Quality Assurance Manual

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Facility Distribution No.: 0 **Distributed To:** See Electronic Distribution Sheet

Title Page:

Quality Assurance Manual
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SECTION 2. TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

REFERENCED CORPORATE SOPs AND POLICIES

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-003	Internal Auditing
CA-Q-S-005	Calibration Curves
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-004	Management Systems Review
CW-L-S-002	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CW-L-P-004	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
CA-T-P-002	Selection of Calibration Points
CA-I-P-002	Electronic Reporting and Signature Policy
CW-F-S-007	Controlled Purchases Policy
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

TestAmerica St. Louis Standard Operating Procedures are listed in Appendix 7.

SECTION 3. INTRODUCTION, SCOPE AND APPLICABILITY

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 U.S. Department of Energy Quality Systems for Analytical Services (QSAS, current revision), U.S. Department of Defense Quality Systems Manual for Environmental Laboratories (QSM, current version), The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. 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 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.
- *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; Final Update IV, January 2008.*
- *U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.2, October 2010.*
- 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, and on-line Editions.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *U.S. Department of Energy* Order 414.1C, *Quality Assurance*, June 17, 2005.
- *U.S. Department of Energy*, *Quality Systems for Analytical Services*, Revision 2.8, January 2012.
- U.S. Department of Defense, *Quality Systems Manual for Environmental Laboratories*, Version 4.2 October 2010
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Federal Register 10CFR 50 Appendix B
- Toxic Substances Control Act (TSCA).
- ASME NQA-1-2000 Quality Assurance Requirements for Nuclear Facility Applications (for nuclear safety related activities)
- ASME NQA-1-1994 Quality Assurance Requirements for Nuclear Facility Applications (for nuclear safety related activities)

- Federal Register 10CFR21

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 processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests 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 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 3.** The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these 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

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself 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".

SECTION 4. MANAGEMENT REQUIREMENTS

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. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica St. Louis is presented in Figure 4-1.

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 Additional Requirements for Laboratories

The responsibility for quality resides 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 laboratory.

4.2.2 Laboratory Director (LD) or Designee

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 General Manager (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 commercial, financial and other undue pressures which might adversely affect their quality of work
- Supervise all laboratory personnel and provide guidance and direction as needed.
- Ensure 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 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation, maintenance and improvement of the quality system.

The QA Manager reports directly 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 (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officers to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary the procedures may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.

- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a percentage of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Captains the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Has 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 the analytical data.
- Evaluation of the thoroughness and effectiveness of training.
- **Compliance with ISO 17025.** (where applicable)
- 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.
- Has signatory authority over the QAM, SOPs and policies pertaining to QA/QC

4.2.4 Technical Manager or Designee

The Technical Manager(s) report(s) directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision and for compliance with the ISO 17025 Standard. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i.e. SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.

- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc.
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.

4.2.5 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.

4.2.6 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 QA 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

4.2.7 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.

4.2.8 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.

4.2.9 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 QAM 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 self-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.

4.2.10 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.

4.2.11 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

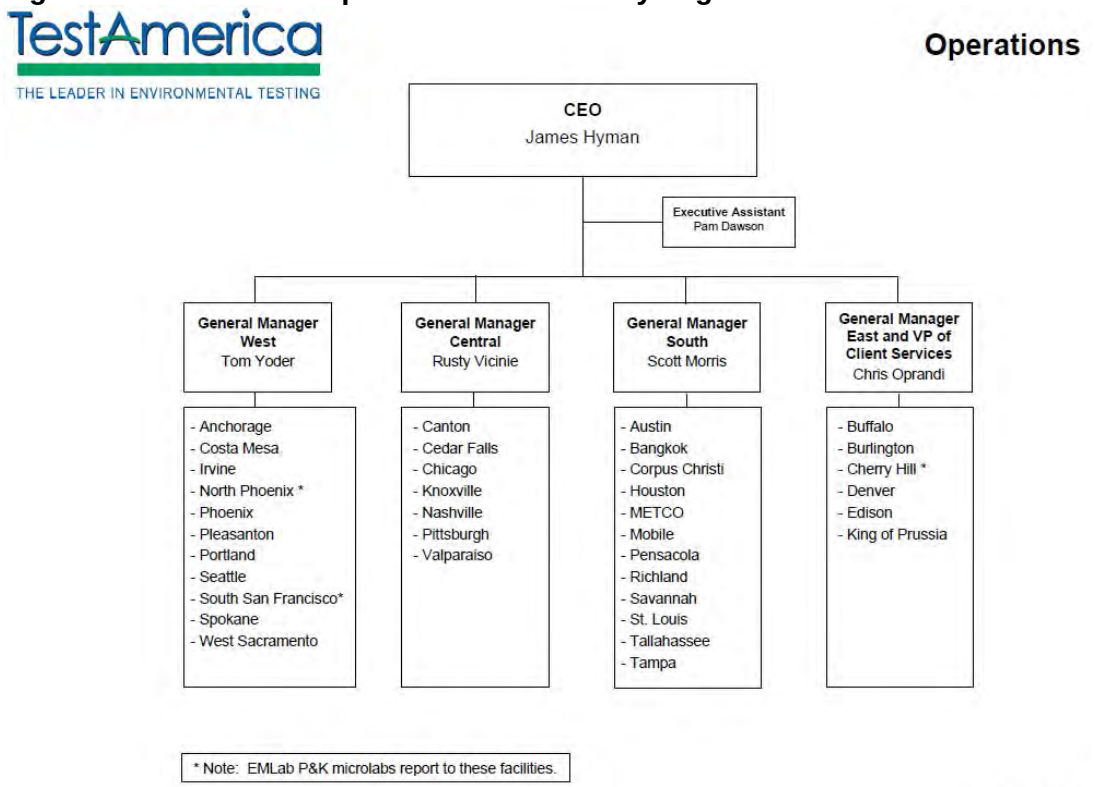
requirements, license provisions, and the Radiation Protection Program.
- Maintains direct access to the Laboratory Director on matters relating to radiological protection.
- Maintains sufficient organizational independence to review and evaluate activities involving the use of radioactive materials.
- 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

