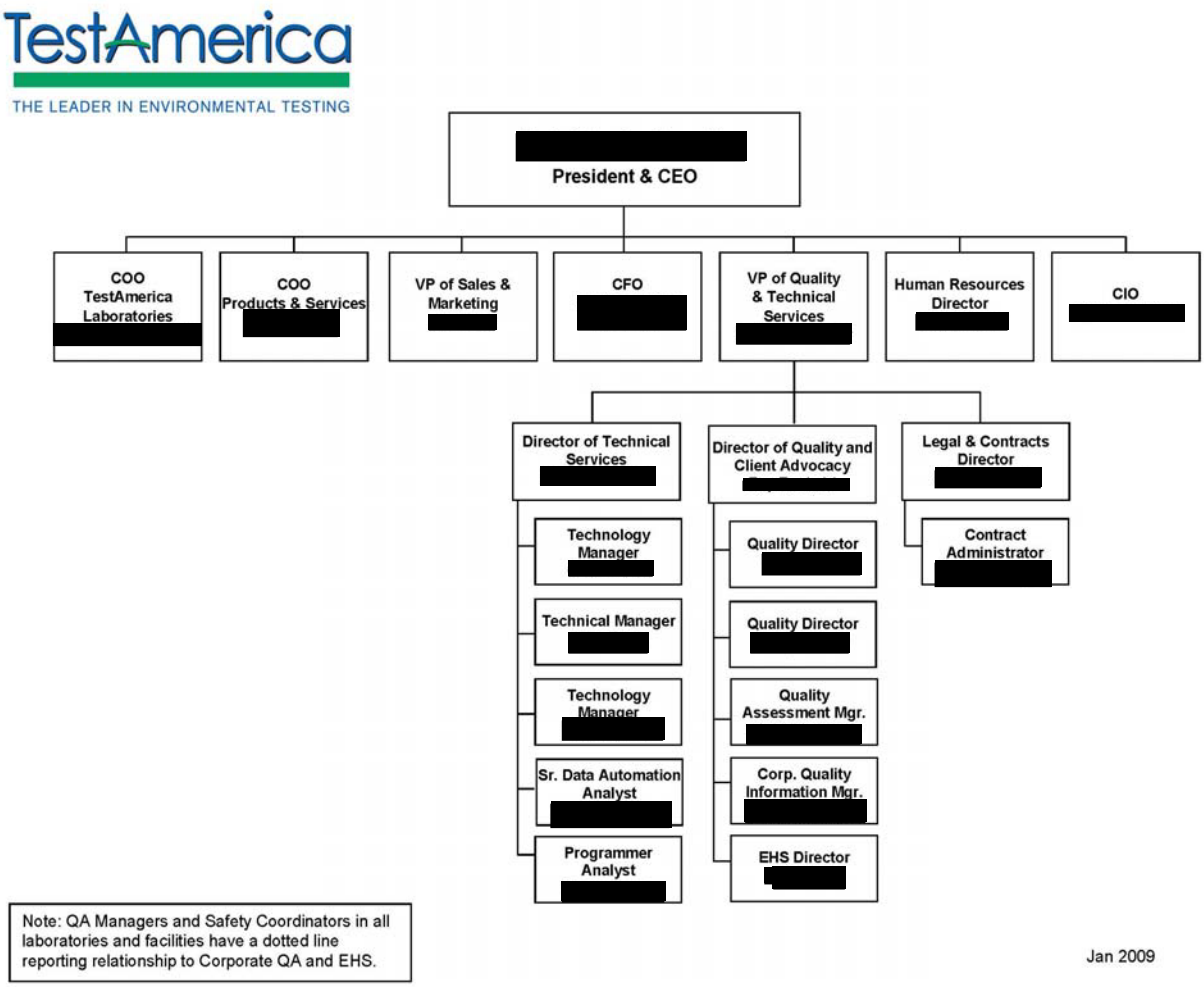
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director: Elaine Wild	Ben Hicks Rhonda Ridenhower	
QA Manager Marti Ward	Terry Romanko	
Technical Director Terry Romanko	Ben Hicks	
Organic Manager Ben Hicks	Wenjun Han	

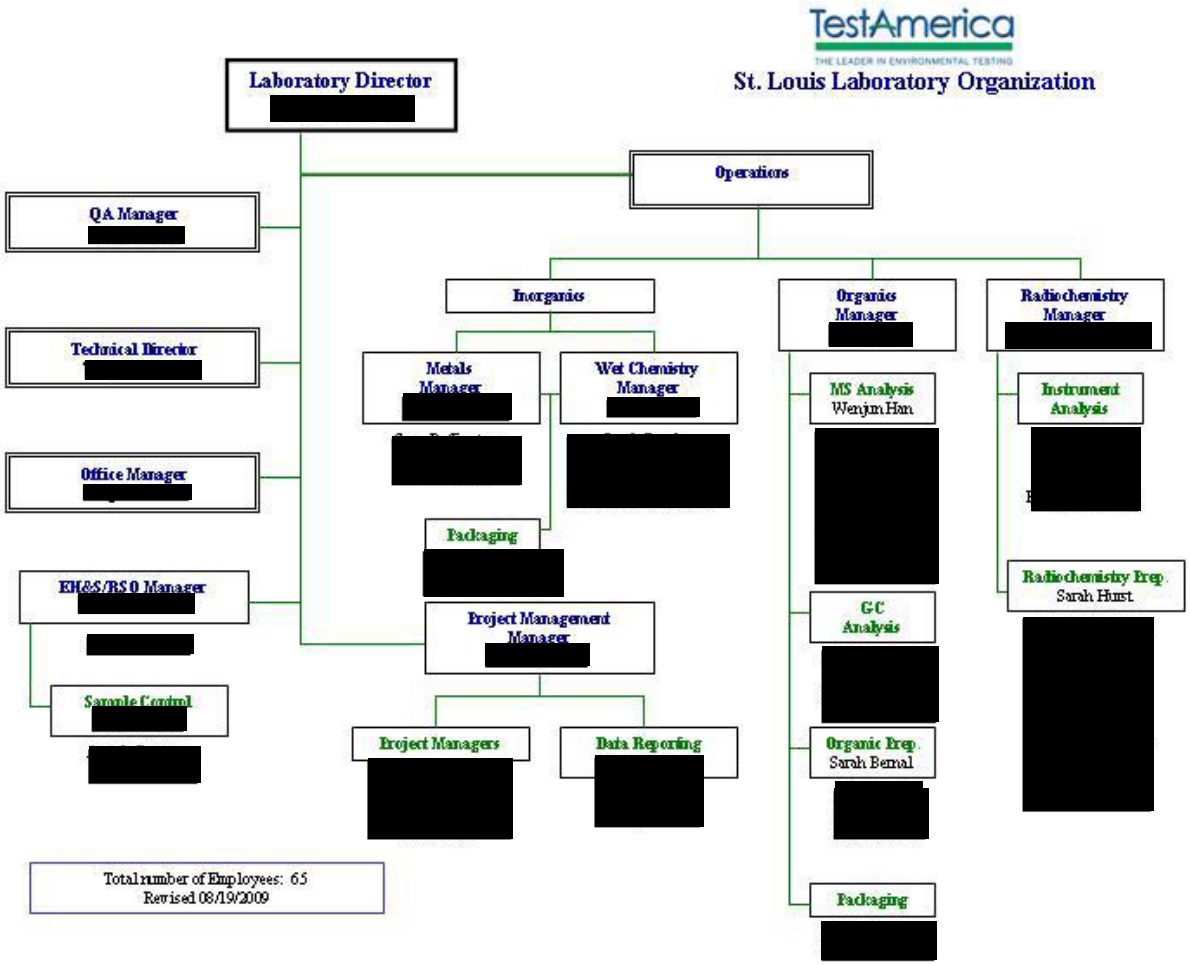
Key Personnel	Deputy	Comment
Radiochemistry Manager Rhonda Ridenhower	Jody Watson	
Metals Manager Fernando Cruz	Elaine Wild	
Wet Chemistry Manager Chris Hough	Elaine Wild	
EHS Coordinator Mike Ridenhower	Jim Kleszczewski	
Radiation Safety Officer Mike Ridenhower	Terry Romanko	
Project Management Department Manager Mike Franks	Elaine Wild	

Figure 4-1.

Corporate Organization Chart



St. Louis Facility Organization Chart



SECTION 5

QUALITY SYSTEM
(NELAC 5.4.2)

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.

This QAM was written to comply with the National Environmental Laboratory Accreditation Conference Standards, Department of Defense QSM and Department of Energy QSAS.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for familiarizing themselves with the quality program documentation and implementing those policies and procedures to ensure the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.1.1 Objectives of the Quality System

The goal of the TestAmerica quality system is to ensure that business and technical operations are conducted with the highest standards of professionalism and ethics in the industry.

To achieve this goal, it is necessary to provide TestAmerica clients with not only scientifically sound, well documented , and regulatory-compliant data, but also to ensure that TestAmerica provides the highest quality service available in the industry with uncompromising data integrity. A well structured and well communicated quality system is essential in meeting this goal. TestAmerica's quality system is designed to minimize systemic error, encourage constructive, documented problem solving and provide a framework for continuous improvement within the organization.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CA-L-P-001) and Employee Ethics Statements (Appendix 1).

- Ethics and Compliance Officer (ECO).
- A training program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CA-L-S-001)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-L-S-001).
- An effective external and internal monitoring system that includes procedures for internal audits (Section 16).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents:

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Corporate Quality Policy Memorandums
- Laboratory QA/QC Policy Memorandums
- Laboratory Waste Management Plan (composed of several SOPs)
- Laboratory Radiation Safety Program (composed of several SOPs)
- Corporate Quality Management Plan

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Policy Memorandum
- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

  Note: The laboratory has theresponsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precendence over the CQMP in those cases.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements

under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), inter-element corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit/Minimum Detectable Activity) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains a ***Reference Data Summary***, through QC Browser, that summarizes the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department. Copies of method specific QC limits are included in the analytical SOPs for the various methods. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, TestAmerica St. Louis has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are contained in Section 25.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. TestAmerica St. Louis routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 25. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the

sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

As the QC limits are calculated, QC charts are generated showing warning and control limits for the purpose of evaluating trends. The QA Manager evaluates these to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file. See SOP ST-QA-0014, "Evaluation of Analytical Accuracy and Precision Through the Use of Control Charts".

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 17). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL
(NELAC 5.4.3)

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions, Operator Aids and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving and in the TestAmerica St. Louis SOP ST-QA-0023 "Document Control".

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, non-conformance memos and validation requests. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, the number of pages of the item, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department and other management. In order to develop a new document, a manager submits a draft to the QA Department and/or Technical Director for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain the official document on file. The official document is provided to all applicable operational units. Controlled documents shall be

available at all locations where the operational activity described in the document is performed (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years. When related to DoD (Department of Defense) work the review will be done every year. Revisions are made as appropriate. Changes to documents occur when a procedural change warrants a revision of the document.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual and SOPs refer to SOP ST-QA-0035, “Preparation and Management of Standard Operating Procedures”. Uncontrolled copies must not be used within the laboratory. Electronic copies are stored on the Public server in the QA folder for the applicable revision. Previous revisions and back-up data are stored by the QA department.

Forms, worksheets, work instructions and information are organized by department in the QA folder. There is an index. Electronic versions are kept on the network server in the QA folder.

6.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are destroyed. At least one copy of the obsolete document is archived as described in Section 15.

SECTION 7

SERVICE TO THE CLIENT
(NELAC 5.4.7)

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these regulatory and client requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the lab's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the

contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.
All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel will review the work request at each stage of evaluation. SOP ST-PM-0001, "Project Setup and Quote" outlines the procedure used at TestAmerica St. Louis.

The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on the scope of contract, to evaluate all of the requirements (not necessarily in the order below).

- Legal & Contracts Director
- General Manager
- The Laboratory Customer Service Manager
- Laboratory and/or Corporate Technical Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Regional and/or National Account representatives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The National Account Director, Legal Contracts Director, or the local Customer Service Manager or Project Manager then submits the final proposal to the client. In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Legal & Contracts Director maintains copies of all signed contracts***.*** A copy is kept in the Project Management Directory on the network server.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. See Figure 7-1 for an example of the proposal review form. This is kept in the hardcopy contract file maintained by the Business Development Manager.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they coordinate opportunities and work with laboratory management and supervisory staff to ensure that available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, a Client Requirement Memo may be associated with each sample lot as a reminder of special sample receipt instructions and analytical requirements.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation may be by letter, e-mail, variance and/or contract addendum.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated on the Client Requirement Memo and are introduced to the department supervisors at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all

client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients.

Note: ISO 17025/NELAC 2003 states that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request".

The laboratory's standard procedures for reporting data are described in Section 26. Special services are also available and provided upon request. These services include:

- Reasonable access to our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon

7.5 CLIENT COMMUNICATION

Project Managers are the primary communication link to the clients. They inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project Management will maintain ongoing client communication throughout the entire client project.

Technical Directors are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with its clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service.

TestAmerica Sales and Marketing teams periodically develop lab and client specific surveys to assess client satisfaction.

Figure 7-1

TestAmerica St. Louis

Quality Assurance Project Plan/Statement of Work Review Form

QAPP/SOW Title:
_____

QAPP/SOW Revision No.: _____

Client Name: _____

Project Name: _____

QAPP/SOW Location: _____

Date QAPP/SOW Received: _____
Requested Tests: _____

Distribution:

Department/Individual		**Review Req'd? Y/N**
Operations	_____	_____
QA Manager	_____	_____
Other	_____	_____

Date Comments/Response Due to Client: ____/_____/_____

Review Completed (PM Initials/Date): _____/_____

Reviewer's Comments (or attached):

SECTION 8

SUBCONTRACTING OF TESTS
(NELAC 5.4.5)

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOPs on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements / specified in NELAC/ISO 17025 and or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-NELAC accredited work where required.

For Department of Defense/Department of Energy projects the subcontractor and/or Work Share laboratories used must have an established and documented laboratory quality system that complies with DoD QSM/DOE QSAS requirements. The subcontractor and/or Work Share laboratories are evaluated following the procedures outlined below and as seen in Figure 8-1. The subcontractor and/or Work Share laboratory must receive project-specific approval from the DoD/DOE client before any samples are analyzed.

The DoD QSM requirements for subcontracting:

1. Subcontractor laboratories must have an established laboratory quality system that complies with the QSM.
2. Subcontractor laboratories must be approved by the specific DoD Component laboratory approval process.
3. Subcontractor laboratories must demonstrate the ability to generate acceptable results from the analysis of PT samples, subject to availability, using each applicable method, in the specified matrix, and provide appropriate documentation to the DoD client.
4. Subcontractor laboratories must receive project-specific approval from the DoD client before any samples are analyzed.
5. Subcontractor laboratories are subject to project-specific, on-site assessments by the DoD client or their designated representatives.

The DOE QSAS has the following requirements for subcontracting:

> "The laboratory shall not use any sub-tier laboratories or subclients (including those possessing the same or similar corporate name) for performance of work under this specification without written approval from the Procurement Representative. The laboratory using the sub-tier laboratory or subclient shall document and is responsible for ensuring that such subclient meets all of the requirements of this specification, including being available for client inspections and audits.
> Some clients may not allow any subcontracting to third party (sub-tier) laboratories. If this is the case, then this will be specifically noted in the site-specific contracts vis Contracts, Task Orders, Laboratory Delivery Orders, etc."

Project Managers (PMs), Customer Service Managers (CSM), or Regional Account Executives (RAE) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies, such as the US Army Corps of Engineers and the USDA, require notification prior to placing such work.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM [or Regional Account Executive (RAE) or Customer Service Manager (CSM)] becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica: a listing of all approved subcontracting laboratories and supporting documentation is available on the TestAmerica intranet site. Verify necessary accreditation, where applicable, (e.g. on the subcontractor's NELAC, A2LA accreditation or State Certification).
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- NELAC accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

With the exception of DOD and DOE programs noted in 8.1, all TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as

other contract needs. Refer to Corporate SOP CA-C-S-001, Work Sharing Process and ST-PM-0001, Project Set Up.

When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 The QA Manager must ensure that the Subcontracting Approval Form (Figure 8-1) has been completed and have supporting documentation on file prior to initiation of any work. In some cases a network laboratory or Corporate QA may have previously completed an approval of a subcontracting laboratory. A listing of all approved subcontract laboratories and supporting documentation is available on the TestAmerica intranet site. If this option is used, the laboratory must ensure that the subcontract lab is capable of meeting the needs of the current project. A letter or e-mail is sent to the lab requesting the following information:

8.2.1.1 A copy of their Quality Assurance Manual (controlled if possible). Determine that data quality limits for relevant methods are acceptable and that training procedures are adequate (optional if a lab is NELAC accredited)

8.2.1.2 Evidence of a current SOP per method. A copy of the first page and signature page from the SOP is sufficient. A Table of Contents that includes effective dates is also acceptable. (optional if a lab is NELAC accredited)

8.2.1.3 The most recent 2 sets of full proficiency testing (PT) results relevant to the analyses of interest and any associated corrective action. (optional if a lab is NELAC accredited)

8.2.1.4 Copy of necessary certifications verifying that the required approvals are current. Ensure that all needed analytes are included; some may not be accredit-able (if so, document). Certificate and scope of International Standard accreditation are required, when applicable.

8.2.1.5 Example final report to confirm format is compliant and provides the necessary information. (minimally it must be determined that Batch QC results are included in the laboratory reports and data is appropriately qualified.

8.2.1.6 Statement of Qualification (SOQ) or summary list of Technical Staff and Qualifications – position, education and years of experience

8.2.1.7 USDA soil permit if available and/or required. USDA permit is required if soils less than three feet deep from New York, North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Texas, Oklahoma, New Mexico, Arizona, California, Hawaii, or outside the continental U. S. are to be analyzed. These samples require special shipping measures; check with the EHS Department. It may be necessary to heat-treat the samples before shipping if the subcontract laboratory does not have a USDA permit; however, some analytes/tests may be irrelevant after heat treatment.

8.2.1.8 Insurance Certificate. This is required by TestAmerica's Chief Financial Officer

8.2.1.9 State Audit with Corrective Action Response

8.2.1.10 Description of Ethics and Data Integrity Plan.

8.2.1.11 DoD work includes additional requirements as described in Section 8.1 above.

8.2.1.12 A copy of raw data associated with the first project is requested for internal review. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. If the QA manager is unfamiliar with the analysis being performed, notify Corporate QA for guidance on the review (it may need to be sent elsewhere for evaluation). This requirement can be skipped if an on-site visit of the laboratory is planned. (This requirement is effective as of the effective date of this section. Laboratories worked with previously [minimum of 6 months] are grandfathered in.)

Note: The lab does not need to complete the approval form (figure 8-1) if the information on the intranet site is sufficient to meet the needs of the project.

8.2.2 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site along with the associated documentation and notify the finance group for JD Edwards.

8.2.3 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.4 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report (Form No. CW-F-WI-009)**.**
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Lab Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM (or RAE or CSM, etc.) responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. For network laboratories, certifications can be viewed on the company's Total Access Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a Chain of Custody (COC). A copy of the original COC sent by the client must be included with all samples subbed within TestAmerica.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-NELAC accredited work must be identified in the subcontractor's report as appropriate. If NELAC accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

With the exception of DOD and DOE programs noted in 8.1, the Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs. In the event this provision is utilized the QA Manager will be required to verify certifications. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

SECTION 9

PURCHASING SERVICES AND SUPPLIES
(NELAC 5.4.6)

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica Corporate Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001, ST-QA-0037, "Procurement of quality Related Items" and ST-QA-0002, "Standards and Reagent Preparation".

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Material used in the analytical processmust be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

The procedure for purchasing/ordering quality related items can be found in the TestAmerica St. Louis SOP ST-QA-0037, "Procurement of Quality Related Items".

9.3.2 Receiving

It is the responsibility of the purchasing manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to date the material when received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are kept in binders in the laboratory's Tech Library and are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

All methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, it may be assumed that it is not significant in that procedure and, therefore, any grade reagent may be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals unless noted otherwise by the manufacturer or by the reference source method.

- An expiration date can not be extended if the dry chemical is discolored or appears otherwise physically degraded; the dry chemical must be discarded.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user. When a traceable standard is not available to use for calibration or verification activities, a nontraceable standard may be used if written client approval is obtained (when required).

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500 psig or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1mmho/cm (or specific resistivity of greater than 1.0 megaohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Laboratory Director and appropriate Department Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade water (or other similar quality) for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased VOA vials must be certified clean and the certificates must be maintained. If uncertified VOA vials are purchased, all lots must be verified clean prior to use. This verification must be maintained.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Standards and Reference Materials are stored separately from samples. Radiochemical standards are stored in a controlled access cabinet. Storage conditions are per the Corporate Environmental Healt and safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Laboratory Director. If they agree with the request the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application.

For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department as specified in the laboratory's procedure for software verification. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is readily accessible to the laboratory.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 21. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Department Managers/Technical Director.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the corporate Finance Documents on Vendor Selection (SOP No> CW-F-S-018) and Procurement and Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers /vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc. As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

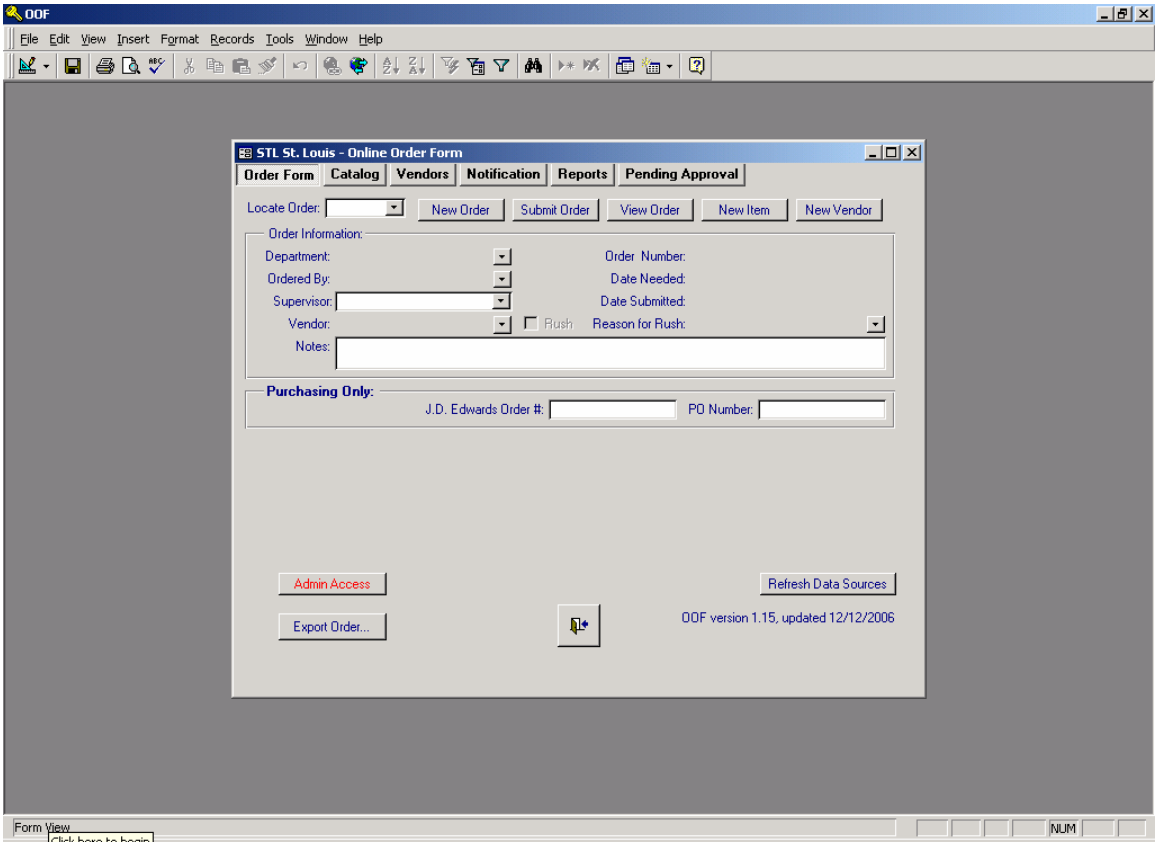
9.6.1 New Vendor Procedure

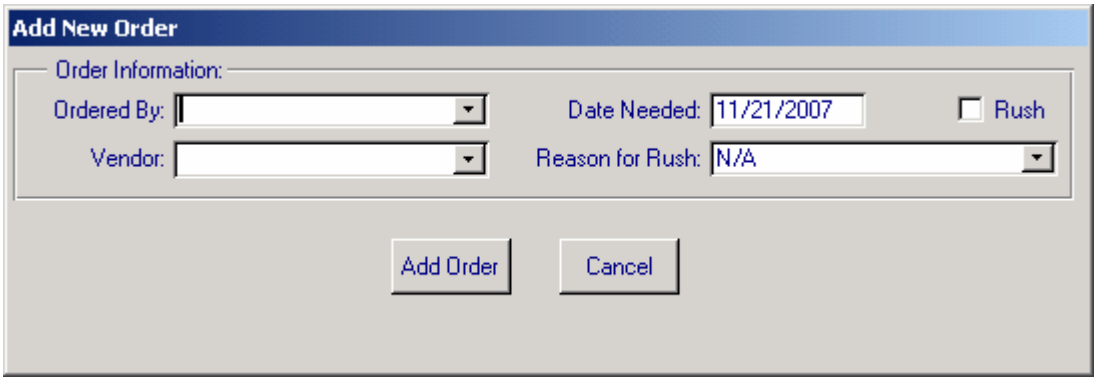
TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form available on the intranet site.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technology Director are consulted with vendor and product selection that have an impact on quality.