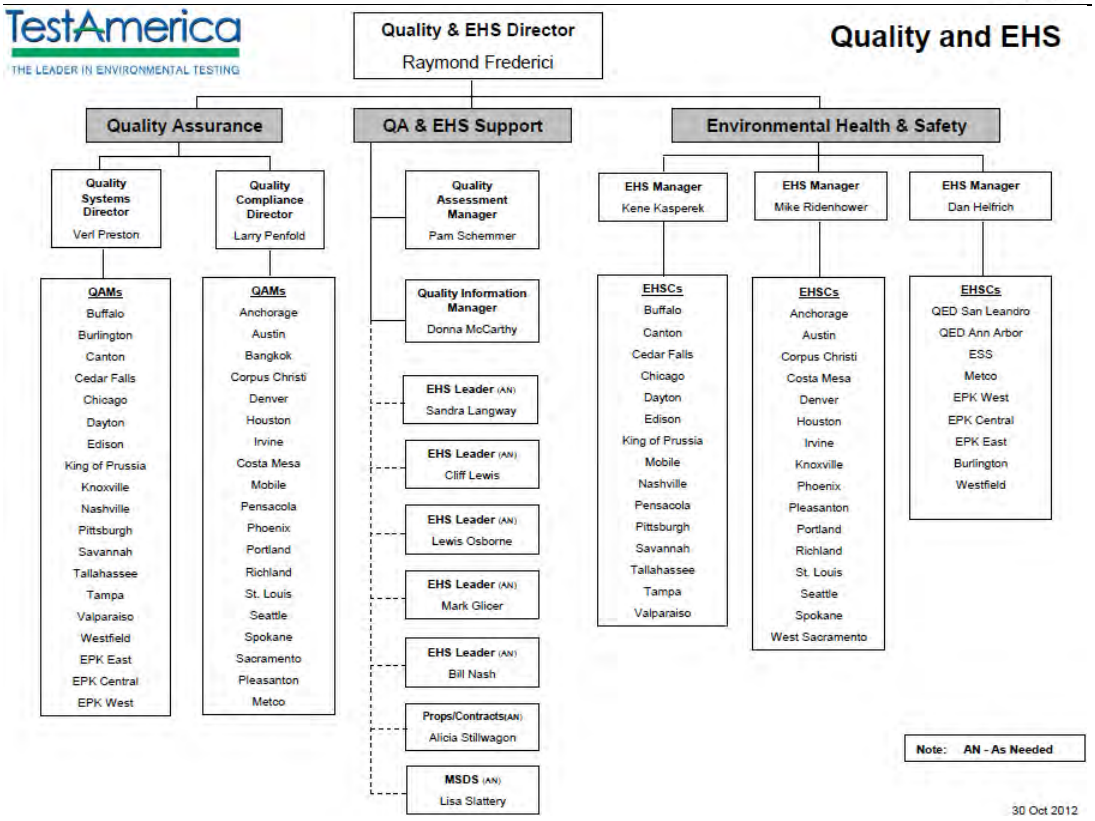
4.3 Deputies

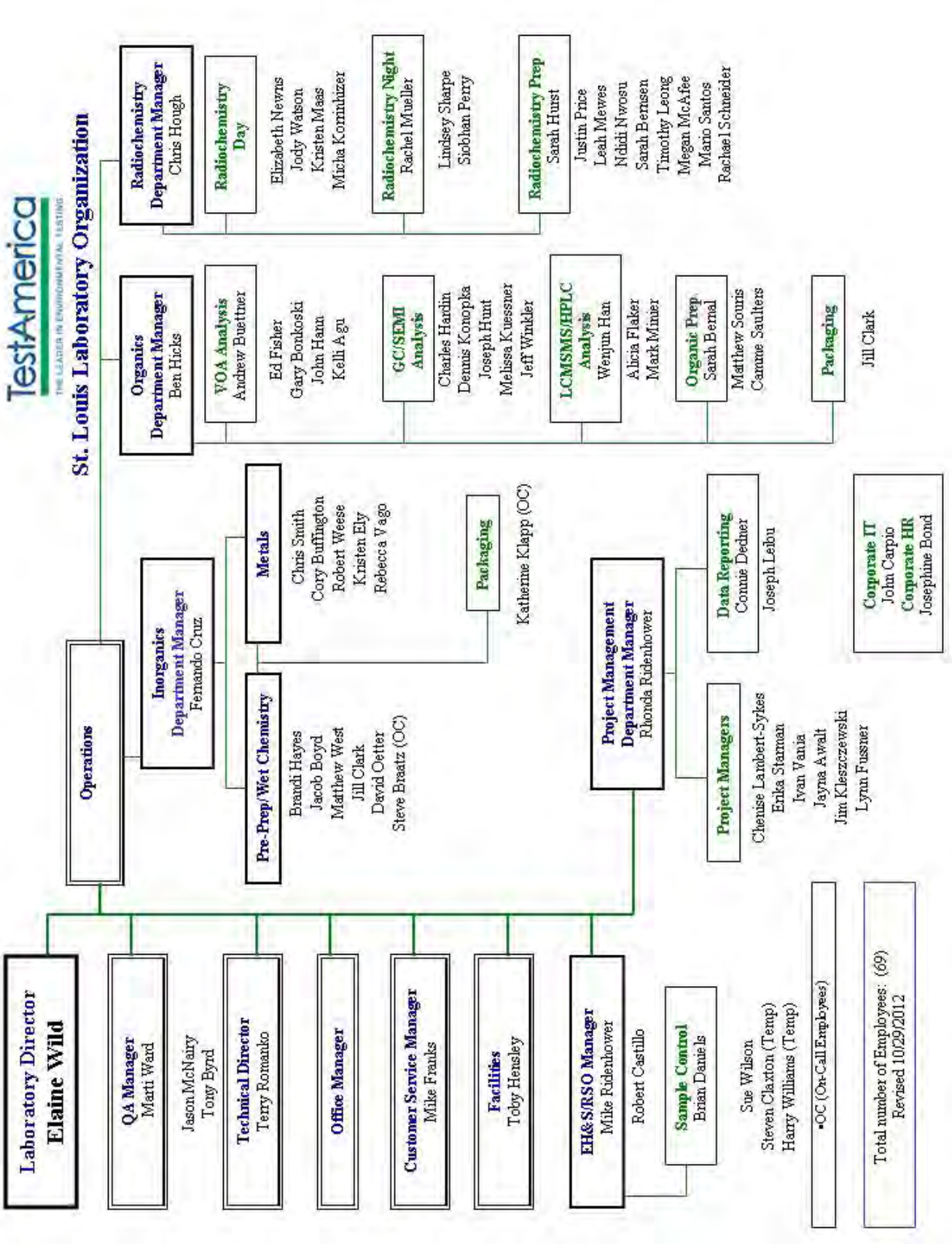
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Elaine Wild Laboratory Director	Michael Franks Customer Service Manager
Marti Ward Quality Manager	Tony Byrd Quality Assurance Specialist
Ben Hicks Organic Technical Manager	Wenjun Han LC/MS/MS Dept. Supervisor
Fernando Cruz Metals Technical Manager	Kristen Ely Metals analyst
Chris Hough Radiochemistry Technical Manager	Terry Romanko Technical Director
Michael Ridenhower EHS Coordinator	Terry Romanko Technical Director
Michael Ridenhower Radiation Safety Officer	Terry Romanko Technical Director
Rhonda Ridenhower Project Management Manager	Jim Kleszczewski Project Manager

Figure 4-1. Corporate and Laboratory Organization Charts






TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
St. Louis Laboratory Organization
Laboratory Director
Elaine Wild
Operations
Inorganics
Department Manager
Fernando Cruz
Metals
Chris Smith
Cory Buffington
Robert Weese
Kristen Ely
Rebecca Vago
Pre-Prep/Wet Chemistry
Brandi Hayes
Jacob Boyd
Matthew West
Jill Clark
David Oetter
Steve Braatz (OC)
Packaging
Katherine Klapp (OC)
Organics
Department Manager
Ben Hicks
VOA Analysis
Andrew Buettner
Ed Fisher
Gary Bonkoski
John Hann
Kelli Agu
GC/SEMI
Analysis
Charles Hardin
Dennis Konopka
Joseph Hunt
Melissa Kuessner
Jeff Winkler
LCMSMS/HPLC
Analysis