Figure 9-1.

Electronic Order Form





SECTION 10
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SECTION 11

COMPLAINTS
(NELAC 5.4.8)

11.1 OVERVIEW

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, (e.g. communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 13 (Corrective Actions) and is documented in the laboratory's Validation Database.

11.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to SOP ST-QA-0036.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelyhood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

11.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 13. In addition, Corporate Management, Sales and Marketing and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 13.

11.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the Laboratory Director and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 17)

SECTION 12

CONTROL OF NON-CONFORMING WORK
(NELAC 5.4.9)

12.1 OVERVIEW

In the context of environmental testing, a non-conformance is any situation in which some aspect of the work does not conform to the laboratory's SOPs or agreed upon client requirements. A non-conformance does not necessarily invalidate reported data, but it does initiate the requirements of this section.

When a non-conformance or deviation from standard laboratory practice is detected, correction and/or corrective action (as defined in Section 13) is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then a plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 13).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the supervisor for resolution. The supervisor may elect to discuss it with the QA Manager and/or Technical Director or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 13. This information can then be supplied to the client in the form of a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 20. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Department Supervisor and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with NELAC (or the analytical method) requirements and the reason. Data being reported to a non-NELAC state would need to note the change made to how the method is normally run.

12.2 RESPONSIBILITIES AND AUTHORITIES

TestAmerica's Corporate SOP entitled Internal Investigation of Potential Data Discrepancies and Determination for Data Recall (SOP No. CA-L-S-001), outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or

violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances the Laboratory Director, a Lab Supervisor, QA Manager may exceptionally authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. For DOE and other programs where required, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures and entered into the Clouseau non-conformance database. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any nonconforming work discovered by any laboratory staff member must be reported to facility senior Management within 24-hours. The laboratory's Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Department Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO) and Director of Quality and Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

All lab employees have the authority to stop work for reasons of unresolved safety or quality issues. Employees are encouraged to work through their chain of command to resolve such problems, but TestAmerica also presents other lines of communication in ethics and safety training that are available to all employees.

12.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation and Recall Procedure (SOP No. CA-L-S-001) distinguishes between situations when it would be appropriate for the laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting (Section 13) in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CA-L-S-001.

When applicable (i.e.DOE and DOD projects) the laboratory notifies affected clients of potential data quality issues. Corrective actions taken to resolve the issues are submitted to the client in a timely and responsive manner.

For projects invoking Federal Regulation 10 CFR21, laboratory SOP ST-QA-0042 shall be followed.

12.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system (Section 13).

On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

12.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any person in the laboratory.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem. The meeting will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases a meeting may not be necessary if all appropriate personnel are in agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 13 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i.e., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Director, QA Manager, Supervisor can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report as described in Section 13.

SECTION 13

CORRECTIVE ACTION
(NELAC 5.4.10)

13.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memos (NCM) and the Validation Request Database.

For DOE and other programs where required, the client will be informed of the proposed corrective action.

13.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibilities for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify Systematic Problems before they become serious.
- Identify and track client complaints and provide resolution.

13.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non matrix related)
- Isolated Reporting / Calculation Errors
- Sample volume issues

13.2.2 Validation Request - used to document the following types of corrective actions:

- Questionable trends that are found in the monthly review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Failed or Unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors

- Client complaints

Health and Safety Violations are documented in the EH&S Quarterly Inspection Reports.

Internal and External Audit Findings are documented in the Audit Database.

13.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

13.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCM or Validation Request must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Supervisor, Lab Director, or QA Manager is consulted.

13.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM or Validation Request is used for this documentation.

13.3.3 Monitoring of the Corrective Actions

- The Department Manager/Supervisor and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Department Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM and Validation Request is entered into a database for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- The QA Manager reviews monthly NCMs and Validation Requests for trends. Highlights are included in the QA monthly report (refer to Section 17). If a significant trend develops that

adversely affects quality, an audit of the area is performed and corrective action implemented.

- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

13.3.4 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

13.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred The documentation of these procedures is through the use of an NCM or Validation Request Database.

For specific criteria and corrective actions refer to the analytical methods or specific method SOPs.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by a written NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

13.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, and not obliterated (e.g. no white-out), and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 13-1.
Example - Corrective Action Report

CLOUSEAU CORRECTIVE ACTION MEMO

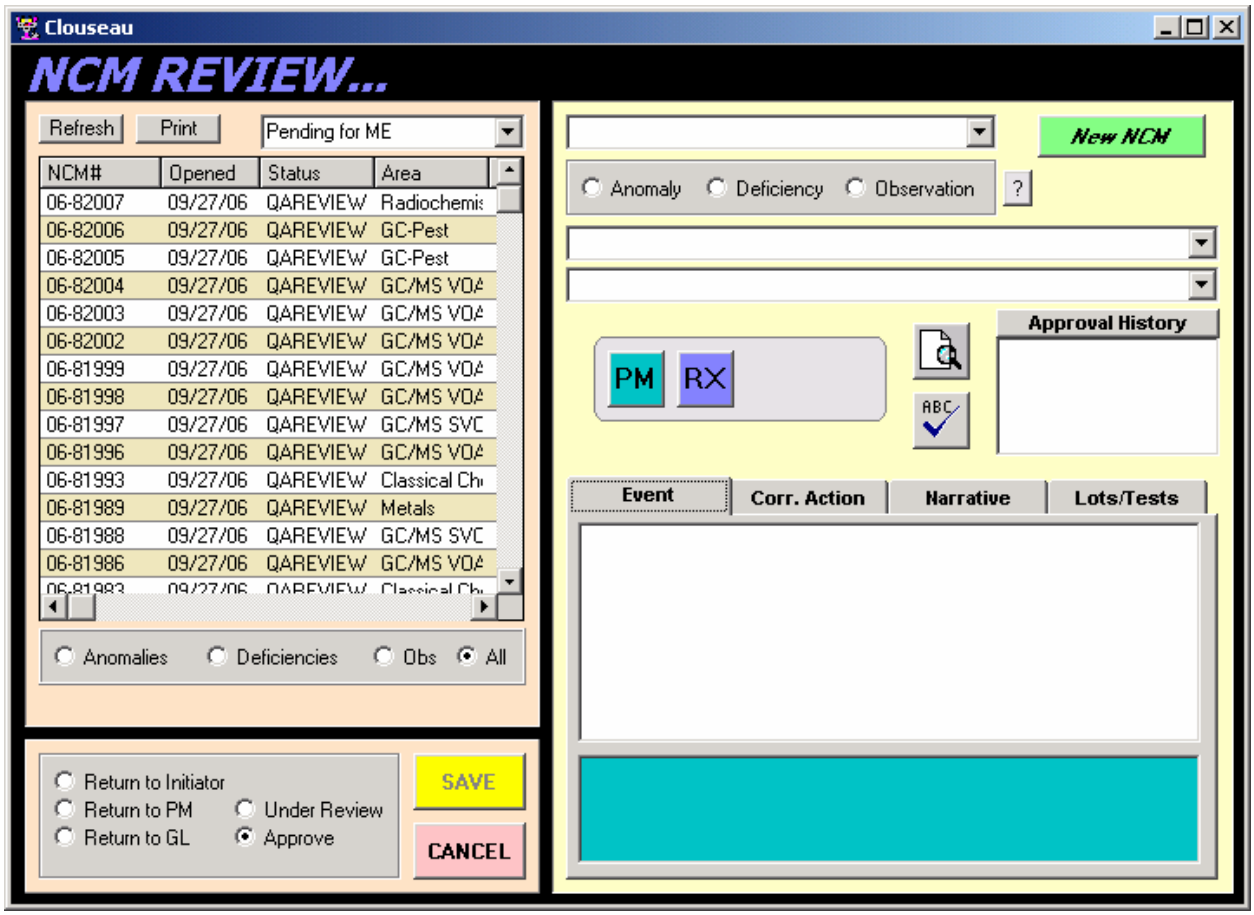


Figure 13-2.
Example – Validation Request

VALIDATION REQUEST DATA BASE

Microsoft Access

File Edit View Insert Format Records Tools Window Help

Validation_New : Form

Client Code | Client Code Help | Lot ID Help

Client

PM

Date Requested 10/29/2007

Due Date 10/31/2007

Record (AutoNumber)

Date Completed

Associated Lots

Validation Questions

Validation Attachments

Open Attachment Directory

Next Entry

PM Response

Response Attachments

Group Leader Section

Group Leader Response

Date Completed

Groups Affected:

METALS SVOA
OPREP VOA
RAD GC
REPORTING WET CHEM
SAMPLE CONTROL
IT
PM

SECTION 14.0

PREVENTIVE ACTION
(NELAC 5.4.11)

14.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive continuous process improvement activity that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Assurance (QA) program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the QA Metrics Report, internal or external audits, proficiency testing performance, client complaints, staff observation, etc.

The monthly QA Metrics Report shows performance indicators in all areas of the quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. These metrics are used to help evaluate quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process (Section 13) is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

14.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

14.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the Annual Management Review (Section 17). A highly detailed recap is not required; a simple recount of success and failure within the preventive action program will provide management a measure for evaluation.

14.1.3 Documentation of preventive actions shall be maintained for review.

14.2 MANAGEMENT OF CHANGE

The laboratory uses a series of spreadsheets and/or data bases to track changes to major capabilities (e.g. equipment, accreditations, etc). An equipment list is kept by the Quality Assurance Department. Accreditation changes are updated in the OASIS Total Access program on the TestAmerica intranet site.

SECTION 15.0

CONTROL OF RECORDS
(NELAC 5.4.12)

The laboratory maintains a record system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. See SOP ST-QA-0023, "Document Control", for TestAmerica St. Louis specific details.

15.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 15-1. Quality records are maintained by the QA department electronically and backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by the Data Reporting Group (raw data, analytical records, lab reports) and the QA department (logbooks, standards, certificates).

Table 15-1. Record Index[1]

Technical Records	Official Documents	QA Records	Project Records	Administrative Records
Retention: 5 Years from analytical report issue*	5 Years from document retirement date*	5 Years from archival* **Data Investigation:** 5years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)	5 Years from analytical report issue*	**Personnel:** 7 Years (HR Records must be maintained as per Policy CW-L-P-001) **Finance:** See Accounting and Control Procedures Manual
Raw Data Logbooks[2] Standards Certificates Analytical Records Lab Reports	Quality Assurance Manual (QAM)	Internal and External Audits/ Responses	Sample receipt and COC Documentation	Finance and Accounting
	Work Instructions	Certifications	Contracts and Amendments	EH&S Manual, Permits, Disposal Records
	SOPs Manuals	Corrective/Preventive Action	Correspondence	Employee Handbook
		Management Reviews	QAPP	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)
		Method & Software Validation, Verification data	SAP	
		Data Investigation	Telephone Logbooks	Administrative Policies

Technical Records	Official Documents	QA Records	Project Records	Administrative Records
Retention: 5 Years from analytical report issue*	5 Years from document retirement date*	5 Years from archival* **Data Investigation:** 5years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)	5 Years from analytical report issue*	**Personnel:** 7 Years (HR Records must be maintained as per Policy CW-L-P-001) **Finance:** See Accounting and Control Procedures Manual
	Policies		Lab Reports	Technical Training Records

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 15-2.

All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss. Retention of hardcopy records are maintained on-site at the laboratory for at least 60 days after their generation and moved offsite for the remainder of the required storage time. Electronic records are stored on site for a minimum of 5 years. Records are maintained for a minimum of five years unless other wise specified by a client or regulatory requirement. All records shall be protected against fire, theft, loss, environmental deterioration and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

15.1.1 Access to the data is limited to laboratory and company employees. All records are held secure and in confidence. Records maintained at the laboratory are located in the Data Reporting Department. Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Logs are maintained in the Reporting Department to note removal and return of records.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 15-2 have lengthier retention requirements and are subject to the requirements in Section 15.1.2.

15.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 15-3 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that

data is marked as to who to contact for authorization prior to destroying the data. For projects/programs that require a retention time longer than five years, the Project Manager informs the Document Control group of the extended storage requirement. The Document Control department tracks these requirements in a database.

Table 15-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

15.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format.

15.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with Client Analysis Summary sheet generated by the LIMS. The chain of custody would indicate the name of the sampler. Per DOE requirements, a log of names, initials and signatures for all individuals responsible for signing or initialing any laboratory records is maintained in the Human Resources Department.

- All information relating to the laboratory facilities equipment, analytical test methods, and

related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run long or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in the Standards Log Program and relevant printouts are included in the data packages.

- Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "Analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 20.15.1 'Computer and Electronic Data Related Requirements'**.**

15.2 TECHNICAL AND ANALYTICAL RECORDS

15.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the performance of each analysis and reviewing results.

15.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

15.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- Date of analysis; Time of analysis is also required if the holding time is seventy-two (72)

hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in a non-instrument analysis, the time is recorded on the bench sheet.

- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs or posted on the instruments.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

15.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and

- results of data review, verification, and crosschecking procedures

15.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.
- Legal Chain of Custody protocols required by DOE and DOD.

15.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 15-1.

15.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

15.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

15.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

15.5.3 Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

15.5.4 The laboratory has a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are numbered sequentially. Within each logbook, pages are sequentially numbered. Bench sheets are filed sequentially electronically. Standards are maintained in the Standards Log program.

15.5.5 Records are considered archived when moved off-site. Dual storage of these records is maintained by the IT department during its daily and weekly back-ups of the laboratory network. These back-ups are stored off site.

15.6 TRANSFER OF OWNERSHIP

15.6.1 In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

15.7 RECORDS DISPOSAL

15.7.1 Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration.

15.7.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

15.7.3 If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 16

AUDITS
(NELAC 5.4.13)

16.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Audits, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are shown in Table 16-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 16-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems	QA Department or Designee	All areas of the laboratory annually
QA Technical Audits - Evaluate raw data versus final reports - Analyst integrity - Data authenticity	QA Department or Designee	All methods within a 2-year period, with at least 15% of methods every quarter
SOP Method Compliance	Technical Director, QA Department, Lab Supervisors	- All SOPs within a 2-year period (DoD SOPs require annual review) - All new analysts or new analyst/methods within 3 months of IDOC
Quality Assurance Manual	QA Dept. or designee	Annually
Special	QA Department or Designee	Surveillance or spot checks performed as needed
Performance Testing	Analysts with QA oversight	Two successful per year for each NELAC field of testing or as dictated by regulatory requirements

16.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, the laboratory's Data Integrity and Ethics Policies, NELAC quality systems, client and

state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed. The audit is divided into modules for each operating or support area of the lab, and each module is comprehensive for a given area. The area audits may be done on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

16.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, MintMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

16.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Director at least every two years (every year for DoD SOPs). The work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

16.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

16.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, Soil, Radiochemistry.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

16.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. A copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

16.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2003 NELAC standards.

16.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. . A copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 17

MANAGEMENT REVIEWS
(NELAC 5.4.14)

17.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director for review and comments. The final report shall be submitted to the laboratory's Corporate Quality Director, the Laboratory Director and General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

17.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Directors, QA Manager, Department Supervisors) conducts an annual review of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals and objectives. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management review (Corporate Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.

- Minutes from prior senior laboratory management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.
  - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed) and external PT program results.
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.
- Laboratory Health and Safety issues
- Radioactive materials management issues

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring updates to the laboratory QA Manual shall be included in the next revision of the QA Manual.

17.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/ Recall SOP shall be followed (SOP No. CA-L-S-001). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's COO, VP of Client and Technical Services, General Managers and Quality Directors receive a monthly report from the Director of Qulaity and Client Advocacy summarizing any current data integrity or data recall investigations. The General Manager's are also made aware of progress on these issues for their specific labs.

SECTION 18

PERSONNEL
(NELAC 5.5.2)

18.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Section 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

The laboratory ensures that all personnel, including part time, temporary, contracted and administrative personnel, are trained in basic laboratory QA and health and safety programs.

Personnel dealing with sample receipt, radioactive waste management and materials shipping are trained in waste management, shipping and handling, and hazardous and/or radioactive material control as appropriate.

18.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training guidelines for TestAmerica employees are outlined in job descriptions.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance or quantitation techniques, etc. are also considered).

18.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame*	Employee Type
Environmental Health & Safety	Prior lab work	All
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given.

The following evidence must be on file at the laboratory for each employee:

- Ethics Training documentation
- Ethics agreement (signed)
- Confidentiality agreement (signed)
- NELAC statement of qualification
- Copy of college degree, if applicable
- New Employee Orientation checklist
- Safety Orientation checklist

The following evidence must be on file at the laboratory for each technical employee:

- Department checklist
- Demonstration of Capability (DOC)
- Manual integration training, if applicable.

- Annual evidence of continued DOC that may include successful analysis of a blind sample on the specific test method, or a similar test method, or an annual DOC, or four successive, successful LCS.
- Specialty training, if applicable

Also refer to "Demonstration of Capability" in Section 20.

The training of technical staff is kept up to date by:

- Each employee must have documentation filed with the QA Department that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics is maintained in their training file.
- Documentation of proficiency (refer to Section 20).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

18.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CA-L-P-001) and an Ethics Statement (Appendix 1). All initial and annual training is documented by signature on the signed Ethics Policy and Ethics Agreement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy (Appendix 1)
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 19

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS
(NELAC 5.5.3)

19.1 OVERVIEW

The laboratory is a 31,000 ft^2 secure laboratory facility with controlled access and is designed to accommodate an efficient workflow and provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

19.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources and lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

19.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.
- Separate high and low level radiochemical preparation areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

19.4 FLOOR PLAN

A floor plan can be found in Appendix 2.

19.5 BUILDING SECURITY

Building keys are distributed to management as necessary. The Human Resources Manager maintains a list of employees who have been issued keys. Electronic access “swipe” cards are issued to all laboratory employees.

All visitors to the laboratory enter through the main entrance and sign in and out in a visitor’s logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed.

Visitors (with the exception of company employees) are given a visitor’s badge and are escorted by laboratory personnel while in the laboratory facility.

SECTION 20.0

TEST METHODS AND METHOD VALIDATION
(NELAC 5.5.4)

20.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

20.2 STANDARD OPERATING PROCEDURES (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory:

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled "Writing a Standard Operating Procedure, No. CW-Q-S-002 and the laboratory SOP ST-QA-0035, "Preparation and Management of Standard Operating Procedures**".**
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.
- A listing of the laboratory's SOPs is included in Appendix 7.

20.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

20.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

20.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM); Non-polar Material) by Extraction and Gravimetry, EPA-821-R-98-002, February 1999*
- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980.*
- *Eastern Environmental Radiation Facility Radiochemistry Procedures Manual, EPA, PB84-215581, June 1984.*
- *HASL-300 28th Edition, Environmental Measurements Laboratory (EML), 1997..*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*

- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

Where required by specific programs (eg. DOE, DoD) the selected or modified methods shall be approved by the client prior to use.

20.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

20.4.2.1 A demonstration of capability is performed whenever there is a change in instrument type, method or personnel.

20.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures (refer to Section 15, Control of Records).

20.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes and the criteria below are acceptable to the client, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values.
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted or narrated.

20.4.3 **<u>Initial Demonstration of Capability (IDOC) Procedures</u>**

20.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

20.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

20.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

20.4.3.4 Calculate the recovery for each aliquot in the appropriate reporting units

20.4.3.5 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

20.4.3.6 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 20.4.3.3 above.
- Beginning with 20.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 20.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (see Figure 20-1) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

20.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

20.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

20.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

20.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

20.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of

sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

20.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

20.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix may be performed.

20.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by the highest acceptable calibration concentration. The lower quantitation limit (or QL) cannot be lower than the lowest bob-zero calibration level, and can be constrained by required levels of bias and precision.

20.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

20.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

20.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

20.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 20.7.10). Generally the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the corporate SOP No. CA-Q-S-006 and the laboratory SOP ST-QA-0016, "MDL/IDL Determination" for details on the MDL process.

20.8 Minimum Detectable Activity (MDA)/Minimum Detectable Concentration (MDC)

For radiochemical analyses, the MDA/MDCs are determined based on normal factors and conditions which influence measurement. The MDA/MDC is used to evaluate the capability of a method relative to the required RDLs. Sample size, count duration, tracer recovery, detector background and detector efficiency all contribute to determining the sample's MDA/MDC.

The Minimum Detectable Concentration (MDC) for a radionuclide by radiochemical measurement is determined from the blank/background variability associated with the appropriate detector, the detector efficiency, sample aliquot size and chemical yield. The background variability is proportional to the sample count time.

NOTE: The background variability is based on the analytical test and derived by: 1) using sample specific parameters, or 2) process blank specific parameters, or 3) by averaging the multiple MDCs derived in 1 or 2.

Matrix material is used whenever possible and is of a similar composition as the client samples.

The MDC is calculated for individual samples (depending on counting technique) using the formulas provided in Appendix 6. The MDC is expected to be less than the client required detection limit. Cesium-137 is the MDC analyte of interest for gamma evaluation.

If the sample MDC is greater than the client required detection limit (CRDL) or reporting limit (RL), the Data Reviewer shall examine the sample volume/weight, counting time, tracer yield and/or other relevant factors. The Data Reviewer shall decide the corrective action which may include reanalysis, recounting or data acceptance and document per laboratory procedure.

20.9 INSTRUMENT DETECTION LIMITS (IDL)

20.9.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

20.9.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

20.9.3 If IDL is > than the MDL, it may be used as the reported MDL.

20.10 VERIFICATION OF DETECTION AND REPORTING LIMITS

20.10.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at approximately 2-3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and 1-4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, and will redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

20.10.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

20.11 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specified in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory's SOPs.

20.12 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

20.13 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

20.13.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides

additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

20.13.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. For environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systemic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

20.13.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

20.13.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l. This approach may be used for chemical analyses. For radiochemical uncertainty determination see the calculations in Appendix 8.

20.13.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g. 524.2, 525, etc) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

20.14 SAMPLE REANALYSIS GUIDELINES

Because there is a certain level of uncertainty with any analytical measurement, a sample reanalysis may result in either a higher of lower value from an initial sample analysis. There are also variables that may be present (e.g., same homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats: (Client specific Contractual Terms and Conditions for reanalysis protocols may supercede the following items)

- Homogenous samples: If a reanalysis agrees with the original result to with RPD limits for MS/MSD or Duplicate analyses, or within +/- 1 reporting limit for samples less than or equal to the reporting lilmit, the original analysis will be reported. At the

clients request, both rsulsts may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.
- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.
- Due to the potential for increased variability, reanalysis may not be applicable to non-homogenous, Encore and Sodium Bisulfate preserved samples.

20.15 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

20.15.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in SOPs ST-IS-0001, ST-IS-0002 and ST-IS-0003. The laboratory is currently running Quantims which is a custom in-house developed LIMS system. It is referred to as LIMS for the remainder of this section. The LIMS utilizes an industry standard relational database platform. It is referred to as Database for the remainder of this section.

20.15.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use.

20.15.1.2 Ensure Information Availability: Protection against loss of information or service through scheduled back-ups, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

20.15.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by the analyst and the review

cover page is signed by both the analyst and second reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, *Acceptable Manual Integration Practices* and ST-QA-0040, "Manual Integration Procedure".

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

20.15.2.1 All raw data must be retained in the reporting department archive files. All criteria pertinent to the method must be recorded.

20.15.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) or pico-curies per liter (pCi/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) or pico-curies per gram (pCi/g) for solids. Values greater than 10,000 mg/L can be reported in percent, i.e., 10,000 mg/L = 1%. Units are defined in laboratory SOPs.

20.15.2.3 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

20.15.2.4 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. Where possible, the data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file. For instruments without the capability of file storage, the data is scanned to a pdf file and archived by the data reporting group.