Wenjun Han
Alicia Flaker
Mark Miner
Organic Prep
Sarah Bernal
Matthew Souris
Carrine Saulters
Packaging
Jill Clark
Radiochemistry
Department Manager
Chris Hough
Radiochemistry
Day
Elizabeth Newns
Jody Watson
Kristen Maas
Micha Kornmayer
Radiochemistry Night
Rachel Mueller
Lindsey Sharpe
Siobhan Perry
Radiochemistry Prep
Sarah Hurst
Justin Price
Leah Mewes
Ndidi Nwosu
Sarah Bernsen
Timothy Leong
Megan McAfee
Mario Santos
Rachael Schneider
Project Management
Department Manager
Rhonda Ridenhower
Project Managers
Chenise Lambert-Sykes
Erika Starman
Ivan Vania
Jayna Awalt
Jim Kleszczewski
Lynn Fussner
Data Reporting
Connie Dedner
Joseph Leibu
Corporate IT
John Carpio
Corporate HR
Josephine Bond
QA Manager
Marti Ward
Jason McNairy
Tony Byrd
Technical Director
Terry Romanko
Office Manager
Customer Service Manager
Mike Franks
Facilities
Toby Hensley
EH&S/RSO Manager
Mike Ridenhower
Robert Castillo
Sample Control
Brian Daniels
Sue Wilson
Steven Claxton (Temp)
Harry Williams (Temp)
•OC (On-Call Employees)
Total number of Employees: (69)
Revised 10/29/2012

SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- ❖ 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.
- ❖ To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.
- ❖ TestAmerica St. Louis' policy includes compliance with the Department of Defense QSM and the 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.