20.15.3 <u>Logbook / Worksheet Use Guidelines</u>

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 13.
- Logbooks have sequentially numbered pages.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Persons responsible for the activity recorded in the logbook sign or initial the entry.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

20.15.4 Review / Verification Procedures

Review procedures are out lined in SOP ST-PM-0004 "Data Review, Verification and Reporting" to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data ST-QA-0040, "Manual Integration Procedure. The general review concepts are discussed below, more specific information can be found in the SOPs.

20.15.4.1 The data review process at TestAmerica St. Louis starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The Sample Control Supervisor reviews the transaction of the chain-of-custody forms and the inputted information. The Project Managers perform final review of the chain-of-custody forms and inputted information.

20.15.4.2 The first level of data review occurs with the Analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the LIMS. To ensure data compliance, a different analyst performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Issues that need further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors

- Results outside of calibration range

20.15.4.3 Unacceptable analytical results may require reanalysis of the samples.

20.15.4.4 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

- As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

20.15.4.5 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. When complete, the report is sent out to the client.

20.15.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using Corporate SOP CA-Q-S-002 and laboratory SOP ST-QA-0040 as the guidelines.

20.15.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

20.15.5.2 Analysts shall not increase or decrease peak areas to for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

20.15.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

20.15.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 20-1.
Demonstration of Capability Documentation

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Analyst Demonstration of Capability
Certification Statement

Analyst Name
Date: 8/28/2009

Method
SOP
Matrix

TestAmerica St. Louis
13715 Rider Trail North
Earth city, MO 63045
(314) 298-8566

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the TestAmerica Quality Assurance Plan, has met the Initial or Ongoing Demonstration of Capability.
2. The test method was performed by the analyst identified on this certification following the TestAmerica SOP.
3. A copy of the laboratory-specific SOP is available for all personnel on-site.
4. The data associated with the initial/ongoing demonstration of capability are true, accurate, complete and self-explanatory (*). These data are attached to this certification statement.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized inspectors.

Comments/Observations:

Analyst's Name	Signature	Date
Supervisor's Name	Signature	Date
QA Manager's Name	Signature	Date

(*) *True: Consistent with supporting data.*
Accurate: Based on good laboratory practices consistent with sound scientific principles/practices
Complete: Includes the results of all supporting performance testing.
Self-explanatory: Data properly labeled and stored so that the results are traceable and requires no additional explanation.

SECTION 21

EQUIPMENT (AND CALIBRATIONS)
(NELAC 5.5.5)

21.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory method SOPs. A list of laboratory equipment and instrumentation is presented in Table 21-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

21.2 PREVENTIVE MAINTENANCE

21.2.1 The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

21.2.2 Routine preventive maintenance procedures and frequency, such as lubrication, cleaning, and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

21.2.3 Table 21-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals.

21.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment.

21.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

21.2.4.2 Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.).

21.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed.

21.2.5 The laboratory equipment list contains:

- The identification of the instrument/equipment (instrument's Serial Number and Model Number)
- The date the instrument/equipment was put into use.
- If available, the condition when the instrument was received (e.g. new, used, reconditioned).

21.2.6 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

21.2.7 In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

21.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. Support equipment is uniquely identified and raw data records associated with the support equipment are retained to document instrument performance.

21.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory.

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

The recalibration/recertification certificates are kept on file.

See SOP ST-QA-0005, "Calibration and Verification Procedure for Thermometers, Balances, Weights and Pipettes".

21.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

21.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. Electronic thermometers calibrated quarterly.

The NIST thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer has increments of 1ºC, and has a range applicable to all method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks or filed in QA records. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in thermometer-specific logbooks. More information on this subject can be found in the SOP ST-QA-0005, "Calibration and Verification Procedure for Thermometers, Balances, Weights and Pipettes".

21.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day (7 days a week for DoE and DoD labs).

Ovens, water baths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept at > 0 ^{o}C and </= 6°C; Freezers < -10 ^{o}C

Specific temperature settings/ranges for other refrigerators, ovens water baths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks.

21.3.5 Autopipettors, Dilutors, and Syringes

For those dispensers that are not used for analytical measurements, calibration is not performed. Any device not regularly verified can not be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy. Glass micro-syringes are considered the same as Class A glassware.

See SOP ST-QA-0005, “Calibration and Verification Procedure for Thermometers, Balances, Weights and Pipettes”.

21.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 13).

Note: Instruments are calibrated initially and as needed after that and at least annually.

21.4.1 CALIBRATION STANDARDS

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

21.4.1.1 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample). This does not apply to radiochemical methods.

21.4.1.2 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

21.4.2 Calibration Verification (Organic and Inorganic)

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and NELAC (2003) standard, Section 5.5.5.10. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analystes and surrogates, including those reported as non-detects, must be included in the periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria. The frequency is found in the determinative methods.

Note: If an internal standard calibration is being used (GC/MS) then bracketing standards are not required, only daily verifiecations are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria, if applicable.

21.4.3 Verification of Linear Calibrations

Calibration verification for linear calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. Use the equations below to calculate % Drift or % Difference, depending on the procedure specified in the method SOP. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

The Percent Difference is calculated as follows:

$$\% \text{ Difference} = \frac{(\text{CF(v) or RF(v)}) - (\text{Avg. CF or RF})}{(\text{Avg. CF or RF})} \times 100$$

Where: CF(v) or RF(v) = CF or RF from verification standard
Avg. CF or RF = Average CF or RF from Initial Calibration.

The Percent Drift is calculated as follows:

$$\% \text{ Drift} = \frac{\text{Result} - \text{True Value}}{\text{True Value}} \times 100$$

The Percent Recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Result}}{\text{True Value}} \times 100$$

21.4.4 Verification of a Non-Linear Calibration

Calibration verification of a non-linear calibration is performed using the percent drift or percent recovery calculations described in 21.4.3 above.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

21.5 Radiochemical Calibrations

21.5.1 CALIBRATION STANDARDS

- Shelf life for stock radioactive standards shall not exceed 5 half lives. Shelf life for stock solutions prepared in the laboratory from salts, metals or dilution from a mother solution shall be no greater than one year, unless stated otherwise on the calibration certificate from the manufacturer. Standards in the form of a soil, sealed sources, filter, plated sources and sealed epoxy Marinelli beakers do not always have an expiration date. After the1 year shelf life of the stock solution has expired, it must be re-certified.

- If the standard is not re-verified, the standard shall be removed or clearly designated as acceptable for qualitative purposes only.

- The expiration date of the secondary standard shall not exceed the expiration date of the primary standard.

The accuracy of calibration standards is checked by comparison with a calibration verification standard from a second source. In cases where a second standard source is not available, a source from a different vendor is acceptable. All cases where this requirement cannot be met shall be documented with a nonconformance memo.

When a traceable standard is not available to use for calibration or verification activities, a nontraceable standard may be used if written client approval is obtained (when required).

Calibration standards are prepared using the appropriate procedures. However, the general procedures are described below.

21.5.1.1 For each analyte of interest, prepare calibration standards at the minimum number of concentrations as stated in the analytical methods.

21.5.1.2 Standards for instrument calibration are obtained from a variety of sources. All radioactive standards are traceable to NIST whenever possible. Dilution standards are prepared from stock standards purchased from commercial suppliers. A standard log is maintained, containing concentration/activity, date of receipt, date of standard preparation, any dilutions made, lot number, supplier, type of solvent and a unique code number to identify the standard.

The frequency of calibration can be found in the laboratory's radiochemical methods and Table 21-4.

21.5.2 RADIOCHEMICAL CONTINUING INSTRUMENT CALIBRATION VERIFICATION and RADIOCHEMICAL BACKGROUND MEASUREMENT

Performance checks shall be performed using appropriate check sources and monitored to ensure that the instruments are running properly and that detector response has not significantly changed. Background measurements are made according to the schedule on Table 21-4 and monitored to ensure that the laboratory maintains its capability to meet required data quality objectives.

21.5.3 RADIOCHEMICAL INSTRUMENT CONTAMINATION MONITORING

The laboratory radiochemical instrumentation SOPs specify the requirements for monitoring radiochemical instrumentation. The SOP specifies the monitoring frequencies and criteria for initiating corrective action.

21.6 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. See SOPs ST-MS-0001 and ST-MS-0002 for guidelines for making tentative identifications and reporting TICs.

21.7 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 21-1.

Laboratory Equipment and Instrumentation – TestAmerica St. Louis

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS – "B"	Hewlett Packard	5970	2623A00600	1989	NEW
GC/MS – "B" GC System	Hewlett Packard	5890	2623A01341	1989	NEW
GC/MS – "B" Concentrator	Tekmar	LSC3000	94187003	1992	NEW
GC/MS – "B" Autosampler	Varian	LSC2016	25101	1989	NEW
GC/MS – "G"	Hewlett Packard	5970	7807A11075	1987	NEW
GC/MS – "G" GC System	Hewlett Packard	5890	2807A11075	1987	NEW
GC/MS – "G" Concentrator	Tekmar	LSC3000	98175006	1992	NEW
GC/MS – "G" Autosampler	Varian	Archon	13540	2001	NEW
GC/MS – "F"	Hewlett Packard	5973	DE00020247	1998	NEW
GC/MS – "F" GC System	Hewlett Packard	6890	US80221392	1998	NEW
GC/MS – "F" Concentrator	IO	Eclipse 4660	D530466888P	2002	NEW
GC/MS – "F" Autosampler	Varian	Archon	14613	2001	NEW
GC/MS – "L"	Hewlett Packard	5973	CN10339019	2004	NEW
GC/MS – "L" Concentrator	Teledyne Tekmar	Velocity XPT	US03346007	2004	NEW
GC/MS – "L" Autosampler	Teledyne Tekmar	SOLATek 72	US03349002	2004	NEW
GC/MS – "M"	Hewlett Packard	5973	CN10412013	2004	NEW
GC/MS – "M" Concentrator	Teledyne Tekmar	Velocity XPT	US0412001	2004	NEW
GC/MS – "M" Autosampler	Teledyne Tekmar	SOLATek 72	US04119003	2004	NEW
GC/MS – "N"	Hewlett Packard	5973	CN10512032	2005	NEW
GC/MS – "N" GC System	Hewlett Packard	6890	US44621325	2005	NEW
GC/MS – "N" Concentrator	IO	Eclipse 4660	C452466563P	2005	NEW
GC/MS – "N" Autosampler	Varian	Archon	14376	2005	NEW
GC/MS – "K	Hewlett Packard	5973	US81221525	1998	NEW
GC/MS – "K" GC System	Hewlett Packard	6890	US00022347	1998	NEW
GC/MS – "K" Series Injector	Hewlett Packard	7683	CN31530345	1998	NEW
GC/MS – "K" Autosampler	Hewlett Packard	G2614A	US83501656	1998	NEW
GC/MS – "J"	Hewlett Packard	5973	US80321385	1998	NEW
GC/MS – "J" GC System	Hewlett Packard	6890	US00021127	1998	NEW
GC/MS – "J" Series Injector	Hewlett Packard	7683	US81801195	1998	NEW
GC/MS – "J" Autosampler	Hewlett Packard	G2614A	US80600251	1998	NEW
GC/MS – "I"	Hewlett Packard	5973	CN10514049	2005	NEW
GC/MS – "I" GC System	Hewlett Packard	G2579A	US44621455	2005	NEW
GC/MS – "I" Series Injector	Hewlett Packard	7683	CN51224243	2005	NEW
GC/MS – "I" Autosampler	Hewlett Packard	G2614A	CN42229061	2005	NEW
GC/MS – "X"	Agilent	5973	US10461280	2008	NEW
GC/MS – "X" GC System	Agilent	6890N	US10144027	2008	NEW
GC/MS – "X" Series Injector	Tekmar	7683	US01330017	2008	NEW
GC/MS – "X" Autosampler	IO	G2614A	1411	2008	NEW
LC/MS/MS – "R" Mass Spectrometer	Waters	Quattro Premier XE	VAB461	2006	NEW
LC/MS/MS – "R" Liquid Chromatograph	Waters	Acquity PDA Detector	L05UPD807N	2006	NEW
LC/MS/MS – "R" Liquid Chromatograph	Waters	Acquity Sample Manager	60UPS056M	2006	NEW
LC/MS/MS – "R" Liquid Chromatograph	Waters	Acquity Binary Solvent Man.	C06UPB008M	2006	NEW
LC/MS/MS – "T" Mass Spectrometer	Micromass	Ultima	VB280	2008	NEW

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
LC/MS/MS – "T" Liquid Chromatograph	Waters	Acquity Sample Manager	H07UPA802M	2008	NEW
LC/MS/MS – "T" Liquid Chromatograph	Waters	Acquity Binary Solvent Man.	H07UPB932M	2008	NEW
GC – "L"	Hewlett Packard	5890	2413A04451	1987	NEW
GC – "L" Autosampler	Varian	Archon	160098	2000	NEW
GC – "L" Concentrator	Tekmar	LSC3000	93300001	1997	NEW
GC – "A"	Hewlett Packard	5890	2843A19513	1987	NEW
GC – "A" Autosampler	Hewlett Packard	7673A	2718A09724	1987	NEW
GC – "F"	Hewlett Packard	5890	2623A08611	1998	NEW
GC – "F" Autosampler	Hewlett Packard	7673A	2718A07794	1998	NEW
GC – "K"	Agilent	6890	US00039258	2000	NEW
GC – "K" Autosampler	Agilent	7683	US04709936	2000	NEW
GC – "E"	Hewlett Packard	6890	US00011425	2000	NEW
GC – "E" Autosampler	Hewlett Packard	6890	US71701354	2000	NEW
GC – "M"	Agilent	6890	US10328036	2003	NEW
GC – "M" Autosampler	Agilent	7683	CN32624339	2003	NEW
GC – "O"	Agilent	6890	CN10422045	2004	NEW
GC – "O" Autosampler	Agilent	7683	CN51132513	2004	NEW
GC – "P"	Agilent	6890N	CN10510018	2005	NEW
GC – "P" Autosampler	Agilent	7683	CN51532846	2005	NEW
HPLC – "N"	Hewlett Packard	G1329A	DE91603153	1999	NEW
HPLC – "N" ALS Therm	Hewlett Packard	G1330A	DE82203165	1999	NEW
HPLC – "N" COLCOM	Hewlett Packard	G1316A	DE91609858	1999	NEW
HPLC – "N" DAD	Hewlett Packard	G1315A	DE91605478	1999	NEW
HPLC – "N" Degasser	Hewlett Packard	G1322A	JP73016399	1999	NEW
HPLC – "N" Quat Pump	Hewlett Packard	G1311A	DE91605960	1999	NEW
HPLC – "N" FLD	Hewlett Packard	G1321A	DE92001122	1999	NEW
HPLC – "Q"	Hewlett Packard	G1329A	DE14907901	1999	NEW
HPLC – "Q" ALS Therm	Hewlett Packard	G1330A	DE13201124	1999	NEW
HPLC – "Q" COLCOM	Hewlett Packard	G1316A	DE14924682	1999	NEW
HPLC – "Q" DAD	Hewlett Packard	G1315A	DE11113468	1999	NEW
HPLC – "Q" Degasser	Hewlett Packard	G1322A	JP05031929	1999	NEW
HPLC – "Q" Quat Pump	Hewlett Packard	G1311A	DE14916965	1999	NEW
HPLC – "Q" FLD	Hewlett Packard	G1321A	DE92001122	1999	NEW
ICP-MS – "6100"	Perkin Elmer	ELAN 6100	0859907	1999	NEW
ICP-MS – "6100" Autosampler	Perkin Elmer	AS-91	4123	1999	NEW
ICP – "61E"	Thermo Jarrell Ash	61E	30083	1987	NEW
ICP – "61T"	Thermo Jarrell Ash	61E trace	247390	1994	NEW
CVAA	Leeman Labs	Hydra AA	204112000641	2002	NEW
IC – "S" Chromatography Oven	Dionex	LC30	98070139	2008	NEW
IC – "S" Conductivity Detector	Dionex	CD20	99070231	2008	NEW
IC – "S" Gradient Pump	Dionex	GP50	99070382	2008	NEW
IC – "S" Autosampler	Dionex	AS40	00090205	2008	NEW
IC – "2500" Chromatography Oven	Dionex	LC25	03120540	2004	NEW
IC – "2500" Conductivity Detector	Dionex	CD25	03120540	2004	NEW
IC – "2500" Gradient Pump	Dionex	GP50	03120633	2004	NEW
IC – "2500" Autosampler	Dionex	AS40	07020461	2004	NEW
IC – "1500" Ion Chromatography System	Dionex	ICS-1500	03080236	2008	NEW
IC – "1500" Autosampler	Dionex	ASM-3	920937	2008	NEW
TOC	Shimadzu	TOC-5050A	36501107	1999	NEW
TOX	Mitsubishi	100 TOX	A7M00017	1999	NEW
UV Spec	Thermospectronic	Genysis	3SGF211001	2003	NEW
TRAACS – "1"	Technicon	Traacs 800	0103011	1988	NEW

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
TRAACS – "2"	Technicon	Traacs 800	054186	1988	NEW
BOD	Man-Tech Associates	04-227	270D3XB245	2003	NEW
Ignitability Apparatus: Open Cup	Fisher	D-92	906N0014	1998	NEW
Ignitability Apparatus: Closed Cup	Fisher	162	1149	1992	NEW
Alpha Spectrometer – "AV1–AV24" & "AV43–AV98"	EG& G / Ortec	Multi-Component	Multiple*	1987-2004	NEW
Gamma Spectrometer Intrinsic Germanium Detector "GE1-GE8"	Tennelec / Ortec	Multi-Component	Multiple*	1991-2003	NEW
GFPC – "Red"	Tennelec	LB4100	24645	1993	NEW
GFPC – "Protean"	Protean	MPC-9604	233126-BO 236534-BO 236532-BO 236533-BO	2003	NEW
GFPC – "Protean2"	Protean	MPC-9604	08217155 08217156 08217154 08217153	2008	NEW
GFPC	Tennelec	LB5100	31360	2000	NEW
LSC – "2200"	Packard	Tricarb 2200	86596	1985	NEW
LSC – "2550"	Packard	Tricarb 2550	400749	2000	NEW
LSC – "3170"	Packard	Tricarb 3170	429670/429774	2002	NEW
KPA	Chemchek	Multi-Component	93-45050051	2000	NEW

Table 21-2.

Schedule of Routine Maintenance

Inductively Coupled Plasma

DAILY OR AS NEEDED - CHECK
- Sample pump tubing/windings
- Gas supply
- Waste and rinse solution levels
- Sample capillary tubing
- Droplet size (nebulizer)
- Check nebulizer pressure
- Vacuum system pressure
- Replace orange/orange tubing

WEEKLY
- Check water level in coolflow
- HF nebulizer rinse
- Replace red/red tubing
- Clean injector tip

MONTHLY
- Clean air filter of power unit
- Clean plasma torch assembly

ANNUALLY
- Check vacuum system oil
- Replace coolant water filter

Inductively Coupled Plasma/Mass Spectrometer

DAILY OR AS NEEDED
- Waste and rinse water container levels
- Roughing pump oil level and color
- Torch and injector
- Replace sample, internal and waste lines

WEEKLY
- Clean interface cones

MONTHLY
- Change pump oil
- Clean auto lens

Cold Vapor Automatic Analysis

DAILY OR AS NEEDED
- Pump and drain tubing

- Gas pressure
- Instrument parameter check

MONTHLY
- Change sample, reductant and draining tubings

QUARTERLY
- Change drying tube

TOX

DAILY OR AS NEEDED
- Cell Performance Test
- Electrodes
- Cell Fluid, Dehydrating Fluid and Electrolyte
- Absorption module (cleaned at end of use)

Autoanalyzer Traacs- 1 & 2

DAILY OR AS NEEDED
- Air Pressure gauge
- Washout procedure (at end)

MONTHLY
- Change tubing

TOC

DAILY OR AS NEEDED
- Air Supply and Gas Flow Rate (150mm)
- Humidifier
- A/LS Rinse Tank
- 25% w/v H3PO4 in non-return trap

MONTHLY
- Rinse all lines and glassware
- Inspect SO3 scrubber – change if crystals at inlet are not white.
- Inspect halogen scrubber – change if black color approaches outlet end.

ANNUALLY
- Change CO2 absorber

Ion Chromatography

DAILY OR AS NEEDED
- Plumbing for leaks
- Gases and Pump Pressure

- Conductivity meter
- Fill eluent

KPA

DAILY OR AS NEEDED
- Rinse out Sample Cuvettes (after each use)

YEARLY
- Drain, rinse and refill Stilbene-90/Methanol Dye Cell
- Replace tubing line
- Oil Actuator arm sliding bars

UV Spec

DAILY OR AS NEEDED
- Rinse out Sample Cuvettes (after each use)

BOD

DAILY OR AS NEEDED
- Calibration
- Calibrate Probe
- Change membrane

Alpha Spectrometer

MONTHLY
- Backgrounds
- Calibrations
- Clean detectors

Gamma Spectrometer

DAILY OR AS NEEDED
- Delete log and list files (DLLF)
- Full Image Backup (FIB)

MONTHLY
- Clean Backgrounds
- Clean Cave

ANNUALLY
- Energy calibrations
- Efficiency calibrations

Gas Flow Proportional Counting

DAILY OR AS NEEDED
- Gas Flow

MONTHLY
- Long Backgrounds

ANNUALLY
- Calibrations

Liquid Scintillation Counter

WEEKLY OR AS NEEDED
- Clean Fan

YEARLY
- Serviced by Packard

Semi-volatile Gas Chomatography / Mass Spectrometer

DAILY OR AS NEEDED
- Gas supply, column flow and inlet pressure
- Fill solvent rinse vials

WEEKLY
- Injection Port Cleaning
- Change Septum, injection port liner, and seals

MONTHLY
- Trim Column

SEMI-ANNUALLY
- Replace Column
- Clean Source

ANNUALLY
- Replace pump oil

Volatile Gas Chomatography / Mass Spectrometer

DAILY OR AS NEEDED
- Gas supply, column flow and inlet pressure

QUARTERLY
- Trim Column
- Change Trap

SEMI-ANNUALLY
- Replace Column
- Clean Source
- Injection port maintenance

ANNUALLY
- Replace pump oil

High Pressure Liquid Chromatograph (HPLC)

DAILY OR AS NEEDED
- Ensure column flow and pressure are correct
- Ensure HPLC solvents are sufficient to run
- Ensure proper DAD signals are on
- Visibly check for leaks

MONTHLY
- Change Purge Valve Frit

SEMIANNUALLY
- Change Guard Cartridge and Frit Cap

BIANNUALLY
- Replace Column
- Replace UV Source
- Replace Visible Source
- Replace Pump Seals

Semi-Volatile Gas Chromatograph (Dual ECD)

DAILY OR AS NEEDED
- Ensure column flow and inlet pressure are correct
- Ensure temperature for oven, inlet(s), and detector(s) are correct
- Ensure solvent rinse vials are full
- Ensure injection syringe is secure in tower and plunger is engaged

MONTHLY
- Replace injection port septum
- Visibly inspect injection port liner; replace if contaminated
- Remove injection syringe and ensure plunger is free moving
- Check system for leaks (injection port, detector(s) and any column connectors)

SEMIANNUALLY
- Perform Radioactive leak test

Semi-Volatile Gas Chromatograph (FID)

DAILY OR AS NEEDED

- Check gas supply, column flow, and inlet pressure
- Fill solvent rinse vials

MONTHLY
- Replace septum, injection port liner and seals
- Trim Guard Column

SEMIANNUALLY
- Replace Column

Volatile Gas Chromatograph

DAILY OR AS NEEDED
- Check gas supply, column flow and inlet pressure
- Change trap
- Trim column

SEMIANNUALLY
- Replace Column
- Injection port maintenance

ANNUALLY
- Clean PID

Liquid Chromatograph Mass Spectrometer Mass Spectrometer (LCMSMS)

DAILY OR AS NEEDED
- Check level of solution in reservoirs
- Check gas supply, column flow and system pressure
- Bubble removal with solvent flush
- Sonicate inlet filters
- Sonicate inlet check values
- Replace PDA lamp
- Clean ionization probes / corona pin
- Ballast Rough Pump

SEMIANNUALLY
- Replace Column
- Clean source
- Injector maintenance

ANNUALLY
- Replace pump oil
- UPLC Pump Preventative Maintenance

Table 21-3.