5.2 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. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- 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. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-L-S-002).

- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- 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 to 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
- Laboratory QA/QC Policy Memorandums
- Laboratory Waste Management Plan
- Laboratory Radiation Safety Program

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 Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies

- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility 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 precedence 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), interelement 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/Detection Limit) or quantified (Reporting Limit/Limit of Quantitation).

5.5 Criteria for Quality Indicators

The laboratory maintains Quality limits Reference Data through the LIMS containing the precision and accuracy acceptability limits for performed analyses. This data is managed by the laboratory's QA department. Printed and/or electronic copies of method specific QC limits are available upon request. Unless otherwise noted, limits are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are contained in SOP ST-QA-0014 and Section 24.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory 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 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

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 to show 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 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

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 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. The laboratory's internal document control procedure is defined in SOP No. ST-QA-0023, "Control of Records".

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 also 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, validation requests and corrective action reports. 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, pagination, the total number of pages of the item or an 'end of document' page, 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 technical manager submits a draft to the QA Department for

suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units (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 annually. Revisions are made as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, refer to SOP No. ST-QA-0035, "Preparation and Management of Standard Operating Procedures". Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. Electronic copies are stored on the Public server in the QA folder.

For changes to SOPs, refer to SOP No. CW-Q-S-002, "Writing a Standard Operating Procedure SOP" and laboratory SOP No. ST-QA-0035, "Preparation and Management of Standard Operating Procedures".

Forms, worksheets, work instructions and information are organized electronically by department in the QA folder on the network server. There is an index. Hard copies are kept in QA files. In order to develop a new form, worksheet or work instruction, the user submits a draft to the QA Department and technical manager for suggestions, approval and validation (where required) before use. Upon approval, QA personnel add the identifying control information to the document. That document is then provided to all applicable operational units (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.

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 marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived as described in Section 14.

SECTION 7. SERVICE TO THE CLIENT

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 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 laboratory'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 process at the TestAmerica St. Louis laboratory.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Sales Directors, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. 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 scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Legal & Contracts Director
- General Manager
- The Laboratory Project Management Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- 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 Sales Director, Legal Contracts Director, Account Executive or 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

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

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 or e-mail chain 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. It is the Project Manager'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.

Project Manager's are the primary client contact and they ensure resources are available to meet project requirements. Although Project Manager's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources is 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 include letters, e-mails, variances and/or contract addendum.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the Client Requirement Memo and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Technical 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 (Section 15 and 25).

Note: ISO 17025 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 25. Special services are also available and provided upon request. These services include:

- Reasonable access for 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 shall 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 Managers/Directors are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our 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's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS

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 accreditation 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. 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 accredited by DoD or its designated representatives.
3. Subcontractor laboratories must receive project-specific approval from the DoD client before any samples are analyzed.
4. 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 sub-client shall document and is responsible for ensuring that such sub-client 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 via Contracts, Task Orders, Laboratory Delivery Orders, etc."

Project Managers (PM), Customer Service Managers (CSM), or Account Executives (AE) 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 Account Executive (AE) 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 is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab. Verify necessary accreditation, where applicable, (e.g., on the subcontractors, 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 accreditation laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

With the exception of DoD and DOE programs noted above, 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. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

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 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 and notify the finance group for JD Edwards.

8.2.2 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.

8.2.3 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.
- 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 Laboratory Directors, 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 EDS, AEs 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 TestAmerica laboratories, certifications can be viewed on the company's TotalAccess 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 TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

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 accreditation 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, the Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

SECTION 9. PURCHASING SERVICES AND SUPPLIES

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, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's 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, laboratory SOP ST-QA-0037, "Procurement of Quality Related Items" and ST-QA0002, "Standard and Reagent Preparation".

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must 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 SOPs.

The procedure for purchasing/ordering quality related items can be found in the laboratory 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 document the date materials where 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 (MSDS) 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

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, analytical reagent grade will 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 and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date.

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Radiochemical standards can be re-verified and a new expiration date applied. See SOP ST-QA-0002, "Standard and Reagent Preparation".

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.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3000 psig of gas should be replaced when it drops to approximately 500 psig. 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 1- µmho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25^{o}C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical–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 (or other similar quality) water 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 bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in electronic files on the network server. These records include date of receipt, lot number (when applicable), and expiration date (when applicable).

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 Health & 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, is 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 instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is 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 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Technical Manager.

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 & 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 J.D. Edwards purchasing system.

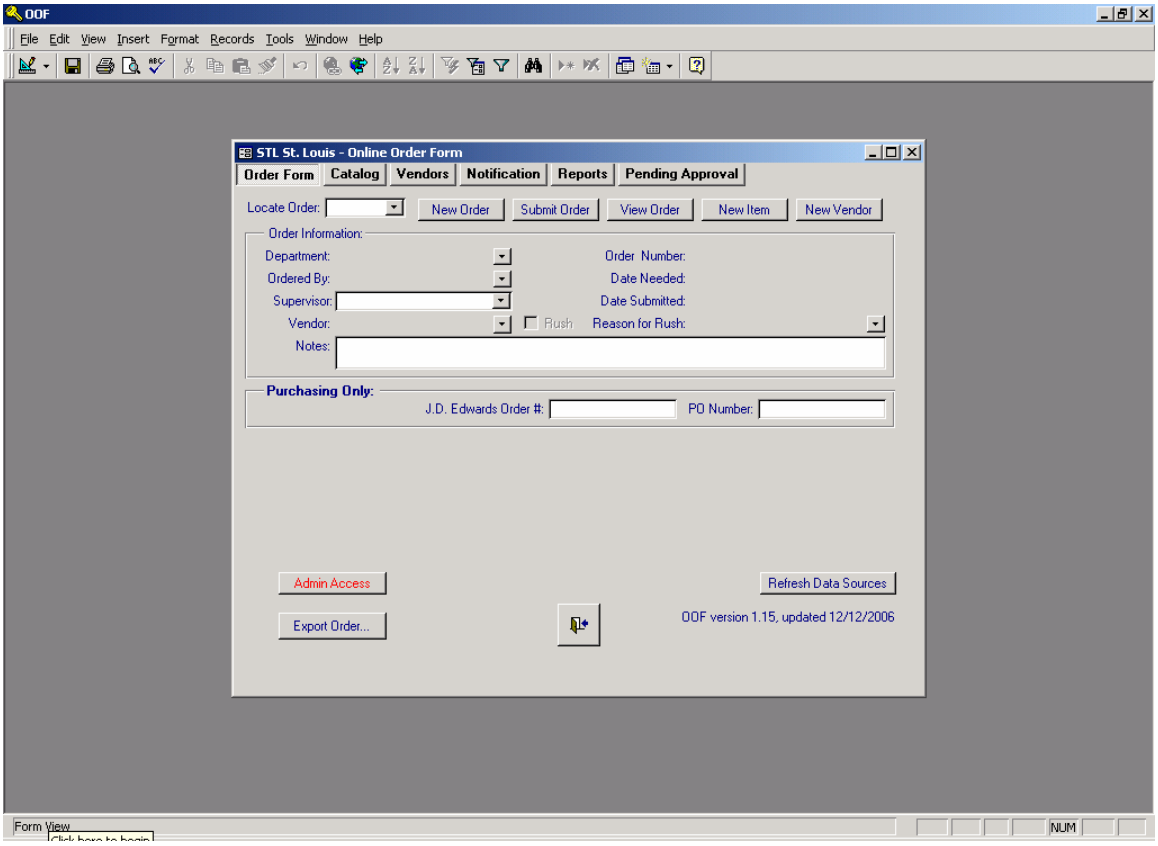
9.6.1 New Vendor Procedure

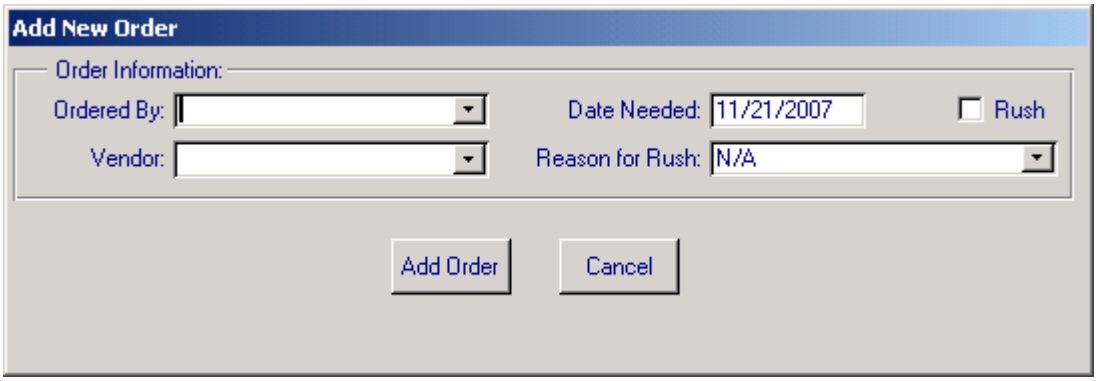
TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

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 Technical Director are consulted with vendor and product selection that have an impact on quality.

Figure 9-1.

Electronic Order Form





SECTION 10. COMPLAINTS

10.1 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 12 (Corrective Actions) and is documented in the laboratory's Validation Database.

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to SOP ST-QA-0036 "Non-conformance Memorandum (NCM)/Validation Request and Corrective Action Processes".

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 likelihood 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.

10.3 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 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory 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 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action 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 12).

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 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 12. This information can then be supplied to the client in the case narrative sent 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 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Technical Manager Director 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.

11.2 Responsibilities and Authorities

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CW-L-S-002) 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 Technical Manager, or a member of the QA team may 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 will be entered into the LIMS non-conformance data base. This information may also be

documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical 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), Director of Quality & 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.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, General Managers and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 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 & Recall Procedure (SOP No. CW-L-S-002) distinguishes between situations when it would be appropriate for 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 in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

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, "Evaluating and Reporting of 10 CFR 21 Defects and Non-compliances", shall be followed.

11.4 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. Monthly 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 need to be followed.

11.5 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 of the persons noted in Section 11.2, Paragraph 5.

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, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is 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 12 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 (e.g., 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 Manager, Technical Director, QA Manager) 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.

SECTION 12. CORRECTIVE ACTION

12.1 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 Validation Requests (refer to SOP ST-QA-0036).

For DOE, DoD and other programs where required, the client will be informed of proposed corrective actions.

12.2 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 responsibility(s) 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.