Example: Periodic Calibration

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using A2LA-accredited NIST weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Each day of use	± 0.1% (DoD requires ± 0.1% or ±0.05 mg, whichever is greater)	Clean, check level, insure lack of drafts, and that unit is warmed up, recheck. If fails, call service.
Top Loading Balance	Accuracy determined using A2LA-accredited NIST weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually. A second annual inspection and calibration by same firm.	Each day of use	± 1.0% (DoD requires ± 2% or ±0.02 g, whichever is greater)	Clean. Replace.
A2LA-accredited NIST Weights	Accuracy determined by accredited weights and measurement laboratory.	5 years	As per certificate.	Replace.
NIST-Traceable Thermometer	Accuracy determined by A2LA-accredited weights and measurement laboratory.	5 years	As per certificate.	Replace.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 1.0°C	Replace
Digital thermometer	Against NIST-traceable thermometer	Quarterly	± 1.0°C	Replace

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again after several hours	0 - 6°C	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Freezer	Temperature checked using NIST-traceable thermometer	Daily. If out of range, check again after several hours	<-10°C	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	104 ± 1°C (drying) 180 ± 2°C (TDS)	Adjust. Replace.
Incubator	Temperature checked using NIST-traceable thermometer.	When in use. For microbi-ology, twice daily when in use.	BOD: 20 ± 1.0°C	Adjust. Replace.
Water Bath	Temperature checked using NIST-traceable thermometer.	When in use.	± 5°C	Adjust. Replace.
Volumetric Dispensing Devices - pipettes	One delivery by weight. Using DI water, dispense into tared vessel. Record weight with device ID number. Before first use: 10 replicate measurements with %RSD ≤ 1%.	Day of use	± 1% Calculate accuracy by dividing weight by stated volume times 100 for percent.	Adjust. Replace.
Volumetric glassware	The laboratory uses only Class A volumetric glassware. Calibration not required	N/A	Check for deterioration	Replace
Glass Microliter Syringes	None	Accuracy must be initially de-monstrated if syringe was not received with a certificate attesting to established accuracy.	± 1%	Not applicable.
Conductivity Meter	Cell impedance calibrated with three KCl standards.	Each use.	r ≥ 0.99	Recalibrate.

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Deionized Water	Check in-line conductivity meter on system with conductivity meter in Inorganics Department.	Daily	<10 µmhos/cm^2	Record on log. Report discrepancies to QA Director.

Table 21-4 Radiochemistry Calibration, Verification & Background Criteria

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria
Gamma Spectroscopy	Initial Calibration	Energy calibrations shall be established for the germanium spectroscopy systems **annually**, or when the calibration quality control check indicates an unacceptable change in the energy calibration parameters.	The curve should have eight calibration points used to determine the energy relationship of the calibration. The calibration source must have radionuclides that "blanket" the intended range of calibration. The energy difference should be less than 0.1 for all points. Computed efficiency test for all points should have a percent difference less than 5%. The FWHM must be less than 3.0 keV at 1332 keV. FWHM difference should be less than 0.500 for all points.
Gamma Spectroscopy	Initial Background	Background subtraction spectrum shall be established for the germanium spectroscopy systems **monthly**, or when the background quality control check indicates an unacceptable change in the daily background parameters, or as needed per client requirements.	Background count time is 12 hours.
Gamma Spectroscopy	Continuing	Daily Checks The energy, resolution and efficiency calibrations for a detector shall be checked with its respective source each day that the germanium spectroscopy system is used. The detector background shall be checked each day that the germanium spectroscopy system is used.	Calibration (efficiency, resolution, energy alignment, and background) quality control parameters will be found **not acceptable** if the result is outside the established limits (2 to range) and marked as "action". The Daily QC check may only be recounted once without corrective action.
Alpha Spectroscopy	Initial Calibration	Energy calibrations shall be established for the alpha spectroscopy systems **monthly**, or when the calibration quality control check indicates an unacceptable change in the energy calibration parameters. Efficiency calibrations shall be established for the alpha spectroscopy systems **monthly**, or when the calibration quality control check indicates an unacceptable change in the efficiency calibration parameters.	Energy Calibrations shall be performed using at least three isotopes within the energy range of 3-6 meV. Final peak energy positions of all observed isotopes shall be within +/- 40 leV of expected energy.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria
Alpha Spectroscopy	Initial Background	Background subtraction spectrum shall be established for the alpha spectroscopy systems **monthly**, or when the background quality control check indicates an unacceptable change in the daily background parameters.	Background count time is 960 minutes.
Alpha Spectroscopy	Continuing	Daily Checks Routine pulser quality control verifications are to performed each day of use. The pulser energy, peak centroid, peak resolution, peak area quality control for a detector shall be checked each day that the alpha spectroscopy system is used.	Routine calibration, background and pulser quality control parameters using the "Boundary" out-of-range test will be found unacceptable if the value is outside reasonable parameter tolerance. The routine quality control check should be rerun to determine the statistical significance of the errant parameter.
Gas Flow Proportional Counter	Initial Calibration	Mass attenuation alpha/beta curves should be performed on an **annual** basis, or when the calibration quality control check indicates an unacceptable change in the efficiency calibration parameters.	The efficiency calibration shall consist of at least seven single or dual sets of mass attenuated calibration standards. The standards shall have enough activity to generate at least 10000 counts in 90 minutes of count time for the most highly attenuated source. The count rate shall not exceed 5000 counts per second. The coefficient of determination (r^2) shall be greater than or equal to 0.9.
Gas Flow Proportional Counter	Initial Background	Background established for the GFPC **monthly**, or when the background quality control check indicates an unacceptable change in the daily background parameters.	Backgrounds are counted for 1000 minutes Alpha < 0.2 counts per minute Beta < 2.0 counts per minute
Gas Flow Proportional Counter	Continuing	Daily Checks Efficiency check and background check	

SECTION 22

MEASUREMENT TRACEABILITY
(NELAC 5.5.6)

22.1 OVERVIEW

- Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards.
- Class A Glassware should be routinely inspected for chips, acid etching or deformity. If Class A glassware is suspect, the accuracy of the glassware will be assessed prior to use.

22.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

The calibration report or certificate submitted to TestAmerica St. Louis contains, in a well designed format, a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. All calibration reports are filed in the QA Office.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

22.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials and have a Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard's Log generated Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number. Reference standards that are used in a radiochemical laboratory shall be obtained from NIST, or suppliers who participate in supplying NIST standards or NIST traceable radionuclides. When a traceable standard is not available written approval for its use must be obtained from DOE clients.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. Radiochemical Standards must be verified prior to initial use. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the corporate Environmental Health and Safety Manual and the analytical method SOPs "Standards and Reagents" section for additional details. Radiochemical Standards and reference material are stored separately from samples and are protected in a controlled cabinet or refrigerator. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

22.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. Purchased stock mixtures and reagents are labeled to indicate the date they are opened. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. Refer to SOP No. CA-Q-S-001, Solvent and Acid Lot Testing and Approval.

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in a directory on the laboratory's network drive. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on

documentation and labeling, please refer to method specific SOPs and ST-QA-0002, "Standards and Reagent Preparation".

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial.

22.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's Standards Log Program database, and are assigned a unique identification number. The following information is typically recorded in the electronic database

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

22.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date
- Standard ID assigned by the Standards Log Program

- Special Health/Safety warnings if applicable

22.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable) required by DOE
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include a preparation date, expiration date and an ID number to trace back to preparation. The expiration date of a secondary standard can not exceed the expiration date of the primary standard.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods; and 3) according to the Standards and reagents section of the laboratory's analytical SOPs.

SECTION 23.0

SAMPLING
(NELAC 5.5.7)

23.1 OVERVIEW

TestAmerica St. Louis does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory

23.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

23.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

23.2.2 Preparing Container Orders

When new containers arrive at the laboratory, the date of receipt is recorded on the packing list received with them for retained documentation. Upon request, the containers are then sent to clients for use in collecting samples. The shipping date, type and number of containers are maintained on file by the lab. Shipping personnel insure that container stock is rotated so that "first in" is "first out." When a client requests containers, a Project Manager creates a "Bottle Order" request. Copies of this request are printed or e-mailed to the Sample Control department. One copy goes to the client with the containers; one copy is filed in the Sample Control. See SOP ST-PM-0003, "Bottle Kit Preparation".

The laboratory also provides EnCore, TerraCore or other soil sampling devices when requested.

If containers are provided directly to the client from the manufacturer or from other sources, the laboratory will not be responsible for any of the above records.

23.3 FIELD QUALITY CONTROL (QC)

Common field quality control samples are defined in the following paragraphs. The frequency of field quality control samples should be specified in the site specific Quality Assurance Project Plan (QAPP) or by the client. TestAmerica provides trip blanks for VOC analysis with the sample containers for all volatile organic analyses. Blanks generated in the field will be analyzed along with the field samples (exception soil samples where the blank is aqueous).

23.3.1 Equipment Blank / Rinsate Blank - The equipment blank, sometimes referred to as a rinsate blank, is a sample of the water used to decontaminate sampling equipment. The source water should be as free of target analytes as possible. An aliquot of this water is poured over or through the sample collection device after decontamination, collected in a sample container, preserved with appropriate reagents, and returned to the laboratory. This serves as a check on sampling device cleanliness, and will also be affected by the site and sample handling conditions evaluated by the other types of blanks. The sampling time for the equipment blank should begin when the equipment is rinsed and the water is collected.

23.3.2 Field Blank - The field blank is water that is as free of target analytes as possible and from the same source as the equipment blank. The water is poured into a sampling container at the sampling site, preserved with the appropriate reagents, and returned to the laboratory. This serves as a check on reagent and environmental contamination. The sampling time for the field blank should be when the blank is prepared in the field.

23.3.3 Trip Blank - The trip blank pertains to volatile analysis only. This serves as a check on sample contamination originating from sample transport, sample container contamination, shipping and storage, or from certain site conditions. Trip blanks are often referred to as travel blanks. They are prepared using pre-cleaned sample containers. They are filled with organic-free water (the source of the organic free water is the same source of water used to prepare volatile standards, method blanks, LCS and sample dilutions), sealed and taken into the field with the empty containers which will be used for sampling. The recommended frequency is one trip blank per cooler (in duplicate or triplicate), per volatiles method. Unless otherwise specified, the sampling time for the trip blank is the time of receipt at the laboratory (When the “Trip” ends).

23.3.4 Field Duplicates - Field duplicates are replicate samples collected from the same sampling point or location during a field collection event. This control sample is used to demonstrate the ability of both the sampling and analytical process to generate data of acceptable precision.

23.4 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the chain-of-custody (COC) form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g. 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis

include any necessary reanalysis. However there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

23.5 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

Preservation and holding time criteria are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time. The laboratory SOP ST-PM-0002 contains a table listing preservation, container and holding time information.

23.6 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

See SOP ST-QA- 0038, "Procedure for Compositing and Subsampling".

SECTION 24

HANDLING OF SAMPLES
(NELAC 5.5.8)

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

24.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 24-1.

24.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 24-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

The samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. Samples are only considered to be received by lab when personnel at the laboratory have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form.

24.1.2 Legal / Evidentiary Chain-of-Custody

The use of legal COC procedures may be required by some State or federal programs. The legal COC records shall establish an intact, continuous record of the physical possession, storage and disposal of sample containers, collected samples, sample aliquots and sample extracts or digestates. The COC records shall account for all time periods associated with the samples. Legal COC shall begin at the point established by the State or federal oversight program.

24.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures is described in SOP ST-PM-0002, "Sample Receipt and Chain of Custody".

24.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. Coolers received from a known or potential radiologically contaminated site are frisked prior to opening. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on a "Condition Upon Receipt Form" and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

24.2.1.1 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy that clearly outlines the circumstances under which samples shall be accepted or rejected. See Figure 24-3 for details.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

24.2.1.2 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

24.2.1.3 For samples from a potentially radiocactive site, an aliquot is removed from the container to perform a “rad screen”.

24.2.1.4 Any deviations from these checks that raise question as to the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMs according to SOP ST-PM-0002.

24.3 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators suitable for the sample matrix. Metals samples are stored unrefrigerated. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples having high levels of radiochemical contamination are labeled as such. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed every two weeks.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample, and return the remaining sample or empty container to the refrigerator from which it originally came. All unused portions of samples, including empty sample containers, are returned to the secure sample control area. All samples are kept in the refrigerators for two to four weeks after analysis, which meets or exceeds most sample holding times. After two to four weeks the samples are moved to dry room temperature sample archive area where they are stored for an additional four weeks before they are disposed of. This eight week holding period allows samples to be checked if a discrepancy or question arises. Special arrangements may be made to store samples for longer periods of time. This extended holding period allows additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only.

Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

24.4 HAZARDOUS SAMPLES AND FOREIGN SOILS

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples known to be hazardous at the time of receipt or, if after completion of analysis the result exceeds the acceptable regulatory levels, are labeled as such. Potentially radioactive samples are "screened" prior to release to the lab. The RAD Category is entered into the LIMs system and alerts the analyst to the radiation level associated wit the sample. The sample itself is clearly marked "FOREIGN SOIL" if applicable. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory. Foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility. See SOPs ST-HS-0006, "Quarantine Soils Procedure" and the Radiation Protection SOPs for more details.

Radioactive and hazardous materials management practices as well as laboratory environmental health and safety requirements for the laboratory are described in laboratory SOPs. See Appendix 9 for listing of the laboratory's SOPs.

24.5 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

24.6 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP ST-HS-0004, "Hazardous Waste Management Plan". All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record (Figure 24-2) should be completed.

Figure 24-1.

Example: Chain of Custody (COC)

TestAmerica St. Louis Chain-of-Custody Record

13715 Rider Trial North
Earth City, MO 63045
Phone: 314-298-8566 Fax: 314-298-8757

Customer Information		Project Information		Analyses / Method Requested
Project Name		Purchase Order		A.
PM/ Quote#		Work Order		B.
Company		Bill To		C.
Send Report To:		Invoice Attn		D.
Address:		Address:		E.
				F.
City/State/Zip		City/State/Zip		G.
Phone		Phone		H.
Fax		Fax		I.

Sx No.	Sample Description	Sample Date	Sample Time	Sample Matrix	Container Type	Preservative	No. of Bottles	A	B	C	D	E	F	G	H	I	Comments
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

	Shipment Method:	Airbill No.:	Required Turnaround:

Relinquished by:	Date	Relinquished by:	Date	Relinquished by:	Date
Company Name:	Time	Company Name:	Time	Company Name:	Time
Received by:	Date	Received by:	Date	Received by:	Date
Company Name:	Time	Company Name:	Time	Company Name:	Time

Figure 24-2.

Example: Sample Disposal Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Sample Audit Report

TestAmerica St. Louis
13715 rider Trail North
Earth City, MO 63045

Sample ID	Lot#	Work Order	ClientID	ClientCode	QuoteNo	EventID	TransferTime	UserID	Disposal Drum ID	ContainerID	Type	UserName	ContainerType	StorageLocation	ClientName

Figure 24-3.

Example: Sample Acceptance Policy

TestAmerica St. Louis
Sample Acceptance Policy

NELAC specifies requirements under which any NELAC accredited laboratory will accept samples. TestAmerica St. Louis will review your sample shipment against those requirements listed below, and will communicate any discrepancies to you. Your project manager will assist you in the appropriate resolution of any issues related to sample receipt. Please contact your project manager with any questions.

When completing the chain of custody form, sign your name in the "relinquished by" box.

NELAC requirements are as follows:

- Proper, full and complete documentation, which includes sample identification, the location, date and time of collection, the collector's name, the preservation type, the sample matrix type, the requested testing method, and any special remarks concerning the samples shall be provided.
- Each sample shall be labeled with unique, durable and indelible identification.
- The samples shall be collected in the appropriate sample containers.
- The samples shall arrive at the laboratory within the specified holding time for the analyses requested.
- Sufficient sample volume must be available to perform the requested analyses.
- The laboratory will notify the client upon sample receipt if the samples exhibit obvious signs of damage, contamination or inadequate preservation.

Figure 24-3a.

DoD QSM SAMPLE ACCETANCE POLICY:

NELAC specifies requirements under which any NELAC accredited laboratory will accept samples. TestAmerica St. Louis will review your sample shipment against those requirements listed below, and will communicate any discrepancies to you. Your project manager will assist you in the appropriate resolution of any issues related to sample receipt. Please contact your project manager with any questions.

When completing the chain of custody form, sign your name in the "relinquished by" box.

NELAC requirements are as follows:

-Proper, full and complete documentation, which includes sample identification, the location, date and time of collection, the collector's name, the preservation type, the sample matrix type, the requested testing method, and any special remarks concerning the samples shall be provided.
-Each sample shall be labeled with unique, durable and indelible identification.
-The samples shall be collected in the appropriate sample containers.
-The samples shall arrive at the laboratory within the specified holding time for the analyses requested.
-Sufficient sample volume must be available to perform the requested analyses.

The laboratory will notify the client upon sample receipt if the samples exhibit obvious signs of damage, contamination or inadequate preservation. Samples shall be considered “compromised” if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond holding time.
- Samples are received without appropriate preservative.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When “compromised” samples are received, it must be documented on a Condition Upon Receipt Form (CUR) for the project records and the client must be contacted for instructions. If the client decides to proceed with analysis, the project report shall clearly indicate any of the above conditions and the resolution.

For DoD QSM project work, sample containers must be certified to meet the “less than” ½ the RL criteria for the analytes of concern. Analytes for which this certification can not be obtained will be noted in the Case Narrative. Upon DoD project approval, the laboratory will analyze method blanks prepared in the containers of concern, qualify and narrate the sample analytes which do not meet the criteria, or take other appropriate action as determined by the DoD project site.

SECTION 25.0

ASSURING THE QUALITY OF TEST RESULTS
(NELAC 5.5.9)

25.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 21, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

25.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

25.3 NEGATIVE CONTROLS

Table 25-1.

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 25-1.

Control Type	Details
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses. Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually the client sample ID will provide information to identify the field blanks with labels such as “FB”, “EB, or “TB”.

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

25.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP

25.4.1 Method Performance Control - Laboratory Control Sample (LCS)

25.4.1.1 The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

25.4.1.2 The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the

associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

25.4.1.3 Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

25.4.1.4 The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

25.4.1.5 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

25.4.1.5.1 For methods that have 1-10 target analytes, spike all components.

25.4.1.5.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

25.4.1.5.3 For methods with more than 20 target analytes, spike at least 16 components.

25.4.1.5.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

25.4.1.5.5 Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis

25.5 SAMPLE MATRIX CONTROLS

Table 25-2. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.
Tracers and Carriers	Use	chemically mimic and do not interfere with the target analytes through radiochemical separations. Isotopic tracers are typically radioactive materials while carriers are typically non-radioactive
	Typical Frequency 1	Added to each client sample, blank, LCS and matrix QC sample, as required by the specific method
	Description	added to samples to determine the overall chemical yield of the analytical preparation steps. Each sample is spiked separately with the same material and individual sample yields are determined. The tracer/carrier is added to the sample at the very beginning of the preparation steps. For solids, the tracer/carrier is added after grinding, but before muffling or dissolution

[1] See the specific analytical SOP for type and frequency of sample matrix control samples

[2] LCSDs are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must mee thte same laboratory eastablished recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as “Relative Percent Difference (RPD). Poor precsion between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

25.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

25.6.1 As mandated by the test method and regulation, each individual analyte in the LCS, MS or surrogate spike is evaluated against the control limits published in the test method.

Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

25.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on a semi-annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

25.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

25.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

25.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If the laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternative analytical method.

25.6.3.3 The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

25.6.3.4 The maximum acceptable recovery limit will be 150%.

25.6.3.5 The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

25.6.3.6 If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

25.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

25.6.4.1 The QA department generates a Quality Control Limit Summary that contains tables that summarize the precision and accuracy acceptability limits for analyses performed at TestAmerica St. Louis. This summary includes an effective date, is updated each time new limits are generated and is located within the QC Browser

program on the network. Copies are also included in the method SOPs and are updated when the SOP is updated. Unless otherwise noted, limits within these tables are laboratory generated. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Director and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory. Limits can also be found in archived SOPs.

25.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 13) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

25.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

25.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

25.6.5.3 Or, for NELAC and Departement Of Defense (DOD) work, there are an allowable number of Marginal Exceedances (ME):

- <11 analytes – 0 marginal exceedances are allowed.
- 11 – 30 Analytes – 1 marginal exceedance is allowed
- 31-50 Analytes – 2 marginal exceedances are allowed
- 51-70 Analytes – 3 marginal exceedances are allowed
- 71-90 Analytes – 4 marginal exceedances are allowed
- > 90 Analytes – 5 marginal exceedances are allowed

25.6.5.3.1 Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (NELAC).

25.6.5.3.2 Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.

25.6.5.3.3 Though marginal excedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

25.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the method SOPs.

25.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

If radiochemical tracer or carrier recovery is outside limits the sample is re-analyzed to confirm matrix interference. If the recoveries confirm or there was obvious interference, results are reported from the original analysis and a note is included in the case narrative. If the reanalysis meets recovery criteria, the second run is reported (or both are reported if requested by the client). When samples are non-detect for the target analytes and the carrier/tracer recovery indicates a high bias in the analysis, the samples are not rerun unless required by a client.

25.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

25.7.1 The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 21), use of certified reference materials (see Section 22) and use of PT samples (see Section 16).

25.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 20.

25.7.3 Use of formulae to reduce data is discussed in the method standard operating procedures.

25.7.4 Selection of appropriate reagents and standards is included in Section 9 and 22.

25.7.5 A discussion on selectivity of the test is included in Section 5.

25.7.6 Constant and consistent test conditions are discussed in Section 19.

25.7.7 The laboratories sample acceptance policy is included in Section 24.

SECTION 26.0

REPORTING RESULTS
(NELAC 5.5.10)

26.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is a conflict between the client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

Review of reported data is included in Section 20.

26.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

26.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

26.2.2 The report cover page is printed on company letter head which includes the laboratory name, address and telephone number.

26.2.3 A unique identification of the report (e.g. lot number or SDG number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

26.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.
- Any additional addenda to the report must be treated in a similar fashion so it is a recognizable part of the report and cannot accidentally get separated from the report (eg. Sampling information).

26.2.5 The name and address of client and a project name/number, if applicable.

26.2.6 Client project manager or other contact

26.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

26.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

26.2.9 Date reported or date of revision, if applicable.

26.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

26.2.11 Practical quantitation limits or reporting limit.

26.2.12 Method detection limits (if requested)

26.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

26.2.14 Sample results.

26.2.15 QC data consisting of method blank, surrogate, tracer/carrier, LCS, and MS/MSD recoveries and control limits.

26.2.16 Condition of samples at receipt including temperature. This is accomplished by attaching sample login sheets (Refer to Sec. 26.2.4 – Item 3 regarding additional addenda).

26.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

26.2.18 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

26.2.19 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not. The following statement is included with the Case Narrative: The test results in this report meet all NELAP requirements for parameters in which accreditations are held by TestAmerica St. Louis. Any exceptions to NELAP requirements are noted in the case narrative. The case narrative is an integral part of this report.

26.2.20 A narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

26.2.21 When Soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

26.2.22 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

26.2.23 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., preliminary data). A complete report must be sent once all work as been completed.

26.2.24 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (no. CA-I-P-002) for details on internally applying electronic signatures of approval.

26.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica St. Louis offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 26.2 above.
- Level II is a Level I report plus summary information, including results for the method blank, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms where available, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. All faxed reports are followed by hardcopy. Procedures used to ensure client confidentiality are outlined in Section 26.7.

26.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. TestAmerica St. Louis offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.
EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD

format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

26.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

26.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

26.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet NELAC sample acceptance requirements such as improper container, holding time, or temperature.

26.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

26.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

26.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in Section 8.

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of the TestAmerica network are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

26.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

26.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

Confidentiality Notice: The information contained in this message is intended only for the use of the addressee, and may be confidential and/or privileged. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender immediately.

26.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

26.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 13).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "Rev".

When the report is re-issued, a notation of "revised " is placed on the cover/signature page of the report and a brief explanation of reason for the re-issue is included in the beginning of the Case Narrative..

26.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

26.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

26.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

SECTION 27.0

REVISION HISTORY

27.1 CHANGES TO REVISION 0

27.1.1 Updated to conform with new Corporate Template. Information that was specific to the company at large, and less specific to the individual laboratory was removed from the template is now in the Corporate Quality Management Plan (CQMP).