12.2.1 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
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Validation Request - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints

- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

Health and Safety violations are documented in the EH&S Quarterly Inspection Reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 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.

12.3.1 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. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- 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 Technical Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 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.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager 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. Technical 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 may be 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 16). 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.

12.3.5 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.

(Also refer to Section 15.1.4, Special Audits.)

12.4 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 (refer to Section 11). The documentation of these procedures is through the use of an NCM or Validation Request.

Table 12-1 includes *examples* of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

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 an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 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.

Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < RL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc...
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits documented in QC Browser database	- reanalyze standard -if still unacceptable, recalibrate and rerun affected samples
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in the LIMS	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in the LIMS	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s) Laboratory Director)*	- Defined in Quality System documentation such as SOPs, QAM, etc...	- Non-conformances must be investigated through Validation system and necessary corrections must be made.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, Corporate QA, Corporate Management)	- SOP CW-L-S-002, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002.
Client Complaints *(Project Managers, Lab Director/Manager, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, *Technical Manager(s)*)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, NCMs and Validations for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director/Manager, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected

Note:
1. Except as noted below for certain compounds, the method blank should be below the detection limit. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates **provided** they appear in similar levels in the reagent blank and samples. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur.

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 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 and continuous process of improvement activities 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 Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and client satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the monthly QA Metrics Report, evaluation of internal or external audits, results & evaluation of proficiency testing (PT) performance, data analysis & review processing operations, client complaints, staff observation, etc.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and 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 in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process 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.

13.1.1 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.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes.

TestAmerica St. Louis uses a series of spreadsheets and/or databases to track changes to major capabilities (e.g. equipment, accreditations, etc.). An equipment list is maintained by the QA department. Accreditations are maintained via the OASIS Total Access program on the TestAmerica intranet site.

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management 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.

14.1 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 14-1. Quality records are maintained by the QA department electronically, which are 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, Quality documents).

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* Data Investigation: 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*

	Record Types [1]:	Retention Time:
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	7 Years (HR Personnel Files must be maintained indefinitely)
	Administrative Policies Technical Training Records	7 years

[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 14-2.

14.1.1 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**.** 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.

Access to the data is limited to laboratory and company employees and shall be documented with an access log**.** Whether on-site or off-site storage is used, logs are maintained in each storage box to note removal and return of records. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

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 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.2

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 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 Reporting Group of the extended storage requirement. The Data Reporting Group tracks these requirements.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	5 years (project records) 10 years - Radiochemistry (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
Ohio VAP	10 years and State contacted prior to disposal
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.

14.1.3 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. For analytical reports that are maintained as copies in PDF format, refer to Section 19.15.1 for more information.

14.1.4 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 COC is stored with the laboratory report. The chain of custody would indicate the name of the sampler. A log of names, initials and signatures for all individuals responsible for signing or initialing laboratory records is maintained in the Human Resources Department. If any sampling notes are provided with a work order, they are kept with the laboratory report.

- 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, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in the Reagent Log in the LIMS and relevant printouts can be included in the data packages as needed.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. 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 19.15.1 'Computer and Electronic Data Related Requirements'**.**

14.2 Technical and Analytical Records

14.2.1 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.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. 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 an analysis, location for such a time is included as part of the documentation in a specific logbook or on a bench sheet.

- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs or posted on the instrument.
- 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**.**

14.3 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

14.3.1 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.
- Chain of Custody protocols required by DOE and DoD

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

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.

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.

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**.**

The laboratory has a record management system (a.k.a., document control) 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. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the Reagents Log Program in LIMS. Records are considered archived when moved off-site or are so labeled. Dual storage of these records is maintained by the IT Department during its daily and weekly back-ups of the laboratory network. These back-up tapes are stored off-site.

14.5.1 Transfer of Ownership

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.

14.5.2 Records Disposal

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. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a “Certificate of Destruction” is required.

SECTION 15. AUDITS

15.1 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 Auditing, SOP No. CA-Q-S-003. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CA-Q-S-003)	Methods Audits Frequency: 50% of methods annually **100% of methods annually (DoD Labs)**
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each NELAC field of testing or as dictated by applicable regulatory requirements

15.1.1 Audit Planning/Reporting

An audit plan is developed to identify the scope of the audit, the time frame, the personnel involved, the activities to be included, reference documents (i.e. Methods, SOPs, Checklists, and Client Requirement Memos) and persons to be notified of results. The audit team is selected prior to the audit. The size of the team is dependant on the scope of the audit. The lead auditor organizes and directs the audit. The audit report is issued to the appropriate departments by the lead auditor in hardcopy or electronically. The audit report is signed or otherwise endorsed by the Lead Auditor. The report describes the scope of the audit, identified auditors and persons contacted, summarizes results and describes all non-conformances found.

15.1.2 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI 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 for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.3 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, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.4 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 Manager or qualified designee at least every two years. It is also recommended that 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.

15.1.5 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.

15.1.6 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, Non-potable Water, Soil and 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.

15.2 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. When requested, 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.

15.2.1 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 2009 TNI standards.

15.3 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 be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, 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 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, their Quality Director as well as the 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.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technical Director, Technical Managers, QA Manager, EH&S Manager and Radiation Safety Officer) conducts a review annually 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, objectives and action items that feed into the laboratory planning system. 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 is related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CW-Q-S-004 & Work Instruction No. CW-Q-WI-003) 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
- Internal and External audit outcomes & corrective actions
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab 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.
  - Changes in the volume and type of work
- The annual internal double blind PT program sample performance (if performed),
- 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].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual. Quality system changes and improvements are incorporated into the laboratory's yearly goals.