27.1.2 The Quality Policy Statement was updated to include compliance with NELAC standards

27.1.3 Section 10 (Services to the Client) was merged with Section 7 (renamed).

27.1.4 Section 10 intentionally empty.

27.1.5 Section 16 (Audits) new text

27.1.6 Section 17 (Management Reviews) Details of QA report revised, some tables removed.

27.1.7 Section 21 Calibration information removed as it can be found in laboratory SOPs.

27.1.8 Radiochemistry equations in Appendix 6 updated.

27.1.9 Tables, figures and Appendices updated and re-numbered.

27.1.10 CHANGES to REVISION 1 (06/02/09)

27.1.10.1 Added reference to ASME NQA-1-2000 to Section 3.1
27.1.10.2 Updated to current Ethics Agreement in Appendix 1
27.1.10.3 Updated Radiochemistry calculations in Appendix 6

27.1.11 CHANGES to REVISION 2 (08/31/09)

27.1.11.1 Added reference to DoD QSM 4.1 to Section 3.1
27.1.11.2 Updated QA Manager job description in Section 4.2.3
27.1.11.3 Updated Laboratory Organization Chart
27.1.11.4 Added Quality Program Objectives to Section 5.1; clarified staff responsibilities regarding QA documents
27.1.11.5 Added QAM review cycle to Table 16-1
27.1.11.6 Added Freezer temperature criteria to Section 21.3.4
27.1.11.7 Updated Calibration information in table 21-3
27.1.11.8 Added current Florida NELAC certificate to Appendix 3
27.1.11.9 Signatures moved from Title Page to cover per DoD requirements

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Employee Printed Name_____

EMPLOYEE ETHICS STATEMENT

I understand that TestAmerica is committed to ensuring the highest standard of ethical and professional conduct in all business activities. The Company and its employees will comply with all applicable laws, regulations and policies. We will ensure the highest standards of quality and integrity of the data and services provided to our clients. I have read the Ethics Policy of the Company.

With regard to the duties I perform, the data I report in connection with my employment at the Company, and all business activities, I agree that:

- *I will not intentionally report data values that are inconsistent with the actual values observed or measured;*
- *I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations;*
- *I will not intentionally misrepresent another individual's work as my own or represent my own work as someone else's;*
- *I will not intentionally misrepresent any data where data does not meet Method or QC requirements. If it is to be reported, I will report it with all appropriate notes and/or qualifiers; I shall not modify data (either sample or QC data) unless the modification can be technically justified through a measurable analytical process, such as one deemed acceptable to the laboratory's Standard Operating Procedures, Quality Assurance Manual or Technical Director. All such modifications must be clearly and thoroughly documented in the appropriate laboratory notebooks/worksheets and/or raw data and include my initials or signature and date.*
- *I shall not make false statements to, or seek to otherwise deceive, members of Management or their representatives, agents, or clients/customers in any aspect of my job, including timekeeping, accounting, and compliance with all safety, environmental and employment regulations.*
- *I will not, through acts of commission, omission, erasure, or destruction, improperly report measurement standards, quality control data, test results or conclusions; nor will I intentionally alter or omit dates, dollar values or other business related information in order to achieve desired financial results.*
- *I shall not compare or disclose results for any Proficiency Testing (PT) sample, or other similar QA or QC requirements, with any employee of any other laboratory, including any other TestAmerica laboratory, prior to the required submission date of the results to the person, organization, or entity supplying the PT sample.*
- *I shall immediately inform my supervisor or other member of management regarding any intentional or unintentional reporting of my own inauthentic data. Such report shall be given both orally and in writing to the supervisor or other member of management contacted and to the local Quality Assurance Officer/Manager. The Quality Assurance Officer/Manager will initial and date the information and return a copy to me; I shall not condone any accidental or intentional reporting of inauthentic data by other employees and will immediately report its occurrence. If I have actual knowledge of such acts committed by any other employees, and I do not report such information to designated members of Management, it shall be considered as serious as if I personally committed the offense. Accordingly, in that event, I understand that I may be subject to immediate termination of employment.*
- *I understand that if any supervisor, manager, or representative of TestAmerica management instructs, requests, or directs me to perform any of the aforementioned improper laboratory practices or illegal or unethical business activities, or if I am in doubt or uncertain as to whether or not such laboratory practices or business activities are proper, I will not comply. In fact, I must report such event to all appropriate members of Management including, but not limited to, the Lab Director, all supervisors and managers with direct line reporting relationship between me and the Lab Director, and the local Quality Assurance representative, excluding such individuals who participated in such perceived improper instruction, request, or directive. In addition, I may contact Corporate Quality Assurance / Ethics Compliance Officer(s) for assistance.*

Company Confidential & Proprietary

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

- *I understand the critical importance of accurately reporting data, measurements, and results, whether initially requested by a client, or retained by TestAmerica and submitted to a client at a later date, or retained by TestAmerica for subsequent internal use;*
- *I will not share the pricing or cost data of Vendors or Suppliers with anyone outside of the TestAmerica family of companies.*
- *I shall not accept gifts of a value that would adversely influence judgment.*
- *I shall avoid conflicts of interest and report any potential conflicts to the management (e.g., employment or consulting with competitors, clients, or vendors);*
- *I shall not participate in unfair competition practices (e.g., slandering competitors, collusion with other labs to restrict others from bidding on projects);*
- *I shall not misrepresent certifications and status of certifications to clients or regulators;*
- *I shall not intentionally discharge wastes illegally down the drain or onto the ground.*
- *I shall not take any action, personally, or on behalf of the Company, which violates any applicable law, regulation, or internal policy, or which causes the Company to incur financial risk or loss or causes the Company to report incorrect financial information.*
- *I understand that any attempt by management or an employee to circumvent these policies will be subject to disciplinary action.*

As a TestAmerica employee, I understand that I have the responsibility to conduct myself with integrity in accordance with the ethical standards described in the Ethics Policy. I will also report any information relating to possible kickbacks or violations of the Procurement Integrity Act, or other questionable conduct in the course of sales or purchasing activities. I will not knowingly participate in any such activity and will report any actual or suspected violation of this policy to management.

I understand that all of my dealings as an employee must be in compliance with applicable Federal and State laws, including safety regulations, environmental regulations, accounting rules, and employment laws, such as the Drug Free Workplace Act and anti-discrimination and harassment legislation.

I understand that if my job includes supervisory responsibilities, I shall not instruct, request, or direct any subordinate to perform any laboratory practice which is unethical or improper. Also, I shall not discourage, intimidate, or inhibit an employee who may choose to appropriately appeal my supervisory instruction, request, or directive which the employee perceives to be improper, nor retaliate against those who do.

The Ethics Policy has been explained to me by my supervisor or at a training session, and I have had the opportunity to ask questions if I did not understand any part of it. I understand that any violation of this policy subjects me to disciplinary action, which can include termination. In addition, I understand that any violation of this policy which relates to work under a government contract or subcontract could also subject me to the potential for prosecution under federal law.

Employee Printed Name_____ Date_____

EMPLOYEE SIGNATURE _____ Date _____

Supervisor/Trainer: _____ Date _____

Company Confidential & Proprietary

TestAmerica

CONFIDENTIALITY AND PROPRIETARY INFORMATION AGREEMENT

TestAmerica and their predecessors, in their businesses, have developed and use commercially valuable technical and non-technical information and to guard the legitimate interests of TestAmerica and its clients, it is necessary to protect certain information as confidential and proprietary.

I, _____ , understand and acknowledge that during the term of my employment by TestAmerica, I will be privy to and entrusted with certain confidential information and trade secrets of TestAmerica and its clients.

Confidential information and trade secrets include, but are not limited to: customer and client lists; price lists; marketing and sales strategies and procedures; operational and equipment techniques; standard operating procedures; business plans and systems; quality control procedures and systems; special projects and technological research, including projects, research and reports for any government entity or client; client's plans and processes; client's manner of operation; the trade secrets of clients; client's data; vendor or supplier pricing; employee lists and personal information, and any other records, data, files, drawings, inventions, discoveries, applications, or processes which are not in the public domain.

I agree as follows:

1. I will not in any way, during the term of my employment, or at any time thereafter, except as authorized in writing by the Legal Department of TestAmerica or the client where client data is involved, disclose to others, use for my own benefit, remove from TestAmerica's premises (except to the extent off-site work is approved by my supervisor), copy or make notes of any confidential information and/or trade secrets of TestAmerica or its clients, excepting only that information which may be public knowledge. Technical and business information of any previous employer or other third party which I may disclose to TestAmerica shall be limited to that which was acquired legitimately and disclosed to me without restriction as to secrecy.

2. I agree that all inventions (whether or not patentable) conceived or made by me during the period of my employment by TestAmerica shall belong to TestAmerica, provided such inventions grow out of my work for TestAmerica and are related to the business of TestAmerica. I agree to disclose and assign such inventions to TestAmerica. In California, this provision shall not apply to any invention which qualifies fully under Section 2870 of the California Labor Code.

3. On termination of my employment from TestAmerica, I will deliver to TestAmerica all documents, records, notes, data, memoranda, files, manuals, equipment and things of any nature which relate in any way to confidential information and/or trade secrets of TestAmerica or its clients and which are in my possession or under my control.

4. I agree that during the period of my employment and for one (1) year from and after the termination (for any reason) of my employment with TestAmerica, I shall not directly or indirectly (without first obtaining the written permission of TestAmerica), recruit for employment, or induce to terminate his or her employment with TestAmerica, any person who is an active employee of TestAmerica on the last day of my employment with TestAmerica.

5. I acknowledge that if I were to breach any provision of this Confidentiality Agreement, money damages will be inadequate, and I hereby agree that TestAmerica shall be entitled, where appropriate, to specific performance and/or injunctive relief (i.e. to require me to comply with this Agreement). I further acknowledge that the willingness of TestAmerica to hire me or to continue my employment constitutes full and adequate consideration for the agreements, and obligations to which I have agreed as set forth in this document.

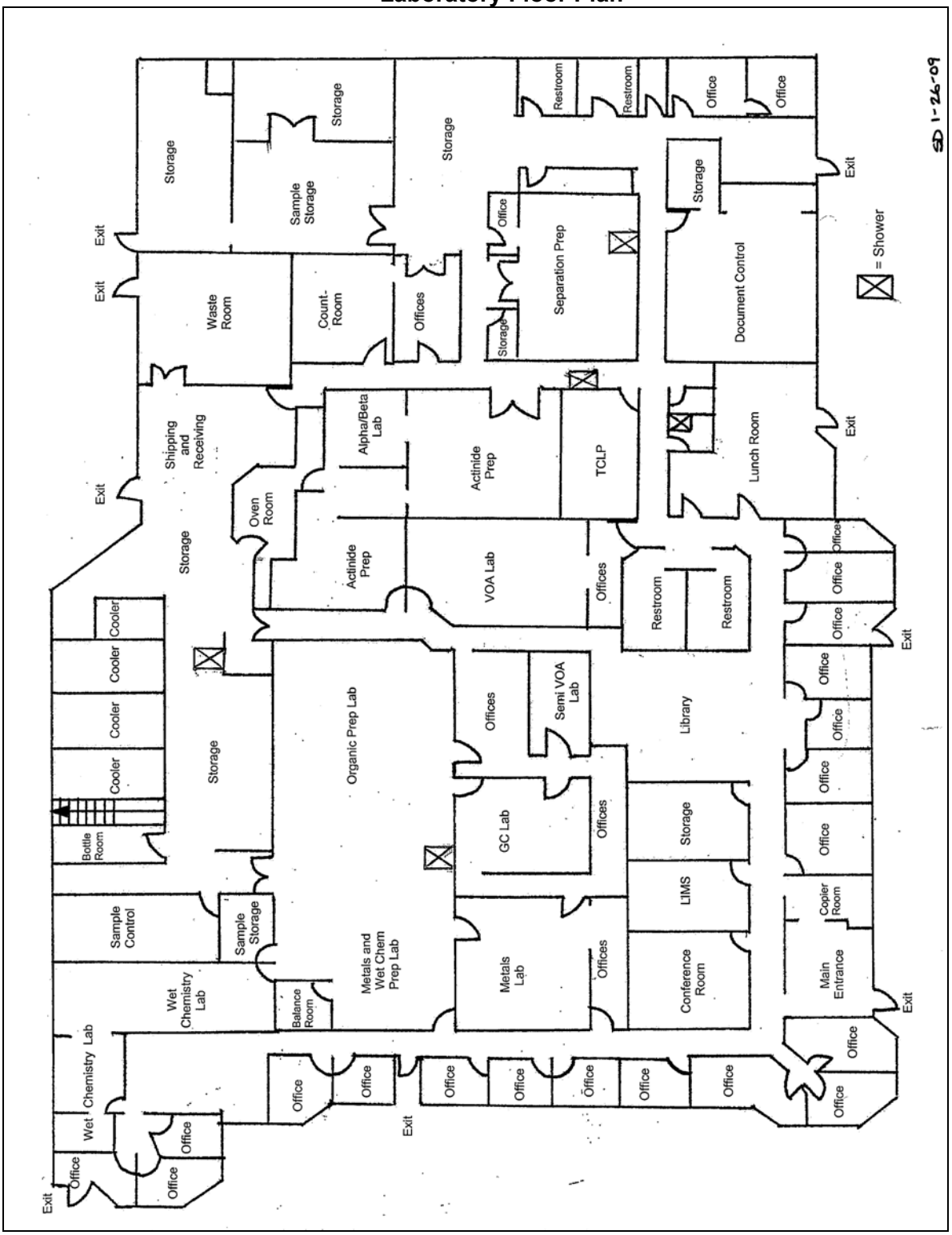
I have executed this Agreement, intending to be legally bound.

_____	_____	_____
Printed Name	*Signature*	*Date*

Work Instruction No. CA-WI-006

Appendix 2.

Laboratory Floor Plan



Appendix 3.
NELAC Certified Tests

FLORIDA DEPARTMENT OF HEALTH

State of Florida
Department of Health, Bureau of Laboratories
This is to certify that
E87689

TESTAMERICA ST. LOUIS
13715 RIDER TRAIL NORTH
EARTH CITY, MO 63045

has complied with Florida Administrative Code 64E-1,
for the examination of Environmental samples in the following categories

DRINKING WATER - GROUP II UNREGULATED CONTAMINANTS, DRINKING WATER - OTHER REGULATED CONTAMINANTS, DRINKING WATER - RADIOCHEMISTRY, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - RADIOCHEMISTRY, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - RADIOCHEMISTRY, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

EFFECTIVE July 24, 2009 THROUGH June 30, 2010

[redacted]

Chief, Bureau of Laboratories
Florida Department of Health
DH Form 1697, 7/04
NON-TRANSFERABLE E87689-19-07/24/2009
Supersedes all previously issued certificates

Charlie Crist
Governor

FLORIDA DEPARTMENT OF HEALTH

Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-19, expiration date June 30, 2010. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,1,1-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
1,1,2,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,1,2-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
1,1-Dichloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,1-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
1,1-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2,3-Trichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2,3-Trichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2,4-Trichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2,4-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
1,2-Dichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
1,2-Dichloropropane	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
1,3,5-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,3-Dichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,3-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
1,4-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
2,2-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
2-Butanone (Methyl ethyl ketone, MEK)	EPA 524.2	Group II Unregulated Contaminants	NELAP	12/10/2008
2-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
2-Hexanone	EPA 524.2	Group II Unregulated Contaminants	NELAP	12/10/2008
4-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
4-Isopropyltoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
4-Methyl-2-pentanone (MIBK)	EPA 524.2	Group II Unregulated Contaminants	NELAP	12/10/2008
Acetone	EPA 524.2	Group II Unregulated Contaminants	NELAP	12/10/2008
Benzene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Bromobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Bromochloromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Bromodichloromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Bromoform	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Carbon disulfide	EPA 524.2	Group II Unregulated Contaminants	NELAP	12/10/2008
Carbon tetrachloride	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Chlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003

Charlie Crist
Governor

FLORIDA DEPARTMENT OF HEALTH

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State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Chloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Chloroform	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
cis-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
cis-1,3-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Dibromochloromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Dibromomethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Dichlorodifluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Dichloromethane (DCM, Methylene chloride)	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Ethylbenzene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Gamma emitters	EPA 901.1	Radiochemistry	NELAP	6/5/2009
Gross-alpha	EPA 900.0	Radiochemistry	NELAP	12/10/2008
Gross-beta	EPA 900.0	Radiochemistry	NELAP	12/10/2008
Hexachlorobutadiene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Isopropylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Methyl bromide (Bromomethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Methyl chloride (Chloromethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Methyl tert-butyl ether (MTBE)	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Naphthalene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
n-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
n-Propylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Radioactive cesium	EPA 901.1	Radiochemistry	NELAP	12/10/2008
Radium-226	EPA 903.0	Radiochemistry	NELAP	12/10/2008
Radium-228	EPA 904.0	Radiochemistry	NELAP	12/10/2008
sec-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Strontium-90	DOE Sr-02	Radiochemistry	NELAP	12/10/2008
Strontium-90	DOE Sr-03-RC	Radiochemistry	NELAP	12/10/2008
Strontium-90	EPA 905.0	Radiochemistry	NELAP	12/10/2008
Styrene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
tert-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Tetrachloroethylene (Perchloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Toluene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
trans-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
trans-1,3-Dichloropropylene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Trichloroethene (Trichloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Trichlorofluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Tritium	EPA 906.0	Radiochemistry	NELAP	12/10/2008

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Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

Laboratory Scope of Accreditation

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State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Uranium	ASTM D5174-91	Radiochemistry	NELAP	12/10/2008
Uranium	EPA 200.8	Radiochemistry	NELAP	6/5/2009
Uranium	EPA 908.0	Radiochemistry	NELAP	12/10/2008
Vinyl chloride	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003
Xylene (total)	EPA 524.2	Other Regulated Contaminants	NELAP	7/17/2003

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State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260	Volatile Organics	NELAP	12/10/2008
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	2/13/2002
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002

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State Surgeon General

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State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	7/1/2003
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
2,3,4,6-Tetrachlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4,5-Trichlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	10/26/2005
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4,6-Trichlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-Diamino-6-nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-Dichlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-Dimethylphenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,6-Diamino-4-nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,6-Dichlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	2/13/2002
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Amino-4,6-dinitrotoluene (2-am-dnt)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2-Aminoanthraquinone	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloroethyl vinyl ether	EPA 624	Volatile Organics	NELAP	2/13/2002
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Chlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Hexanone	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Methyl-4,6-dinitrophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	12/10/2008
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	12/10/2008
2-Methylphenol (o-Cresol)	EPA 8041	Extractable Organics	NELAP	12/10/2008
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
2-Nitrophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	2/13/2002
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dimethoxybenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,5-Dinitroaniline	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
3/4-Methylphenols (m/p-Cresols)	EPA 8041	Extractable Organics	NELAP	12/10/2008
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	7/24/2006
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
3-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	12/10/2008
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Chloro-3-methylphenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
4-Nitrophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
4-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
a-a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 625	Extractable Organics	NELAP	2/13/2002
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Acetone	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetophenone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acrolein (Propenal)	EPA 624	Volatile Organics	NELAP	2/13/2002
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acrylonitrile	EPA 624	Volatile Organics	NELAP	2/13/2002
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Alkalinity as CaCO3	EPA 310.1	General Chemistry	NELAP	2/13/2002
Alkalinity as CaCO3	SM 2320 B	General Chemistry	NELAP	5/4/2007
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/2/2005

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State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-19, expiration date June 30, 2010. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Aluminum	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Aluminum	EPA 200.8	Metals	NELAP	2/13/2002
Aluminum	EPA 6010	Metals	NELAP	7/1/2003
Aluminum	EPA 6020	Metals	NELAP	7/1/2003
Ammonia as N	EPA 350.1	General Chemistry	NELAP	2/13/2002
Aniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 625	Extractable Organics	NELAP	2/13/2002
Anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Antimony	EPA 200.7	Metals	NELAP	2/13/2002
Antimony	EPA 200.8	Metals	NELAP	2/13/2002
Antimony	EPA 6010	Metals	NELAP	7/1/2003
Antimony	EPA 6020	Metals	NELAP	7/1/2003
Aramite	EPA 8270	Extractable Organics	NELAP	7/1/2003
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Arsenic	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Arsenic	EPA 200.8	Metals	NELAP	2/13/2002
Arsenic	EPA 6010	Metals	NELAP	7/1/2003
Arsenic	EPA 6020	Metals	NELAP	7/1/2003
Barium	EPA 200.7	Metals	NELAP	2/13/2002
Barium	EPA 200.8	Metals	NELAP	2/13/2002
Barium	EPA 6010	Metals	NELAP	7/1/2003
Barium	EPA 6020	Metals	NELAP	7/1/2003

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TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzene	EPA 624	Volatile Organics	NELAP	2/13/2002
Benzene	EPA 8021	Volatile Organics	NELAP	7/1/2003
Benzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Beryllium	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Beryllium	EPA 200.8	Metals	NELAP	2/13/2002
Beryllium	EPA 6010	Metals	NELAP	7/1/2003
Beryllium	EPA 6020	Metals	NELAP	7/1/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Biochemical oxygen demand	EPA 405.1	General Chemistry	NELAP	2/13/2002
Biochemical oxygen demand	SM 5210 B	General Chemistry	NELAP	5/4/2007
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 625	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	2/13/2002

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TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Boron	EPA 200.7	Metals	NELAP	2/13/2002
Boron	EPA 6010	Metals	NELAP	7/1/2003
Boron	EPA 6020	Metals	NELAP	7/24/2006
Bromide	EPA 300.0	General Chemistry	NELAP	2/13/2002
Bromide	EPA 9056	General Chemistry	NELAP	7/1/2003
Bromobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	2/13/2002
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromoform	EPA 624	Volatile Organics	NELAP	2/13/2002
Bromoform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Cadmium	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Cadmium	EPA 200.8	Metals	NELAP	2/13/2002
Cadmium	EPA 6010	Metals	NELAP	7/1/2003
Cadmium	EPA 6020	Metals	NELAP	7/1/2003
Calcium	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Calcium	EPA 6010	Metals	NELAP	7/1/2003
Calcium	EPA 6020	Metals	NELAP	11/7/2003
Carbazole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbon tetrachloride	EPA 624	Volatile Organics	NELAP	2/13/2002
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chemical oxygen demand	EPA 410.4	General Chemistry	NELAP	2/13/2002
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chloride	EPA 300.0	General Chemistry	NELAP	2/13/2002
Chloride	EPA 9056	General Chemistry	NELAP	7/1/2003
Chlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroethane	EPA 624	Volatile Organics	NELAP	2/13/2002
Chloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroform	EPA 624	Volatile Organics	NELAP	2/13/2002
Chloroform	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Chloroprene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chromium	EPA 200.7	Metals	NELAP	2/13/2002
Chromium	EPA 200.8	Metals	NELAP	2/13/2002
Chromium	EPA 6010	Metals	NELAP	7/1/2003
Chromium	EPA 6020	Metals	NELAP	7/1/2003
Chromium VI	EPA 7196	Metals	NELAP	7/1/2003
Chrysene	EPA 625	Extractable Organics	NELAP	2/13/2002
Chrysene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Chrysene	EPA 8310	Extractable Organics	NELAP	7/1/2003
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	2/13/2002
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Cobalt	EPA 200.7	Metals	NELAP	2/13/2002
Cobalt	EPA 200.8	Metals	NELAP	2/13/2002
Cobalt	EPA 6010	Metals	NELAP	7/1/2003
Cobalt	EPA 6020	Metals	NELAP	7/1/2003
Conductivity	EPA 120.1	General Chemistry	NELAP	2/13/2002
Conductivity	EPA 9050	General Chemistry	NELAP	7/1/2003
Copper	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Copper	EPA 200.8	Metals	NELAP	2/13/2002
Copper	EPA 6010	Metals	NELAP	7/1/2003
Copper	EPA 6020	Metals	NELAP	7/1/2003
Corrosivity (pH)	EPA 9040	General Chemistry	NELAP	7/1/2003
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diallate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenz(a,h)anthracene	EPA 625	Extractable Organics	NELAP	2/13/2002
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenz(a,h)anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	12/10/2008
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	2/13/2002
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dibromomethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	10/26/2005
Diethyl ether	EPA 8260	Volatile Organics	NELAP	7/1/2003
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	2/13/2002
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8041	Extractable Organics	NELAP	12/10/2008
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/2/2005
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethylbenzene	EPA 624	Volatile Organics	NELAP	2/13/2002
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	7/1/2003
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Famphur	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluoranthene	EPA 625	Extractable Organics	NELAP	2/13/2002
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 625	Extractable Organics	NELAP	2/13/2002

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Fluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Fluoride	EPA 300.0	General Chemistry	NELAP	2/13/2002
Fluoride	EPA 9056	General Chemistry	NELAP	7/1/2003
Gamma emitters	EPA 901.1	Radiochemistry	NELAP	12/10/2008
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/2/2005
Gasoline range organics (GRO)	EPA 8015	Volatile Organics	NELAP	10/26/2005
Gross-alpha	EPA 900.0	Radiochemistry	NELAP	12/10/2008
Gross-alpha	EPA 9310	Radiochemistry	NELAP	12/10/2008
Gross-beta	EPA 900.0	Radiochemistry	NELAP	12/10/2008
Gross-beta	EPA 9310	Radiochemistry	NELAP	12/10/2008
Hardness	EPA 130.2	General Chemistry	NELAP	2/13/2002
Hardness	SM 2340 C	General Chemistry	NELAP	5/4/2007
Heptachlor	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloroethane	EPA 625	Extractable Organics	NELAP	2/13/2002
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Ignitability	EPA 1010	General Chemistry	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	12/10/2008