16.3 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. CW-L-S-002). 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 CEO, VP of Quality, Technical and Operations Support, General Managers and Quality Directors receive a monthly report from the Corporate Quality Director 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 17. PERSONNEL

17.1 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 Figure 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.

Management is responsible for authorizing specific personnel to perform specific tests (i.e. environmental testing, issue reports, interpret data, operate equipment).

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 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 materials control as appropriate.

17.2 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 requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

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, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Managers – General	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Managers – Wet Chem only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewers or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 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 to 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
Computer Security Awareness	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. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The following documentation must be on file at the laboratory for each employee:

- Ethics Training documentation
- Signed Ethics agreement
- Signed Confidentiality agreement
- TNI statement of qualification
- Copy of degree, if applicable
- New Employee Orientation checklist
- Safety Orientation checklist

In addition to items listed above, the following documentation is also included in the employee training record:

- Department training checklist
- Demonstration of Capability (IDOC/DOC)
- Manual Integration training, if applicable
- Annual evidence of continuing DOC (may be successful analysis of a blind sample on the specific test method, or a similar method or four successful LCS analyses.
- Specialty training as applicable

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 19).
- 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 maintain 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.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analyst's knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice match SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

17.4 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 followed by technical data integrity training within 30 days, comprehensive training within 90 days, and quarterly refreshers 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. CW-L-P-004) and an Ethics Statement. All initial training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity. The Ethics Statement is re-signed annually.

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
- 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 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 52,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to 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, radiological sample analysis, and administrative functions.

18.2 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.

18.3 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.

18.4 Floor Plan

A floor plan can be found in Appendix 2.

18.5 Building Security

Building keys are distributed to management as necessary. The Human Resources Manager maintains a list of all employees who have been issued keys. Electronic “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 at all times. Vendors may be issued badges which state that escorts are not required. Visitors and vendors must sign out before leaving the premises.

Entry via the warehouse dock area is permitted for client sample delivery or material supply delivery, without Visitor Log sign-in. The Sample Control Department is responsible for the proper escorting of these visitors.

Vendors issued electronic swipe cards are not required to sign in or out. Visitors from other TestAmerica facilities, while required to sign the Visitor's log, may not require visitor badges.

At the laboratory's discretion, visitors may be asked to show photo identification.

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 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.

19.2 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's 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 TestAmerica St. Louis' SOPs is included in appendix 7.

19.3 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.

19.4 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), 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.

19.4.1 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:

- *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.*
- *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*
- *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/ on-line 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; Final Update IV, January 2008.*
- *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.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly perform 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.

A demonstration of capability is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

For tasks where spiking is not possible (prep techniques including but not limited to compositing, drying and grinding, sub-sampling) the initial demonstration of capability is documented in the analysts training record by the analyst and supervisor signing off on the relevant SOP on the department training checklist. The yearly review and the analyst's acknowledgement of revisions to the SOP serve as the continuing demonstration of capability.

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, 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. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- 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.

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 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.

19.4.3.3 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).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 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.

19.4.3.7 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 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, may 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 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (see Figure 19-1) shall be used to document the completion of each initial and continuing demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 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.

19.6 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 validation process may include one, or a combination of the following: calibration using known reference standards, comparison of results achieved with other methods, PT samples, etc. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 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.

19.6.1.1 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.

19.6.1.2 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.

19.6.1.3 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.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 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 highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 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.

19.6.1.7 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.

19.6.1.8 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.

19.7 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. 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 or the laboratory's SOP No. ST-QA-0016 "MDL/IDL, LOD/LOQ Determination", for details on the laboratory's MDL process.

19.8 Minimum Detectable Activity (MDA)/Minimum Detectable Concentration (MDC)

For radiochemical analyses, the MDA/MDC is 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 RLs. 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.

19.9 Instrument Detection Limits (IDL)

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.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like the MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 times the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.10 Verification of Detection and Reporting Limits

Once the MDL is determined, it must be verified on each instrument used for the given method. TestAmerica defines the DoD QSM Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do 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 MDLV standard is not successful, then the laboratory will redevelop their MDL or perform and pass two consecutive MDLVs at a higher concentration and set the LOD at the higher concentration. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to the laboratory SOP ST-QA-0016, "MDL/IDL, LOD/LOQ Determination", for further details.

The laboratory quantitation limit is equivalent to the DoD Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects where required. For DoD projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.11 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific 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 SOPs.

19.12 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.

19.13 Estimation of Uncertainty of Measurement

19.13.1 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 human factors, 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.

19.13.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On 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 systematic 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.

19.13.3 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.

19.13.4 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 6.

19.13.5 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.

19.14 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample 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 & Conditions for reanalysis protocols may supersede the following items).

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results 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 the 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. See the Area Supervisor *or* Laboratory Director if unsure.

19.15 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.

19.15.1 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 laboratory SOPs ST-IS-0001 "Software Change Management", ST-IS-0002, "Software Testing, Verification and Validation", and ST-IS-0003, "Information Systems". The laboratory is currently running QuantIMS which is a custom in-house developed laboratory

information management system that has been highly customized to meet the needs of the laboratory. 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.