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Iron	EPA 200.7	Metals	NELAP	2/13/2002
Iron	EPA 6010	Metals	NELAP	7/1/2003
Iron	EPA 6020	Metals	NELAP	11/7/2003
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isodrin	EPA 8270	Extractable Organics	NELAP	7/1/2003
Isophorone	EPA 625	Extractable Organics	NELAP	2/13/2002
Isophorone	EPA 8270	Extractable Organics	NELAP	12/10/2008
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isosafrole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Kepone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Lead	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Lead	EPA 200.8	Metals	NELAP	2/13/2002
Lead	EPA 6010	Metals	NELAP	7/1/2003
Lead	EPA 6020	Metals	NELAP	7/1/2003
Lithium	EPA 6010	Metals	NELAP	7/1/2003
m+p-Xylenes	EPA 8260	Volatile Organics	NELAP	7/24/2006
Magnesium	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Magnesium	EPA 200.8	Metals	NELAP	2/13/2002
Magnesium	EPA 6010	Metals	NELAP	7/1/2003
Magnesium	EPA 6020	Metals	NELAP	11/7/2003
Manganese	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Manganese	EPA 200.8	Metals	NELAP	2/13/2002
Manganese	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 6020	Metals	NELAP	7/1/2003
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Mercury	EPA 245.1	Metals	NELAP	2/13/2002
Mercury	EPA 7470	Metals	NELAP	7/1/2003
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methapyrilene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	2/13/2002
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	2/13/2002
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Charlie Crist
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Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-19, expiration date June 30, 2010. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methyl parathion (Parathion, methyl)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methylene chloride	EPA 624	Volatile Organics	NELAP	2/13/2002
Methylene chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Molybdenum	EPA 200.7	Metals	NELAP	2/13/2002
Molybdenum	EPA 200.8	Metals	NELAP	2/13/2002
Molybdenum	EPA 6010	Metals	NELAP	7/1/2003
Molybdenum	EPA 6020	Metals	NELAP	7/24/2006
Naphthalene	EPA 625	Extractable Organics	NELAP	2/13/2002
Naphthalene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Naphthalene	EPA 8310	Extractable Organics	NELAP	7/1/2003
n-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	7/1/2003
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Nickel	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Nickel	EPA 200.8	Metals	NELAP	2/13/2002
Nickel	EPA 6010	Metals	NELAP	7/1/2003
Nickel	EPA 6020	Metals	NELAP	7/1/2003
Nitrate	EPA 9056	General Chemistry	NELAP	7/1/2003
Nitrate as N	EPA 300.0	General Chemistry	NELAP	2/13/2002
Nitrate as N	EPA 353.1	General Chemistry	NELAP	2/13/2002
Nitrate as N	SM 4500-NO3 H	General Chemistry	NELAP	5/4/2007
Nitrate-nitrite	EPA 300.0	General Chemistry	NELAP	2/13/2002
Nitrite	EPA 9056	General Chemistry	NELAP	12/10/2008
Nitrite as N	EPA 300.0	General Chemistry	NELAP	12/10/2008
Nitrite as N	EPA 354.1	General Chemistry	NELAP	12/10/2008
Nitrite as N	SM 4500-NO2-B	General Chemistry	NELAP	12/10/2008
Nitrobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	7/1/2003
Nitrobenzene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Nitroglycerin	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	2/13/2002

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TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	2/13/2002
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	12/10/2008
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	2/13/2002
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
o,o,o-Triethyl phosphorothioate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Oil & Grease	EPA 1664A	General Chemistry	NELAP	2/13/2002
Orthophosphate as P	EPA 300.0	General Chemistry	NELAP	2/13/2002
Orthophosphate as P	EPA 9056	General Chemistry	NELAP	7/1/2003
o-Toluidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
o-Xylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Pentachloronitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002
Pentachlorophenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentaerythritoltetranitrate (PETN)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Perchlorate	EPA 6850	General Chemistry	NELAP	12/10/2008
pH	EPA 150.1	General Chemistry	NELAP	2/13/2002
pH	EPA 9040	General Chemistry	NELAP	7/1/2003
pH	SM 4500-H+-B	General Chemistry	NELAP	5/4/2007
Phenacetin	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenanthrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Phenanthrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Phenol	EPA 625	Extractable Organics	NELAP	2/13/2002
Phenol	EPA 8041	Extractable Organics	NELAP	12/10/2008
Phenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phorate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phosphorus, total	EPA 365.2	General Chemistry	NELAP	7/24/2006
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Potassium	EPA 200.7	Metals	NELAP	2/13/2002
Potassium	EPA 6010	Metals	NELAP	7/1/2003
Potassium	EPA 6020	Metals	NELAP	11/7/2003
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Pyrene	EPA 625	Extractable Organics	NELAP	2/13/2002
Pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Radium-226	EPA 903.0	Radiochemistry	NELAP	12/10/2008
Radium-228	EPA 904.0	Radiochemistry	NELAP	12/10/2008
Radium-228	EPA 9320	Radiochemistry	NELAP	12/10/2008
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Reactive cyanide	Sec. 7.3 SW-846	General Chemistry	NELAP	7/24/2006
Reactive sulfide	Sec. 7.3 SW-846	General Chemistry	NELAP	7/24/2006
Residue-filterable (TDS)	EPA 160.1	General Chemistry	NELAP	2/13/2002
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	5/4/2007
Residue-nonfilterable (TSS)	EPA 160.2	General Chemistry	NELAP	2/13/2002
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	5/4/2007
Residue-total	EPA 160.3	General Chemistry	NELAP	2/13/2002
Residue-total	SM 2540 B	General Chemistry	NELAP	5/4/2007
Safrole	EPA 8270	Extractable Organics	NELAP	7/1/2003
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Selenium	EPA 200.7	Metals	NELAP	2/13/2002
Selenium	EPA 200.8	Metals	NELAP	2/13/2002
Selenium	EPA 6010	Metals	NELAP	7/1/2003
Selenium	EPA 6020	Metals	NELAP	11/7/2003

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TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Silicon	EPA 200.7	Metals	NELAP	2/13/2002
Silicon	EPA 6010	Metals	NELAP	7/1/2003
Silver	EPA 200.7	Metals	NELAP	2/13/2002
Silver	EPA 200.8	Metals	NELAP	2/13/2002
Silver	EPA 6010	Metals	NELAP	7/1/2003
Silver	EPA 6020	Metals	NELAP	7/1/2003
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Sodium	EPA 200.7	Metals	NELAP	2/13/2002
Sodium	EPA 6010	Metals	NELAP	7/1/2003
Sodium	EPA 6020	Metals	NELAP	11/7/2003
Strontium	EPA 200.7	Metals	NELAP	7/24/2006
Strontium	EPA 6010	Metals	NELAP	7/1/2003
Strontium	EPA 6020	Metals	NELAP	7/24/2006
Strontium-90	DOE Sr-02	Radiochemistry	NELAP	12/10/2008
Strontium-90	DOE Sr-03-RC	Radiochemistry	NELAP	12/10/2008
Strontium-90	EPA 905.0	Radiochemistry	NELAP	12/10/2008
Styrene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Sulfate	EPA 300.0	General Chemistry	NELAP	2/13/2002
Sulfate	EPA 9056	General Chemistry	NELAP	7/1/2003
Sulfide	EPA 376.1	General Chemistry	NELAP	2/13/2002
Sulfide	EPA 9030/9034	General Chemistry	NELAP	5/4/2007
Sulfide	SM 4500-S F (20th/21st Ed.)	General Chemistry	NELAP	5/4/2007
Sulfotepp	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	7/24/2006
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	2/13/2002
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Thallium	EPA 200.7	Metals	NELAP	2/13/2002
Thallium	EPA 200.8	Metals	NELAP	2/13/2002
Thallium	EPA 6010	Metals	NELAP	7/1/2003
Thallium	EPA 6020	Metals	NELAP	7/1/2003
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Thorium	EPA 200.8	Metals	NELAP	7/24/2006

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Tin	EPA 200.7	Metals	NELAP	7/24/2006
Tin	EPA 6010	Metals	NELAP	7/1/2003
Tin	EPA 6020	Metals	NELAP	7/24/2006
Titanium	EPA 200.7	Metals	NELAP	7/24/2006
Titanium	EPA 6010	Metals	NELAP	7/24/2006
Titanium	EPA 6020	Metals	NELAP	7/24/2006
Toluene	EPA 624	Volatile Organics	NELAP	2/13/2002
Toluene	EPA 8021	Volatile Organics	NELAP	7/1/2003
Toluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Total cyanide	EPA 9010	General Chemistry	NELAP	7/1/2003
Total cyanide	EPA 9012	General Chemistry	NELAP	7/1/2003
Total nitrate-nitrite	SM 4500-NO3 H	General Chemistry	NELAP	5/4/2007
Total organic carbon	EPA 415.1	General Chemistry	NELAP	5/14/2003
Total organic carbon	EPA 9060	General Chemistry	NELAP	7/1/2003
Total organic carbon	SM 5310B	General Chemistry	NELAP	5/4/2007
Total organic halides (TOX)	EPA 9020	General Chemistry	NELAP	7/1/2003
Total radium	EPA 9315	Radiochemistry	NELAP	12/10/2008
Total sulfides	EPA 9034	General Chemistry	NELAP	7/1/2003
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	7/24/2006
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	2/13/2002
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,3-Dichloropropylene	EPA 624	Volatile Organics	NELAP	2/13/2002
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	2/13/2002
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichlorofluoromethane	EPA 624	Volatile Organics	NELAP	12/16/2002
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tri-o-cresylphosphate (TOCP)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Tritium	EPA 906.0	Radiochemistry	NELAP	12/10/2008
Uranium	ASTM D5174-91	Radiochemistry	NELAP	12/10/2008
Uranium	EPA 200.8	Metals	NELAP	2/13/2002
Uranium	EPA 6020	Metals	NELAP	6/5/2009

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Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Vanadium	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Vanadium	EPA 200.8	Metals	NELAP	2/13/2002
Vanadium	EPA 6010	Metals	NELAP	7/1/2003
Vanadium	EPA 6020	Metals	NELAP	11/7/2003
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Vinyl chloride	EPA 624	Volatile Organics	NELAP	2/13/2002
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Xylene (total)	EPA 624	Volatile Organics	NELAP	2/13/2002
Xylene (total)	EPA 8021	Volatile Organics	NELAP	7/1/2003
Xylene (total)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Zinc	EPA 200.7	General Chemistry,Metals	NELAP	2/13/2002
Zinc	EPA 200.8	Metals	NELAP	2/13/2002
Zinc	EPA 6010	Metals	NELAP	7/1/2003
Zinc	EPA 6020	Metals	NELAP	7/1/2003

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260	Volatile Organics	NELAP	12/10/2008
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	Extractable Organics	NELAP	2/13/2002
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	2/13/2002
1,3,5-Trinitrobenzene (1,3,5-TNB)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	12/9/2002
1,3-Dinitrobenzene (1,3-DNB)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	2/13/2002
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002

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FLORIDA DEPARTMENT OF HEALTH

Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

Laboratory Scope of Accreditation

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State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	2/13/2002
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	10/26/2005
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	2/13/2002
2,4,6-Trinitrotoluene (2,4,6-TNT)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
2,4-Diamino-6-nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	2/13/2002
2,4-Dinitrotoluene (2,4-DNT)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,6-Diamino-4-nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	5/14/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	5/14/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	5/14/2003
2,6-Dinitrotoluene (2,6-DNT)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	5/14/2003
2-Amino-4,6-dinitrotoluene (2-am-dnt)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2-Aminoanthraquinone	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	2/13/2002
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	2/13/2002
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	2/13/2002

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E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Hexanone	EPA 8260	Volatile Organics	NELAP	2/13/2002
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	12/10/2008
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	12/10/2008
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	2/13/2002
2-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	2/13/2002
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	2/13/2002
3,3'-Dimethoxybenzidine	EPA 8270	Extractable Organics	NELAP	2/13/2002
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	2/13/2002
3,5-Dinitroaniline	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	7/24/2006
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	2/13/2002
3-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	5/14/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	12/10/2008
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	2/13/2002
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	2/13/2002

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Analyte	Method/Tech	Category	Certification Type	Effective Date
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	2/13/2002
4-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
a-a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acenaphthene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acenaphthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Acetone	EPA 8260	Volatile Organics	NELAP	2/13/2002
Acetonitrile	EPA 8260	Volatile Organics	NELAP	2/13/2002
Acetophenone	EPA 8270	Extractable Organics	NELAP	2/13/2002
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	2/13/2002
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	2/13/2002
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/2/2005
Aluminum	EPA 6010	Metals	NELAP	2/13/2002
Aluminum	EPA 6020	Metals	NELAP	2/13/2002
Aniline	EPA 8270	Extractable Organics	NELAP	2/13/2002
Anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Anthracene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Antimony	EPA 6010	Metals	NELAP	2/13/2002
Antimony	EPA 6020	Metals	NELAP	2/13/2002
Aramite	EPA 8270	Extractable Organics	NELAP	2/13/2002
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Arsenic	EPA 6010	Metals	NELAP	2/13/2002

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Earth City, MO 63045

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Arsenic	EPA 6020	Metals	NELAP	2/13/2002
Barium	EPA 6010	Metals	NELAP	2/13/2002
Barium	EPA 6020	Metals	NELAP	2/13/2002
Benzene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Benzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	5/14/2003
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	5/14/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	2/13/2002
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	2/13/2002
Beryllium	EPA 6010	Metals	NELAP	2/13/2002
Beryllium	EPA 6020	Metals	NELAP	2/13/2002
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	2/13/2002
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	2/13/2002
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	2/13/2002
Boron	EPA 6010	Metals	NELAP	5/14/2003
Boron	EPA 6020	Metals	NELAP	7/24/2006
Bromide	EPA 9056	General Chemistry	NELAP	2/13/2002
Bromobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Bromoform	EPA 8260	Volatile Organics	NELAP	2/13/2002
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Cadmium	EPA 6010	Metals	NELAP	2/13/2002
Cadmium	EPA 6020	Metals	NELAP	2/13/2002
Calcium	EPA 6010	Metals	NELAP	12/9/2002
Calcium	EPA 6020	Metals	NELAP	11/7/2003

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Carbazole	EPA 8270	Extractable Organics	NELAP	2/13/2002
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	2/13/2002
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Chloride	EPA 9056	General Chemistry	NELAP	5/28/2003
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chloroform	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chloroprene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Chromium	EPA 6010	Metals	NELAP	2/13/2002
Chromium	EPA 6020	Metals	NELAP	2/13/2002
Chromium VI	EPA 7196	General Chemistry	NELAP	2/13/2002
Chrysene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Chrysene	EPA 8310	Extractable Organics	NELAP	2/13/2002
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Cobalt	EPA 6010	Metals	NELAP	2/13/2002
Cobalt	EPA 6020	Metals	NELAP	2/13/2002
Conductivity	EPA 9050	General Chemistry	NELAP	2/13/2002
Copper	EPA 6010	Metals	NELAP	2/13/2002
Copper	EPA 6020	Metals	NELAP	2/13/2002
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Dibenz(a,h)anthracene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	12/10/2008
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	12/16/2002
Dibromomethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	10/26/2005
Diethyl ether	EPA 8260	Volatile Organics	NELAP	2/13/2002
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	2/13/2002
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/2/2005
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	2/13/2002
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	2/13/2002
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Famphur	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Fluoranthene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Fluoranthene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Fluorene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Fluorene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Fluoride	EPA 9056	General Chemistry	NELAP	2/13/2002
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/2/2005
Gasoline range organics (GRO)	EPA 8015	Volatile Organics	NELAP	10/26/2005
Gross-alpha	EPA 9310	Radiochemistry	NELAP	12/10/2008
Gross-beta	EPA 9310	Radiochemistry	NELAP	12/10/2008
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/28/2003
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics,Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Ignitability	EPA 1010	General Chemistry	NELAP	2/13/2002

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	12/10/2008
Iron	EPA 6010	Metals	NELAP	2/13/2002
Iron	EPA 6020	Metals	NELAP	11/7/2003
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Isophorone	EPA 8270	Extractable Organics	NELAP	12/10/2008
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Isosafrole	EPA 8270	Extractable Organics	NELAP	2/13/2002
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Lead	EPA 6010	Metals	NELAP	2/13/2002
Lead	EPA 6020	Metals	NELAP	2/13/2002
Lithium	EPA 6010	Metals	NELAP	2/13/2002
m+p-Xylenes	EPA 8260	Volatile Organics	NELAP	7/24/2006
Magnesium	EPA 6010	Metals	NELAP	2/13/2002
Magnesium	EPA 6020	Metals	NELAP	11/7/2003
Manganese	EPA 6010	Metals	NELAP	2/13/2002
Manganese	EPA 6020	Metals	NELAP	2/13/2002
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Mercury	EPA 7471	Metals	NELAP	2/13/2002
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methapyrilene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methyl parathion (Parathion, methyl)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Methylene chloride	EPA 8260	Volatile Organics	NELAP	2/13/2002
Molybdenum	EPA 6010	Metals	NELAP	12/9/2002
Molybdenum	EPA 6020	Metals	NELAP	7/24/2006
Naphthalene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Naphthalene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Naphthalene	EPA 8310	Extractable Organics	NELAP	2/13/2002

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Charlie Crist
Governor

FLORIDA DEPARTMENT OF HEALTH

Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-19, expiration date June 30, 2010. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87689 **EPA Lab Code: MO00054** **(314) 298-8566**

E87689
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
n-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	2/13/2002
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Nickel	EPA 6010	Metals	NELAP	2/13/2002
Nickel	EPA 6020	Metals	NELAP	2/13/2002
Nitrate	EPA 9056	General Chemistry	NELAP	2/13/2002
Nitrite	EPA 9056	General Chemistry	NELAP	2/13/2002
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	2/13/2002
Nitrobenzene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Nitroglycerin	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	12/10/2008
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	2/13/2002
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
o,o,o-Triethyl phosphorothioate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	2/13/2002
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Orthophosphate as P	EPA 9056	General Chemistry	NELAP	2/13/2002
o-Toluidine	EPA 8270	Extractable Organics	NELAP	12/9/2002
o-Xylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Paint Filter Liquids Test	EPA 9095	General Chemistry	NELAP	2/13/2002
Parathion, ethyl	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pentachloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Pentachloronitrobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002

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TestAmerica St. Louis
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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Pentaerythritoltetranitrate (PETN)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Perchlorate	EPA 6850	General Chemistry	NELAP	12/10/2008
pH	EPA 9040	General Chemistry	NELAP	2/13/2002
pH	EPA 9045	General Chemistry	NELAP	2/13/2002
Phenacetin	EPA 8270	Extractable Organics	NELAP	2/13/2002
Phenanthrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Phenanthrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Phenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
Phorate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Phosphorus	EPA 6020	Metals	NELAP	7/24/2006
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Potassium	EPA 6010	Metals	NELAP	2/13/2002
Potassium	EPA 6020	Metals	NELAP	11/7/2003
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	2/13/2002
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Pyrene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pyrene	EPA 8310	Extractable Organics	NELAP	2/13/2002
Pyridine	EPA 8270	Extractable Organics	NELAP	2/13/2002
Radium-228	EPA 9320	Radiochemistry	NELAP	12/10/2008
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	2/13/2002
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Reactive cyanide	EPA 7.3.3.2	General Chemistry	NELAP	2/13/2002
Reactive sulfide	EPA 7.3.4.2	General Chemistry	NELAP	2/13/2002
Safrole	EPA 8270	Extractable Organics	NELAP	2/13/2002
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Selenium	EPA 6010	Metals	NELAP	2/13/2002
Selenium	EPA 6020	Metals	NELAP	11/7/2003
Silicon	EPA 6010	Metals	NELAP	2/13/2002
Silver	EPA 6010	Metals	NELAP	2/13/2002
Silver	EPA 6020	Metals	NELAP	2/13/2002
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Sodium	EPA 6010	Metals	NELAP	2/13/2002
Sodium	EPA 6020	Metals	NELAP	11/7/2003
Strontium	EPA 6010	Metals	NELAP	12/9/2002

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Strontium	EPA 6020	Metals	NELAP	7/24/2006
Styrene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Sulfate	EPA 9056	General Chemistry	NELAP	2/13/2002
Sulfotepp	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	2/13/2002
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	2/13/2002
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Thallium	EPA 6010	Metals	NELAP	2/13/2002
Thallium	EPA 6020	Metals	NELAP	2/13/2002
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Tin	EPA 6010	Metals	NELAP	5/14/2003
Tin	EPA 6020	Metals	NELAP	7/24/2006
Titanium	EPA 6010	Metals	NELAP	7/24/2006
Titanium	EPA 6020	Metals	NELAP	7/24/2006
Toluene	EPA 8021	Volatile Organics	NELAP	2/13/2002
Toluene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Total cyanide	EPA 9010	General Chemistry	NELAP	2/13/2002
Total cyanide	EPA 9012	General Chemistry	NELAP	2/13/2002
Total nitrate-nitrite	EPA 9056	General Chemistry	NELAP	2/13/2002
Total radium	EPA 9315	Radiochemistry	NELAP	12/10/2008
Total sulfides	EPA 9034	General Chemistry	NELAP	2/13/2002
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/13/2002
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	2/13/2002
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	2/13/2002
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	2/13/2002
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Tri-o-cresylphosphate (TOCP)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Vanadium	EPA 6010	Metals	NELAP	2/13/2002
Vanadium	EPA 6020	Metals	NELAP	11/7/2003
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	2/13/2002

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	2/13/2002
Xylene (total)	EPA 8021	Volatile Organics	NELAP	2/13/2002
Xylene (total)	EPA 8260	Volatile Organics	NELAP	2/13/2002
Zinc	EPA 6010	Metals	NELAP	2/13/2002
Zinc	EPA 6020	Metals	NELAP	2/13/2002

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Appendix 4. Glossary/Acronyms

Glossary:

Acceptance Criteria:
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation:
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority:
The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (NELAC) [1.5.2.3]

Accuracy:
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS) It reflects the total error associated with a measurement.

Analyst:
The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Batch:
Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee) Instrument conditions must be the same for all standards, samples and QC samples. Each analytical batch may contain up to 20 environmental samples, a method blank, and a single Laboratory Control Sample (LCS) and either a Matrix Spike/Matrix Spike Duplicate (MS/MSD) pair or a Matrix Spike and a Sample Duplicate, depending on the analysis requested.

Blank:
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Blind Sample:
A sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibration:
To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve:
The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method:
A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Carrier:
Carriers are stable counterparts of the radioactive isotope(s) to be measured. When used, carriers are added to all samples in an analytical batch so that each sample has a specific measurable QC parameter (yield). The carrier yield is used in the date calculations to correct for all sources of analytical losses. The term carrier can also be used for a non-radioactive compound added to assist in isolation of the target analyte(s).

Certified Reference Material (CRM):
A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30–2.2)

Chain of Custody:
An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. (NELAC) [5.12.4]

Clean Air Act:
The enabling legislation in 42 U>S>C> 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and enforce them. (NELAC)

Clouseau:
TestAmerica custom software developed to document, track and trend non-conformance throughout the laboratory. The software interfaces with our laboratory information management system, QuantIMS and our report narrative generating software, KATO to provide the laboratory with a complete corrective action system.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/SUPERFUND):

The enabling legislation in 42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601 et seq., to eliminate the health and environmental threats posed by hazardous waste sites. (NELAC)

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (NELAC)

Confidential Business Information (CBI):
Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation:
Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength
Derivatization
Mass spectral interpretation (including spectra obtained by diode array)
Alternative detectors or
Additional Cleanup procedures
(NELAC)

Conformance:
An affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Control Chart:
A graphical QC tool to monitor method performance over time and to establish acceptance limits.

Corrective Action:
The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction:

The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability (DOC):
Procedure to establish the ability to generate acceptable accuracy and precision.

Detection Limit:
The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

Document Control:
The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses:
The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Environmental Detection Limit (EDL):
The smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (NELAC Radioanalysis Subcommittee)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC) This is a field QC parameter and thus the choice of terminology (equipment blank, rinsate blank, etc.) is determined by the client.

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Federal Water Pollution Control Act (Clean Water Act, CWA):
The enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

Field Blank:

Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Testing:
NELAC's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required to submit to only that portion of the accreditation process not previously addressed (see NELAC, section 1.9ff). (NELAC)

Holding Times (Maximum Allowable Holding Times):
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard:
A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL):
The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ±100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Internal Chain of Custody:
An unbroken trail of accountability that ensures the physical security of samples, data and records. Internal Chain of Custody refers to additional documentation procedures implemented within the laboratory that includes special sample storage requirements, and documentation of all signatures and/or initials, dates and times of personnel handling specific samples or sample aliquots.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):
A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), there is no LCS. It is generally used to establish intra-

laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

For aqueous samples, the blank matrix consists of DI water. For solid samples, the blank matrix may consist of sand, glass beads or another inert solid material. If an inert material is not easily identified, the laboratory will use DI water that is taken through the sold sample preparation.

Note: NELAC standards allow a matrix spike to be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. (NELAC)

Laboratory Duplicate:
Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Least Squares Regression (1st Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD):
An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit. TestAmerica St. Louis does not use the term LOD in its' SOPs or reports.

Marginal Exceedance (ME): A large number of analytes in a Laboratory Control Sample make it statistically likely that a few will be outside control limits. This may not indicate that the system is out of control. Upper and lower marginal exceedance (ME) limits are established to determine when corrective action is required. An ME is defined as being byond the LCS control limits (3 standard deviations), but within the ME limits. The ME limits are set at 4 standard deviations around the mean. For DOE work, the ME applies only to organic analyses.

Matrix:
The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

> Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with, <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, wipes, filters and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (NELAC)

Matrix Duplicate (MD):
Duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate; Laboratory Duplicate. TestAmerica St. Louis distinguishes that a Sample Duplicate is a replicate sample collected in the field for analysis where as a Laboratory Duplicate is a replicate aliquot of a single field sample. Sample Duplicates are analyzed like an environmental sample and results are reported accordingly. Laboratory Duplicates are performed as part of laboratory batch QC requirements for precision.

Matrix Spike (spiked sample or fortified sample) (MS):
Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. Matrix spikes shall be performed at a frequency of one in 20 samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as, total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate) (MSD):
A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Matrix spike duplicates or laboratory duplicates shall be analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory shall document their procedure to select the use of an appropriate type of duplicate. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates may indicate a problem with the sample

composition and shall be reported to the client whose sample was used for the duplicate. (QAMS)

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC) For aqueous samples, the blank matrix consists of DI water. For solid samples, the blank matrix may consist of sand, glass beads or another inert solid material. If inert material is not easily identified, the laboratory will use DI water that is taken through the solid sample preparation.

Method Detection Limit:
The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Minimum Detectable Activity or Concentration (MDA/MDC):
For radiological analyses, it is the smallest amount of activity that can be detected given the conditions of a specific sample. It is reported at the 95% confidence interval, meaning that there is a 5% chance that a false signal was reported as activity and a 5% chance that true activity went undetected.

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

Non-conformance:
An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation. A deviation from an established protocol or plan. The deviation may be the result of laboratory or client actions, or related to the behavior of the sample. Non-conformance memorandums (NCMs) are documented using the Clouseau software program.

Performance Audit:
The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS):
A set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

Positive Control:
Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision:

The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC) Precision is expressed either as Relative Standard Deviation (RSD) for greater than two measurements or as Relative Percent Difference (RPD) for two measurements. Precision is determined, in part, by analyzing date from aggregate LCS results, MS, MSD, and MD. For radiochemical determinations, counting statistics can also provide and estimate of uncertainty.

Preservation:
Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC) [2.1]

Proficiency Testing Program:
The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (NELAC)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Quality Assurance:
An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP):
A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control:
The overall system of technical activities which purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample:
An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual:

A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC (ANSI/ASQC-E-41994)

QuantIMS:
The laboratory's information tracking system.

Quantitation Limits:
The maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. (NELAC) The QL can be based on the MDL, and is generally calculated as 3-5 times the MDL, however, there are analytical techniques and methods where this relationship is not applicable. Also referred to as Practical Quantitation Level (PQL), Estimated Quantitation Level (EQL), and Limit of Quantitiation (LOQ). TestAmerica St. Louis equated the Quantitation Limit to the Reporting Limit. Please see "Reporting Limit" definition.

RadCapture:
Software used to process and report radiochemical data.

Range:
The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data:
Any original information from a measurement activity or study recorded in laboratory notebooks, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data my include photography, microfilm or microfiche copies, computer printouts, magnetic/optical media, including dictated observations, and recorded data from automated instruments. Reports specifying inclusion of "raw data" do not need all of the above included, but sufficient information to create the reported data.

Reagent Blank (method reagent blank):
A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Record Retention:
The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material:

A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Standard:
A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.0-8)

Replicate Analyses:
The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limit (RL):
The level to which date is reported for a specific test method and/or sample. The RL is generally related to the QL. The RL must be minimally at or above the MDL. The Reporting Limit takes into consideration: 305 times the MDL value, technical judgment and publications f analyte performance, and market demand for quantitation. For multi-point calibration methodologies, the reporting limit must be substantiated by analyzing a low level standard which is approximately equal to the reporting limit.

Resource Conservation and Recovery Act (RCRA):
The enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the “cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal. (NELAC)

Safe Drinking Water Act (SDWA):
The enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample Duplicate:
Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis. (EPA-QAD)

Sample Transfer Utility (STU):
TestAmerica custom software developed to document, and track samples through the laboratory. The software interfaces with our laboratory information management system, QuantIMS. STU employs barcode technology for rapid processing of sample transfer events including removal from storage, transfer between personnel, and sample disposal.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity:
(Analytical chemistry) the capability of a test method or instrument to respond to a target substance of constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, a representative number (at a minimum 10%) of the listed components may be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.. (NELAC)

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of NELAC and meets the approval requirements of NELAC procedures and policies. (ASQC)

Standard Operating Procedures (SOPs):
A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Storage Blank:
A blank matrix stored with field samples of a similar matrix. TestAmerica St. Louis uses DI or HPLC water for all storage blanks.

Standardized Reference Material (SRM):
A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not

available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Surveillance:
Monitors compliance with TestAmerica St. Louis' quality system as defined in laboratory or Corporate Standard Operating Procedures, the TestAmerica Quality Management Plan (QMP), the TestAmerica St. Louis Laboratory Quality Manual (LQM) and other associated official policies and procedures, including any client-specific requirements. The spot assessments of TestAmerica St. Louis' systems are performed monthly.

Systems Audit (also Technical Systems Audit):
A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Target:
Instrument acquisition software used for GC and GC/MS analyses.

Toxic Substances Control Act (TSCA):
The enabling legislation in 15 USC 2601 et seq., (1976) that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture. (NELAC)

Traceability:
The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

Tracer:
Tracers are radioactive and/or massless. Where used, they are added to all samples in an analytical batch so that each sample has a specific measurable QC parameter (yield). Tracers are counted and the yield is used in the data calculations to correct for any and all sources of analytical losses.

TRAQAR:
A computer module interfaced to QuantIMS, which provides a means of producing control charts and limits.

Trip Blank:
A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples. TestAmerica St. Louis purchases pre-prepared trip blanks from our sample container provider. In the event that trip blanks are prepared by TestAmerica St. Louis, we use HPLC water for all Trip Blanks.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

BS – Blank Spike
BSD – Blank Spike Duplicate
CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
CRS – Change Request Form
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DU – Duplicate
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
MD – Matrix Duplicate
MDA/MDC – Minimum Detectable Activity/Concentration
MDL – Method Detection Limit
ME – Marginal Exceedance
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NCM – non-conformance memo
NELAC - National Environmental Laboratory Accreditation Conference
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RL – Reporting Limit
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 5.

Laboratory Certifications, Accreditations, Validations

TestAmerica St. Louis maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

Organization	Certificate Number	Organization	Certificate Number
AFCEE	n/a	USACE	n/a
Alaska	MO54-08	USEPA Region 5	n/a
California	2093	USDA	S-37573
Connecticut	PH-0241	USDOE	n/a
Florida	E87689	US NRC	24-24817-01
Illinois	200023	Washington	C1310
Iowa	373		
Kansas	E-10236		
Kentucky	90125		
Louisiana DHH	LA020012		
Louisiana DEQ	4080		
Maryland	310		
Missouri	780		
New Mexico	n/a		
NFESC	NFESC 413		
Nevada	MO00542007A		
New Jersey	MO002		
New York	11616		
Pennsylvania	68-540		
South Carolina	85002		
Texas	T104704193-06-TX		
Utah	QUAN4		

The certificates and parameter lists (which may differ) for each organization may be found on the corporate web site and are posted in the laboratory.

Appendix 6: Calculations

Common Calculations

- Percent Recoveries *(ICV, CCV, LCS, Surrogates, Tracers) are calculated according to the equation:*

$$\%R = 100\left(\frac{Found}{True}\right)$$

- Matrix Spike Recoveries *are calculated according to the following equation:*

$$\%R = 100\left(\frac{SSR - SR}{SA}\right)$$

Where:
SSR = Spike Sample Result
SR = Sample Result
SA = Spike Added

- The relative percent difference (RPD*) of matrix spike/matrix spike duplicates is calculated according to the following equation:*

$$RPD = 100\left[\frac{|MSD - MS|}{\left(\frac{MSD + MS}{2}\right)}\right]$$

Where:
MS = determined spiked sample concentration
MSD = determined matrix spike duplicate concentration

- The relative percent difference (RPD) *of sample/sample duplicates is calculated according to the following equation:*

$$RPD = 100\left[\frac{|SR - SD|}{\left(\frac{SR + SD}{2}\right)}\right]$$

Where:
SR = sample result
SD = sample duplicate result

- The percent difference (%D) is calculated as follows***:***

$$\%Difference = \frac{|R_1 - R_2|}{R_1} \times 100$$

Where:
R_1 = First result
R_2 = Second result

- Standard Deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(X_i - X)^2}{N-1}}$$

Where:

X_i = Value of X as i through N
N = Number of points
X = Average value of X_i

ADDITIONAL Calculations for Metals

- The final concentration for a digested aqueous sample is calculated as follows:

$$mg/L = \frac{C \times V1 \times D}{V2}$$

Where:
C = Concentration (mg/L) from instrument readout
D = Instrument dilution factor
V1 = Final volume in liters after sample preparation
V2 = Initial volume of sample digested in liters

- *The final concentration determined in digested solid samples when reported on a dry weight basis is calculated as follows:*

$$mg/Kg, dry\ weight = \frac{C \times V \times D}{W \times S}$$

Where:
C = Concentration (mg/L) from instrument readout
D = Instrument dilution factor
V = Final volume in liters after sample preparation
W = Weight in Kg of wet sample digested
S = Percent solids/100

Note: A Percent Solids determination must be performed on a separate aliquot when dry weight concentrations are to be reported. If the results are to be reported on wet weight basis the "S" factor should be omitted from the above equation.

Additional Calculations for Organics

- *The calibration factor for an external calibration standard is calculated as follows:*

$$Calibration\ Factor\ (CF) = \frac{Area\ or\ Height\ of\ Peak}{Mass\ Injected\ (ng)}$$

- *Relative Standard Deviation (%RSD), applicable to initial calibration, is calculated as follows:*

$$\%RSD = \frac{SD}{CF_{avg}} \times 100$$

Where:

CF_{avg} = The average of the initial CFs for a compound

SD = The standard deviation (using n-1) of the initial calibration CFs for a compound

- *Aqueous sample concentration using external standard calibration is calculated as follows:*

$$Concentration\,(mg/L) = \frac{(A_x \times V_t \times D_f)}{(CF \times V_i \times V_s)}$$

Where:

A_x = Response for the analyte in the sample
V_i = Volume of extract injected, µL
D_f = Dilution factor
V_t = Volume of total extract, µL
V_s = Volume of sample extracted or purged, mL
CF = Calibration factor, area or height/ng

- *Non-aqueous sample concentration using external standard calibration is calculated as follows:*

$$Concentration\,(mg/kg) = \frac{(A_x \times V_t \times D_f)}{(CF \times V_i \times W \times D)}$$

Where:

A_x = Response for the analyte in the sample
V_i = Volume of extract injected, µL
D_f = Dilution factor
V_t = Volume of total extract, µL
CF = Calibration factor, area or height/ng
W = Weight of sample extracted or purged, g

$$D = \frac{100 - \%Moisture}{100}$$ (D = 1 if wet weight is required)

Additional Calculations for GC/MS SVOA

- Concentration calculation using average response factor:

$$C_{ex} = \frac{R_x C_{is}}{R_{is} \overline{RF}}$$

- Concentration calculation using linear fit:

$$C_{ex} = A + B\frac{(R_x C_{is})}{R_{is}}$$

Where:
C_{ex} = Concentration in extract, µg/ml
R_x = Response for analyte
R_{is} = Response for internal standard
C_{is} = Concentration of internal standard
A = Intercept
B = Slope

- Concentration calculation using quadratic fit:

$$C_{ex} = A + B\left(\frac{R_x C_{is}}{R_{is}}\right) + C\left(\frac{R_x C_{is}}{R_{is}}\right)$$

Where:
C = Curvature

- Aqueous sample concentration is calculated as follows:

$$Concentration, ug/L = \frac{C_{ex} V_t}{V_o}$$

Where:
V_t = Volume of total extract, µL, taking into account dilutions
V_o = Volume of water extracted (ml)

- Sediment/soil, sludge and waste concentration is calculated as follows:

$$Concentration, ug/kg = \frac{C_{ex} V_t}{W_s D}$$

Where:
W_s = Weight of sample extracted or diluted in grams
D = (100 - % moisture in sample)/100, for a dry weight basis or 1 for a wet weight basis

Additional Calculations for GC/MS VOA

- Calculation *(x)* for water and water-miscible waste:

$$x = \frac{(A_x)(I_s)(D_f)}{(A_{is})(V_o)}$$

Where:
A_x = Area of characteristic ion for the compound being measured
A_{is} = Area of the characteristic ion for the internal standard
I_s = Amount of internal standard added in ng
V_o = Volume of water purged, mL

$$D_f = Dilution\ Factor = \frac{Total\ volume\ purged\ (mL)}{Volume\ of\ original\ sample\ used\ (mL)}$$

- Calculation *(x)* for medium level soils:

$$x = \frac{(A_x)(I_s)(V_t)(1000)(D_f)}{(A_{is})(V_a)(W_s)(D)}$$

Where:
A_x, I_s, D_f, A_{is} are the same as for water
V_t = Volume of total extract, mL (typically 25 mL)
V_a = Volume of extract added for purging, µL
W_s = Weight of sample extracted, g

$$D = \frac{100 - \%\,moisture}{100}$$

- Calculation *(x)* for low level soils:

$$x = \frac{(A_x)(I_s)}{(A_{is})(W_s)(D)}$$

Where:
A_x, I_s, A_{is} are the same as for water
D is the same as for medium level soils
W_s = Weight of sample added to the purge vessel, g

Gamma Activity Concentration

The activity concentration of a sample will be calculated using the following equation.

$$ACT_S = \frac{Net_Counts}{2.22 * E * t_S * Ab * V_A * D_C * D_S}$$

where:

ACT_S	=	the activity in pCi/(units of the volume)
Net_Counts	=	the net area of a peak
2.22	=	the correction factor to pCi
E	=	the efficiency – corrected for transmission
t_S	=	the count time in minutes
Ab	=	the gamma abundance factor
V_A	=	the sample aliquot volume
D_C	=	the decay correction during the analysis
D_S	=	the decay correction from collection date to start of analysis

Gamma Uncertainty of Concentration (at 2σ confidence level)

The Total Promulgated Uncertainty (TPU) will be calculated using the following equation.

The software calculates the 2σ TPU term by incorporating the stochastic counting uncertainty and by examinging the nuclide library for the error in the nuclide half-life and abundance for their respective contributions. The software routine also includes the standard certificate file and the calibration standard uncertainties. Finally, a 1% factor is added in quadrature due to the uncertainty in the preparation of the sample. This is attributed to the maximum allowable variability of the balances.

$$TPU_S = 1.96 * ACT_S * \sqrt{\left(\frac{\Delta P}{P}\right)^2 + \left(\frac{\Delta Ab}{Ab}\right)^2 + \left(\frac{\Delta \varepsilon}{\varepsilon}\right)^2 + \left(\frac{\Delta V}{V}\right)^2 + \left(\frac{sys}{100}\right)^2 + (\Delta Decay)^2}$$

Where:

$$\Delta\ Decay = \left[\frac{\Delta T_{1/2}}{T_{1/2}}\right] * \left[\frac{\lambda E_r}{1 - e^{-\lambda E_r}} - \lambda (T_S + E_r) - 1\right]$$

Where:

TPU_S	= the 2σ uncertainty of the activity of the sample
ACT_S	= the activity in pCi/(units of volume)
1.96	= the statistical multiplication factor for 95% confidence level
ΔP	= the uncertainty in the peak area
ΔAb	= the uncertainty in gamma abundance
$\Delta\varepsilon$	= the uncertainty in the efficiency ε
ΔV	= the uncertainty in the volume
sys	= the systematic error estimate (in %)*
$\Delta T_{1/2}$	= the uncertainty in the half-life
$T_{1/2}$	= the half life of the nuclide of interest
λ	= the decay constant
E_r	= the elapsed real time during count
T_s	= the sample collection time

Gamma MDC

The minimum detectable concentation will be calculated using the following equation.

$$MDC = \frac{4.65 * \sqrt{R_B * t_S} + 2.71}{2.22 * E * t_S * Ab * V_A * D_C * D_S}$$

Where:

MDC	=	Minimum Detectable Activity of the sample
R_B	=	Count rate of detector background (in cpm)
t_S	=	Count time for analysis
E	=	Detector efficiency
Ab	=	Abundance of the gamma emission
V_A	=	sample aliquot volume
D_C	=	Decay during sample analysis
D_S	=	Decay from collection to start of analysis

Alpha Activity Concentration for each region of interest (ROI) in pCi/unit volume.

$$ACT_S = \frac{(C_S - C_B)}{2.22 * E * Ab * Y * D * V_S * t_S)}$$

Where:

ACT_S	=	Activity of the sample
C_S	=	Sample Counts
C_B	=	Background counts
E	=	Detector efficiency
Ab	=	Abundance of the alpha emission
Y	=	Yield
D	=	Decay
t_s	=	Count time for analysis
V_A	=	Sample aliquot volume

Alpha Uncertainty of Concentration (at 2s confidence level)

The 2-sigma (s) Total Propagated Uncertainty (TPU) term for each region of interest (pCi/unit volume) is calculated by the computer software. The software calculates the stochastic counting uncertainty and software reviews the nuclide library for the error in the nuclide half-life and abundance. The software also reviews the standard certificate file to review the calibration standard uncertainty. A 5% factor is added in quadrature (the square root of the sum of the squares) due to the error in the sample volume, the chemical yield and geometry reproducibility.

$$TPU_S = (1.96)\,|ACT_S|\sqrt{U_C^2 + U_E^2 + U_{Ab}^2 + U_{t1/2}^2 + U_Y^2 + U_V^2 + U_{Prep}^2}$$

Where:

U_C^2	=	Stochastic counting uncertainty
U_E^2	=	Uncertainty in efficiency
U_{Ab}^2	=	Uncertainty in abundance
$U_{t1/2}^2$	=	Uncertainty in half-life
U_Y^2	=	Uncertainty in yield
U_V^2	=	Uncertainty in volume
U_{Prep}^2	=	Uncertainty in prep

Following is the alpha spectroscopy Minimum Detectable Concentration (MDC)

$$MDC = \frac{4.65 * \sqrt{R_B * t_S} + 2.71}{2.22 * E * Ab * Y * D * V_A * t_S}$$

Where:

MDC	=	Minimum Detectable Activity/Concentration of the sample
RB	=	Count rate of detector background (in cpm)
E	=	Detector efficiency
Ab	=	Abundance of the alpha emission
Y	=	Yield
D	=	Decay
t_s	=	Count time for analysis
V_A	=	Sample aliquot volume

Tracer Yield Recovery

$$Y = \frac{(C_T - C_B)}{E * A_T * t_S}$$

Where:

Y	=	Chemical Yield
C_T	=	Tracer Counts
C_B	=	Tracer ROI background counts
A_T	=	Tracer dpm
t_s	=	Count time for analysis
E	=	Detector efficiency

Upon request, and with discussion as to the specification of the application, the laboratory will provide MDAs calculated using non-paired observations as noted below in the DOE QSAS.

When sample and background counts are different, the following equation is used.

$$MDA = \frac{3.29\sqrt{\frac{b}{T_s} + \frac{b}{T_b}}}{K} + \frac{3}{K * Ts}$$

where

b = background count rate in cpm
T = count time in minutes
K = efficiency * $e^{\lambda t}$ * aliquot taken * tracer recovery * ABN
Efficiency = detector efficiency
T = time from sample collection to mid-point of count time (or nuclide separation, as applicable)
Λ – Analyte decay constant = ln2/(half-life)
ABN = abundance
T_s = count time of the sample in minutes
T_b = count time of the background in minutes

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Carbon-14 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645 \cdot \sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: R=1, A=1, P=0.037

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TestAmerica
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Equations for
Chlorine-36 by GFPC

Activity

$$\left(\frac{(SampleCPM - BkgCPM)}{DEIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Court Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: R=1, A=1, P=0.040

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TestAmerica
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Equations for

Gross Alpha-Beta Solid, Direct Count

Activity

$$\left(\frac{(\text{SampleCPM} - \text{BkgCPM})}{\text{DEIVRA}}\right) \times \text{UnitCorrectionFactor}$$

CPM, Crosstalk Corrected

$$\left(\frac{(C_s - C_x)}{T_s}\right)$$

Where:
C_x = CrosstalkCounts

Cross Talk Count Determination

$$C_s \times \left(\text{Intercept} + \left((\text{ResidualMass})^3 \times V3\right) + \left((\text{ResidualMass})^2 \times V2\right) + \left((\text{ResidualMass}) \times V1\right)\right)$$

Where:
V3 = 3rd Order Cross Talk Variable
V2 = 2nd Order Cross Talk Variable
V1 = 1st Order Cross Talk Variable

Note : C_s denotes α counts for β determination, or β counts for α determination

DER (Normalized Absolute Difference)

$$\text{abs}\left(\frac{(\text{SampleActity} - \text{SampleDuplicateActity})}{\sqrt{(\text{SampleUncertainty})^2 + (\text{SampleDuplicateUncertainty})^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645 \sqrt{2 \times (CPM_b \times T_s)}}{\text{DEIVTRA}}\right) \times \text{UnitCorrectionFactor}$$

Efficiency

$$\text{Intercept} + \left((\text{ResidualMass})^3 \times V3\right) + \left((\text{ResidualMass})^2 \times V2\right) + \left((\text{ResidualMass}) \times V1\right)$$

Where:
V3 = 3rd Order Efficiency Variable
V2 = 2nd Order Efficiency Variable
V1 = 1st Order Efficiency Variable

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{\text{CPMb}}{\text{Ts}} + \frac{\text{CPMb}}{\text{Tb}}}}{\text{D} \times \text{Ex} \times \text{V} \times \text{R} \times \text{A}}\right) + \frac{2.71}{\text{D} \times \text{Ex} \times \text{V} \times \text{Ts} \times \text{R} \times \text{A}}\right) \times \text{DilutionFactor} \times \text{UnitConversionFactor}$$

RER (DOE Alberqueque)

$$\text{abs}\left(\frac{(\text{SampleActivity} - \text{SampleDuplicateActivity})}{(\text{SampleUncertainty} + \text{SampleDuplicateUncertainty})}\right)$$

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As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2}+\frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2+(A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = Propogated Error Factor

Equation Legend:
- C = counts
- D = Decay Factor
- E = Efficiency
- I = Ingrowth Factor
- V = Volume (aliquot)
- T = Time (count duration)
- R = Recovery (carrier/tracer yield)
- A = Abundance
- P = Propogated Error Factor
- s (subscript) = denotes factor is associated with analytical sample
- b (subscript) = denotes factor is associated with background sample
- x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.040 for alpha, P=0.037 for beta

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Equations for
Gross Alpha-Beta, Total Dissolution

Activity

$$\left(\frac{(SampleCPM - BkgCPM)}{DEIVRA}\right) \times UnitCorrectionFactor$$

CPM, Crosstalk Corrected

$$\left(\frac{(C_s - C_x)}{T_s}\right)$$

Where :
C_x – CrosstalkCounts

Cross Talk Count Determination

$$C_s \times \left(Intercept + \left((ResidualMass)^3 \times V3\right) + \left((ResidualMass)^2 \times V2\right) + \left((ResidualMass) \times V1\right)\right)$$

Where :
V3 = 3rd Order Cross Talk Variable
V2 = 2nd Order Cross Talk Variable
V1 = 1st Order Cross Talk Variable

Note : C_s denotes α counts for β determination, or β counts for α determination

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

Efficiency

$$Intercept + \left((ResidualMass)^3 \times V3\right) + \left((ResidualMass)^2 \times V2\right) + \left((ResidualMass) \times V1\right)$$

Where :
V3 = 3rd Order Efficiency Variable
V2 = 2nd Order Efficiency Variable
V1 = 1st Order Efficiency Variable

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times Ei \times V \times R \times A}\right) + \frac{2.71}{D \times Ei \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

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As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2}+\frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2+(A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = Propogated Error Factor

Equation Legend:
- C = counts
- D = Decay Factor
- E = Efficiency
- I = Ingrowth Factor
- V = Volume (aliquot)
- T = Time (count duration)
- R = Recovery (carrier/tracer yield)
- A = Abundance
- P = Propogated Error Factor
- s (subscript) = denotes factor is associated with analytical sample
- b (subscript) = denotes factor is associated with background sample
- x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.040 for alpha, P=0.037 for beta

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Equations for

Iodine-129, Precipitation Method by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{DigestionVolume - InitialTracerSplit}{DigestionVolume}\right) \times \left(\frac{ElutionVolume - FinalTracerSplit}{ElutionVolume}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to account for the portion of sample removed for chemical recovery (R) determination.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

Recovery, Yield

$$\frac{TracerConcFinal - \left(\frac{ElutionVolume}{TracerSplitFinal}\right)}{TracerConcInitial - \left(\frac{DigestionVolume}{TracerSplitInitial}\right)}$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, R=1, A=1, P=0.037

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Equations for

Iodine-129 by LCS w/ Gravimetric Carrier

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, R=1, A=1, P=0.037

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TestAmerica
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Equations for
Iron-55 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{DigestionVolume - InitialTracerSplit}{DigestionVolume}\right) \times \left(\frac{ElutionVolume - FinalTracerSplit}{ElutionVolume}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to account for the portion of sample removed for chemical recovery (R) determination.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(\frac{3.29 \times \sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

Recovery, Yield

$$\frac{TracerConcFinal - \left(\frac{ElutionVolume}{TracerSplitFinal}\right)}{TracerConcInitial - \left(\frac{DigestionVolume}{TracerSplitInitial}\right)}$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R-1, A=1, P=0.042

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Lead-210 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{DigestionVolume - InitialTracerSplit}{DigestionVolume}\right) \times \left(\frac{ElutionVolume - FinalTracerSplit}{ElutionVolume}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to account for the portion of sample removed for chemical recovery (R) determination.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

Recovery, Yield

$$\frac{TracerConcFinal - \left(\frac{ElutionVolume}{TracerSplitFinal}\right)}{TracerConcInitial - \left(\frac{DigestionVolume}{TracerSplitInitial}\right)}$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, A=1, P=0.039

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Nickel-59/63 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

Recovery, Yield

$$\frac{TracerConcFinal - \left(\frac{ElutionVolume}{TracerSplitFinal}\right)}{TracerConcInitial - \left(\frac{DigestionVolume}{TracerSplitInitial}\right)}$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: I=1, A=1, P=0.042 for Ni-59, P=0.039 for Ni-63

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Plutonium-241 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645 \cdot \sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left[3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right] + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: A=1, P=0.045

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TestAmerica
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Equations for
Promethium-147 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{VolumeCounted}{FinalVolume}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to represent the the amount of sample actually counted.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: A=1, P=0.042

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TestAmerica
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Equations for
Radium-226

Activity

$$\left(\frac{(SampleCPM - BkgCPM)}{DEIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertaint)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

Ingrowth Factor

$$1 + \left(3 \times \left(1 - E^{\left(\frac{-0.6931}{Rn222HalfLife}\right)} \times \left(\left(CountDateTime + \left(\frac{T_s}{2880}\right)\right) - Ba\,PrecipitationTime\right) \times 1440\right)\right)$$

Corrects for ingrowth of Ra-222

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: I=1, A=1, P=0.039

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Equations for
Radium-228

Activity

$$\frac{(CPM_s - CPM_b)}{V \times E \times R} \times \frac{\lambda \times t_2}{1 - EXP(-\lambda \times t_2)} \times \frac{1}{1 - EXP(-\lambda \times t_3)} \times \frac{1}{EXP(-\lambda t_1)} \times UnitCorrectionFactor$$

Where:
t_1 = Count Start Time - Y Precipitation Time
t_2 = Sample Count Duration
t_3 = Y Precipitation Time - Y Ingrowth Start Time
λ = Ac-228 Halflife (in days)
NOTE: Recovery (R) is product of Ba Yield x Y Yield

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\frac{\left(1.645 x \sqrt{2 x CPM_b x T_s}\right) x (\lambda t_2)}{V x E x R x T_s x (1 - EXP(-\lambda t_2)) x (1 - EXP(-\lambda t_3)) x EXP(-\lambda t_1)} x Unit\ Correction\ Factor$$

Where:
$t_1 = Count\ Start\ Time\ x\ Y\ precipitation\ Time$
$t_2 = Sample\ Count\ Duration$
$t_3 = Y\ precipitation\ Time - Y\ Ingrowth\ Start\ Time$
$\lambda = Ac - 228\ Halflife$
Note: Recovery (R) is product of Ba Yield x Y Yield

MDA

$$\frac{\left(\left(3.29 x \sqrt{\frac{CPM_b}{T_s} + \frac{CPM_b}{T_b}}\right) + \frac{2.71}{T_s}\right) x (\lambda t_2)}{V x E x R x (1 - EXP(-\lambda t_2)) x (1 - EXP(-\lambda t_3)) x EXP(-\lambda t_1)} x Unit\ Correction\ Factor$$

Where:
$t_1 = Count\ Start\ Time\ x\ Y\ precipitation\ Time$
$t_2 = Sample\ Count\ Duration$
$t_3 = Y\ precipitation\ Time - Y\ Ingrowth\ Start\ Time$
$\lambda = Ac - 228\ Halflife$
Note: Recovery (R) is product of Ba Yield x Y Yield

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

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Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = Propogated Error Factor

Equation Legend:
- C = counts
- D = Decay Factor
- E = Efficiency
- I = Ingrowth Factor
- V = Volume (aliquot)
- T = Time (count duration)
- R = Recovery (carrier/tracer yield)
- A = Abundance
- P = Propogated Error Factor
- s (subscript) = denotes factor is associated with analytical sample
- b (subscript) = denotes factor is associated with background sample
- x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: A=1, P=0.040

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TestAmerica
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Equations for
Strontium, Total by GFPC

DER (Normalized Absolute Difference)

$$\text{abs}\left(\frac{(\text{SampleActivity}-\text{SampleDuplicateActivity})}{\sqrt{(\text{SampleUncertainty})^2+(\text{SampleDuplicateUncertainty})^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2\times(\text{CPM}_b\times T_s)}}{\text{DEIVTRA}}\right)\times\text{UnitCorrectionFactor}$$

Ingrowth Factor

$$1+\left(1-e^{(-\lambda t_1)}\right)$$

Where :

$\lambda = Y-90$ *Halflife*

$t_1 = Y$ *Separation Time to Midpoint of Count*

MDA

$$\left(\left(3.29\times\frac{\sqrt{\frac{\text{CPMb}}{\text{Ts}}+\frac{\text{CPMb}}{\text{Tb}}}}{\text{D}\times\text{E}\times\text{I}\times\text{V}\times\text{R}\times\text{A}}\right)+\frac{271}{\text{D}\times\text{E}\times\text{I}\times\text{V}\times\text{Ts}\times\text{R}\times\text{A}}\right)\times\text{DilutionFactor}\times\text{UnitConversionFactor}$$

RER (DOE Alberqueque)

$$\text{abs}\left(\frac{(\text{SampleActivity}-\text{SampleDuplicateActivity})}{(\text{SampleUncertainty}+\text{SampleDuplicateUncertainty})}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2}+\frac{C_b}{(T_b)^2}}}{\text{DEIVRA}}\times\text{UnitCorrectionFactor}\times\text{DilutionFactor}\times\text{Sigma}$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2+(A\times P)^2}\times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: A=1, P=0.035

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TestAmerica
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Equations for
Strontium-90 by GFPC

Activity, Sr-90

$$\frac{CPMs - CPMb}{DEIVRA} \times DilutionFactor \times UnitConversionFactor$$

NOTE: Recovery (R) is product of Y Yield and Total Sr Yield

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC, Sr-90

$$\left(\frac{1.64S\sqrt{2\times(CPM_b \times T_s)}}{DEIVTRA}\right) \times DilutionFactor \times UnitCorrectionFactor$$

NOTE: Recovery(R) is product of Y Yield and Total Sr Yield

MDA, Sr-90

$$\left(\left(3.29\times\frac{\sqrt{\frac{CPMb}{Ts}+\frac{CPMb}{Tb}}}{DEIVRA}\right)+\frac{2.71}{DEIVT_sRA}\right)\times DilutionFactor \times UnitConversionFactor$$

NOTE: Recovery(R) is product of Y Yield and Total Sr Yield

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2}+\frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = Propogated Error Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: A=1, P=0.041

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Equations for
Strontium-89 by GFPC

Activity

$$\left(\frac{(SampleCPM - BkgCPM)}{DEIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: A=1

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TestAmerica
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Equations for
Total Activity by LSC

Activity

$$\left(\frac{SampleDPM - BkgDPM}{\left(\frac{VolumeCounted}{VolumeCollected}\right) \times Aliquot}\right) \times UnitConversionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{VolumeCounted}{FinalVolume}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to represent the the amount of sample actually counted.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.055

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TestAmerica
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Equations for
Radium, Total Alpha-Emitting

Activity

$$\left(\frac{(SampleCPM - BkgCPM)}{DEIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

Ingrowth Factor

$$1 + \left(3 \times \left(1 - E^{\left(\frac{-0.6931}{Rn222Halflife}\right) \times \left(\left(CountDateTime + \left(\frac{T_s}{2880}\right)\right) - Ra\,PrecipitationTime\right) \times 1440}\right)\right)$$

Corrects for ingrowth of Ra-222

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: I=1, A=1, P=0.039

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TestAmerica
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Equations for
Tritium, Cryogenic

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{VolumeCounted}{VolumeAdded + (SampleAliquot \times PercentMoisture)}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to represent the the amount of sample actually counted.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.030

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Tritium in Silica Gel, Brookhaven

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertaint)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times EI \times V \times R \times A}\right) + \frac{2.71}{D \times EI \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.030

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THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Tritium in Silica Gel, Pantex

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times EI \times V \times R \times A}\right) + \frac{2.71}{D \times EI \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.030

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Tritium in Soil by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{VolumeCounted}{VolumeAdded + (SampleAliquot \times PercentMoisture)}\right)$$

NOTE: This value is used for the V coefficient in other listed equations. The aliquot is adjusted to represent the the amount of sample actually counted.

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.030

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Tritium in Liquid by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645 \cdot \sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, R=1, A=1, P=0.030

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Technecium-99 by LSC

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActity - SampleDuplicateActity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \sqrt{\frac{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}{D \times E \times I \times V \times R \times A}}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, A=1, P=0.042

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for

Thorium, Isotopic by Alpha Spectroscopy

Activity

$$\left(\frac{(SampleCPM - BkgCPM)}{DEIVRA}\right) \times UnitCorrectionFactor$$

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645 \cdot \sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

RER (DOE Alberqueque)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{(SampleUncertainty + SampleDuplicateUncertainty)}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError Factor

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

Constants: D=1, I=1, A=1, P=0.042

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Uranium, Total by KPA

DER (Normalized Absolute Difference)

$$\text{abs}\left(\frac{(\text{SampleActivity}-\text{SampleDuplicateActivity})}{\sqrt{(\text{SampleUncertainty})^2+(\text{SampleDuplicateUncertainty})^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2\times(CPM_b\times T_s)}}{DEIVTRA}\right)\times\text{UnitCorrectionFactor}$$

MDA

$$\left(\left(3.29\times\frac{\sqrt{\frac{CPMb}{Ts}+\frac{CPMb}{Tb}}}{D\times E\times I\times V\times R\times A}\right)+\frac{271}{D\times E\times I\times V\times Ts\times R\times A}\right)\times\text{DilutionFactor}\times\text{UnitConversionFactor}$$

RER (DOE Alberqueque)

$$\text{abs}\left(\frac{(\text{SampleActivity}-\text{SampleDuplicateActivity})}{(\text{SampleUncertainty}+\text{SampleDuplicateUncertainty})}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Result

$$\left(\frac{(\text{InstrumentConc}_{(ug/L)}\times\text{InstrumentDilution}\times\text{DigestionVolume})}{\text{Aliquot}\times 1000}\right)\times\text{UnitCorrectionFactor}$$

Uncertainty, Count

$$\text{Result}\times\text{Sigma}\times\frac{\text{InstrumentUncertainty}}{\text{InstrumentConc}}$$

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2}+\frac{C_b}{(T_b)^2}}}{DEIVRA}\times\text{UnitCorrectionFactor}\times\text{DilutionFactor}\times\text{Sigma}$$

Uncertainty, Total

$$\text{Result}\times\text{Sigma}\times\sqrt{\left(\frac{\text{InstrumentUncertainty}}{\text{InstrumentConc}}\right)^2+0.025}$$

Uncertainty, Total Propogated

$$\sqrt{\left(\frac{U_c}{S}\right)^2+(A\times P)^2}\times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity

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Equation Legend:

C = counts
D = Decay Factor
E = Efficiency
I = Ingrowth Factor
V = Volume (aliquot)
T = Time (count duration)
R = Recovery (carrier/tracer yield)
A = Abundance
P = Propogated Error Factor
s (subscript) = denotes factor is associated with analytical sample
b (subscript) = denotes factor is associated with background sample
x (subscript) = denotes factor is associated with crosstalk correction (Gross alpha/beta only)

NOTE: Some factors listed may not apply to this analysis.

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Appendix 7

TestAmerica SOP List

Dept	SOP Number	SOP Title
GC/HPLC	ST-GC-0005	Extractable Total Petroleum Hydrocarbons
GC/HPLC	ST-GC-0013	Extraction and analysis of Phenols
GC/HPLC	ST-GC-0014	Aromatic Volatiles and Volatile Petroleum Hydrocarbons
GC/HPLC	ST-GC-0015	PCB GC Analysis
GC/HPLC	ST-GC-0016	Pesticide GC Analysis
GC/HPLC	ST-GC-0017	Herbicide GC Analysis
GC/HPLC	ST-GC-0018	Analysis of Water Miscible Non-Halogenated Organic Compounds
Health and Safety	ST-HS-0001	Waste Minimization Plan
Health and Safety	ST-HS-0002	Facility Addendum to Corporate Safety Manual
Health and Safety	ST-HS-0003	St. Louis Facility Contingency Plan
Health and Safety	ST-HS-0004	Hazardous Waste Management Plan
Health and Safety	ST-HS-0005	Laboratory Security Systems
Health and Safety	ST-HS-0006	Quarantine Soils Procedure
Health and Safety	ST-HS-0007	Fume Hood Calibration
Inorganic Prep	ST-IP-0001	Reactive Cyanide & Sulfide
Inorganic Prep	ST-IP-0002	Acid Digestion of soil
Inorganic Prep	ST-IP-0013	Acid Digestion of Aqueous Samples & Extracts
Inorganic Prep	ST-IP-0014	Alkaline Digestion of Hexavalent Chromium
Inorganic Prep	ST-IP-0015	Filtration Procedure for Dissolved Metals Analysis
Inorganic Prep	ST-IP-0016	TCLP/SPLP and CWET Procedures
Inorganic Prep	ST-IP-0018	Kd Leaching Procedure
Inorganic Prep	ST-IP-0019	Sulfide Distillation
Information Technology	ST-IS-0001	Software Change Management
Information Technology	ST-IS-0002	Software Testing, Validation & Verification
Information Technology	ST-IS-0003	Information Systems
GC/HPLC	ST-LC-0001	HPLC Analysis of PAH/PNA
GC/HPLC	ST-LC-0002	Analysis of Nitroaromatic & Nitroamine Explosives
GC/HPLC	ST-LC-0004	Analysis of Perchlorates by LC/MS/MS
GC/HPLC	ST-LC-0005	Analysis of Nitroaromatics by LC/MS/MS
GCMS	ST-MS-0001	GC/MS Analysis based on 8270C and 625
GCMS	ST-MS-0002	Volatile Organics by GCMS
Metals	ST-MT-0001	Metals by ICP/MS
Metals	ST-MT-0003	Metals by ICP-AES
Metals	ST-MT-0005	Mercury in Aqueous Samples by CVAA
Metals	ST-MT-0007	Mercury in Solid Samples by CVAA
Metals	ST-MT-0008	Total Uranium by KPA

Organic Prep	ST-OP-0001	Labware Preparation for Organic Analysis
Organic Prep	ST-OP-0002	Extraction & Cleanup of Organic Compounds
Organic Prep	ST-OP-0007	Extraction of Herbicieds - Water & Soil
Organic Prep	ST-OP-0008	Extraction of Nitroaromatics
Project Management	ST-PM-0001	Project Setup and Quote
Project Management	ST-PM-0002	Sample Receipt & Chain of Custody
Project Management	ST-PM-0003	Bottle Kit Preparation
Project Management	ST-PM-0004	Data Review, Verification & Reporting
Quality Assurance	ST-QA-0002	Standard and Reagent Preparation
Quality Assurance	ST-QA-0005	Calbration & Verification Procedure for Thermometers
Quality Assurance	ST-QA-0014	Evaluation of Accuracy and Precision via Control Charts
Quality Assurance	ST-QA-0016	IDL/MDL Determination
Quality Assurance	ST-QA-0021	Internal Surveillance
Quality Assurance	ST-QA-0023	Document Control
Quality Assurance	ST-QA-0024	Preventative Maintenance
Quality Assurance	ST-QA-0028	Water System Maintenance & Monitoring
Quality Assurance	ST-QA-0031	VOA Holding Blank Analysis
Quality Assurance	ST-QA-0035	Preparation and Management of SOPs
Quality Assurance	ST-QA-0036	Non-Conformance Memo Process
Quality Assurance	ST-QA-0037	Procurement of Quality Related Items
Quality Assurance	ST-QA-0038	Procedure for Compositing and Subsampling
Quality Assurance	ST-QA-0039	Sample Transfer Utility
Quality Assurance	ST-QA-0040	Manual Integration Procedure
Rad Prep	ST-RC-0002	Planchet Prep for Radiochemistry
Rad Prep	ST-RC-0003	Drying & Grinding of Soil & Solid Samples
Rad Prep	ST-RC-0004	Prep of Soil, Sludge, Filter, Biota &)/G Samples
Rad Prep	ST-RC-0010	Screening Samples for Presence of Radioactive Materials
Rad Prep	ST-RC-0015	Total Activity Screening Procedure by LSC
Rad Prep	ST-RC-0020	Determination of Gross Alpha/Beta Activity
Rad Prep	ST-RC-0021	Gross Alpha Radiation in Water - Coprecipitation
Rad Prep	ST-RC-0025	Preparation of Samples for Gamma Spectroscopy
Rad Prep	ST-RC-0030	Determination of Tritium in Water, Fluids, Soil
Rad Prep	ST-RC-0031	Tritium Determination by Cryogenic Distillation
Rad Prep	ST-RC-0039	Radium 226 by Alpha Spec
Rad Prep	ST-RC-0040	Total Alpha Emitting Isotopes of Radium
Rad Prep	ST-RC-0041	Radium 228 in Water
Rad Prep	ST-RC-0042	Iodine-129 in Water
Rad Prep	ST-RC-0050	Preparation of Strontium 89 & 90
Rad Prep	ST-RC-0055	Determination of Fe55, Ni59 & Ni63 by LSC
Rad Prep	ST-RC-0056	Carbon-14 by LSC

Rad Prep	ST-RC-0100	Actinide Coprecipitation
Rad Prep	ST-RC-0125	Determination of TC99 using Eichrom Teva Resin
Rad Prep	ST-RC-0210	Determination of Po210 by Alpha Spectrometry
Rad Prep	ST-RC-0211	Determination of Pb210 by LSC
Rad Prep	ST-RC-0232	Isotopic Th/Np in Various Matrices by Eichrom Teva
Rad Prep	ST-RC-0238	Isotopic U by Eichrom UTEVA Reson for Various Matrices
Rad Prep	ST-RC-0240	Isotopic Am/Cu/Pu/Th/U in Various Matrices Eichrom
Rad Prep	ST-RC-0241	Am/Pu/Cu/U in Various Matrices by Eichrom UTEVA
Rad Prep	ST-RC-0242	Isotopic Th/Pu/U in Various Matrices by Eichrom Separation
Rad Prep	ST-RC-0245	Determination of Pu241 by LSC
Rad Prep	ST-RC-0246	Isotopic Am/Cu/U in Various Matrices by Eichrom S
Rad Prep	ST-RC-0247	Promethium247 & Samarium151 Lanthide Resin Separation
Rad Prep	ST-RC-0300	NJ 48 Hour Gross Alpha Testing PWTA
Rad Prep	ST-RC-5006	Decontamination of Lab Glassware, Labware & Equipment
Radiochemistry	ST-RD-0102	Gamma Vision Analysis
Radiochemistry	ST-RD-0210	Alpha spectroscopy
Radiochemistry	ST-RD-0302	Liquid Scintillation Counter Analysis
Radiochemistry	ST-RD-0403	Low Background Gas Flow Proportional Counting
Radiation Protection	ST-RP-0001	Radiation Protection Program
Radiation Protection	ST-RP-0005	ALARA Program
Radiation Protection	ST-RP-0010	Internal Exposure Control
Radiation Protection	ST-RP-0020	External Exposure Control
Radiation Protection	ST-RP-0030	Radiological Contamination
Radiation Protection	ST-RP-0031	Radiation Work Permits
Radiation Protection	ST-RP-0032	Instrumentation and surveillance
Radiation Protection	ST-RP-0033	Radiological Areas and Posting
Radiation Protection	ST-RP-0034	Engineered Controls
Radiation Protection	ST-RP-0042	Handling of Sealed Sources
Radiation Protection	ST-RP-0050	Purchase, Receipt, Handling and ID of Radioactive Material
Radiation Protection	ST-RP-0051	Packaging/Transportation of Radioactive Material
Radiation Protection	ST-RP-0100	Radiation Protection Records
Radiation Protection	ST-RP-0110	Radiation Protection Training
Radiation Protection	ST-RP-0120	Emergency Response & notification
Radiation Protection	ST-RP-0140	Quality Assurance in Radiological Protection
Wet Chemistry	ST-WC-0001	Turbidity
Wet Chemistry	ST-WC-0002	Cyanide Analysis by Technicon TRAACS 800
Wet Chemistry	ST-WC-0003	Hardness
Wet Chemistry	ST-WC-0004	Chemical Oxygen Demand
Wet Chemistry	ST-WC-0005	Percent Solids Determination
Wet Chemistry	ST-WC-0006	Total Organic Halides in Water (TOX) and Soil(EOX)

Wet Chemistry	ST-WC-0009	Oil & Grease (Partition-Gravimetric Method)
Wet Chemistry	ST-WC-0011	Analysis of pH in Water & Soil
Wet Chemistry	ST-WC-0012	Analysis of Sulfide in Water
Wet Chemistry	ST-WC-0013	Phosphorus, all Forms
Wet Chemistry	ST-WC-0014	Analysis of Ammonia as N in Water & Soil
Wet Chemistry	ST-WC-0015	Biochemical Oxygen Demand
Wet Chemistry	ST-WC-0016	Total Organic Carbon
Wet Chemistry	ST-WC-0017	Phenolics, Total Recoverable
Wet Chemistry	ST-WC-0019	Alkalinity in Water & Soil
Wet Chemistry	ST-WC-0023	Nitriate/Nitrite analysis by TRAACS
Wet Chemistry	ST-WC-0025	Conductivty in Water & Soil
Wet Chemistry	ST-WC-0026	Flashpoint by Pensky-Martens Closed Cup
Wet Chemistry	ST-WC-0028	Anions by Ion Chromatography
Wet Chemistry	ST-WC-0031	Paint Filter
Wet Chemistry	ST-WC-0033	Hexavalent Chromium
Wet Chemistry	ST-WC-0034	Heat of Combustion
Wet Chemistry	ST-WC-0036	Determination of Solids in Water and Wastewater
Wet Chemistry	ST-WC-0039	Method 1664, N-Hexane Extractable Material
Wet Chemistry	ST-WC-0042	Chlorophyll-a
Wet Chemistry	ST-WC-0044	Potentiometric Determination of Fluoride ISE
Wet Chemistry	ST-WC-0046	Reactivity to Air, Water, Physcial Properties