19.15.1.1 **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. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.15.1.2 **Ensure Information Availability:** Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, and secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.15.1.3 **Maintain Confidentiality:** Ensure data confidentiality through physical access controls such as password protection or website access approval.

19.15.2 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 both the analyst and second level 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 No. CA-Q-S-002, *Acceptable Manual Integration Practices"* and the laboratory SOP ST-QA-0040, "Manual Integration Procedure".

Analytical results are reduced to the appropriate concentration units as 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.

19.15.2.1 All raw data must be retained in the reporting departments archive files. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (i.e. month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.15.2.2 In general, concentration results are reported in milligrams per liter (mg/L) or picocuries per liter (pCi/L) or micrograms per liter (µg/L) for liquids and milligrams per kilogram (mg/kg), micrograms per kilogram (µg/kg) or picocuries per gram (pCi/g) for solids. For values greater than 10,000 mg/L, results can be reported in percent, i.e., 10,000 mg/L = 1**%.**

19.15.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.15.2.4 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.

19.15.2.5 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, and removing unrequested or poor spectrally-matched compounds. The analyst reviews what has been entered to check for errors. If printed, the 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.

19.15.3 Logbook / Worksheet Use Guidelines

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 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Logbooks have sequentially numbered pages.
- Unused portions of pages must be "Z'd" out, signed and dated.

- Worksheets are created with the approval of the QA Manager or Technical Manager at the facility. The QA Department controls all worksheets following the procedures in Section 6.

19.15.4 Review / Verification Procedures

Data 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). The general review concepts are discussed below, more specific information can be found in the SOPs.

19.15.4.1 The data review process at the laboratory starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information and required analyses into LIMS. The Sample Control Supervisor, or designee, reviews the transcription 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.

19.15.4.2 The next 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 and add/review data qualifiers if applicable. 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, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. One hundred percent of all manual integrations are reviewed. The review is documented on the chromatogram by the analyst responsible for the integration and on the Second Review Checklist by the peer reviewer. Manual integrations are also periodically electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. Issues that deem 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

19.15.4.3 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.15.4.4 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is created for the client.

19.15.4.5 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, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.15.4.6 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.

19.15.5 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 TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP No. ST-QA-0040, entitled "Manual Integration Procedure".

19.15.5.1 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.

19.15.5.2 Analysts shall not increase or decrease peak areas 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.

19.15.5.3 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.

19.15.5.4 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 done on samples, 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 19-1. Example - Demonstration of Capability Documentation

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Analyst Demonstration of Capability
Certification Statement

Analyst Name Method
Date: 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 20. EQUIPMENT and CALIBRATIONS

20.1 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 SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

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.

Routine preventive maintenance procedures and frequency, such as 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.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures maybe/are also outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

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. Instrument maintenance logs may also be used to specify instrument parameters.

- 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.
- 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.) must also be documented in the instrument records.

- 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. Folder pockets are used in some logbooks to store service receipts.

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. The instrument is "tagged-out" by the analyst who observed the issue, the department manager or the QA department. A non-conformance memo, or some other "tag", is posted on the affected instrument.

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 or MDL verification sample) prior to return to lab operations.

20.3 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. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 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 serviceable 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. Any weights (including ASTM Type 1) used for daily balance checks or

other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).
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.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

Refer to SOP ST-QA-0005, "Calibration and Verification Procedures for Thermometers, Balances, Weights and Pipettes," for detailed information.

20.3.2 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.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The NIST thermometers are 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(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to 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 of method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the SOP ST-QA-0005.

20.3.4 Refrigerators/Freezer Units, Water baths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. (Sample storage is monitored 7 days a week for units storing DOE and/or DoD samples).

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 between > 0ºC and ≤ 6 ºC; freezers are kept below 10 ºC.

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.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is applied to the device stating that it is non-critical Any device not regularly verified cannot 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.

20.4 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 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

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).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards. This also does not apply to radiochemical methods.

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, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification (Organic/Inorganic)

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. 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. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here 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 analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Standard.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after every 10 samples or injections, including matrix or batch QC samples.

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed and documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions and reported based upon discussion and approval of the client:

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for 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. (These calculations are available in Appendix 6). 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.

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.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.4.2 Radiochemical Calibrations

20.4.2.1 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 parent 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 the 1 year shelf life of the stock solution has expired, it must be re-verified.

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 non-traceable standard may be used if written client approval is obtained (when required).

Calibration standards are prepared using the appropriate procedures.

For each analyte of interest, prepare calibration standards at the minimum number of concentrations as stated in the analytical methods.

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 20-4.

20.4.3 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 20-4 and monitored to ensure that the laboratory maintains its capability to meet required data quality objectives.

20.4.4 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.

20.5 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 on making tentative identifications and reporting TICs.

20.6 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 20-1. Example: Instrumentation List

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
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	Tekmar/Dohrmann	Velocity XPT	US03247002	2009	Used
GC/MS – "N" Autosampler	Teledyne Teckmar	Solatek 72	US03100004	2009	Used
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
GC/MS – "Y"	Hewlett Packard	5970	3449A02079	2009	Used
GC/MS – "Y" GC System	Hewlett Packard	5890	3336A57239	2009	Used
GC/MS – "Y" Concentrator	Tekmar	Tekmar 3000	93300001	2009	NEW
GC/MS – "Y" Autosampler	Varian	Archon	12541	2009	Used
GC/MS – "Z"	Hewlett Packard	5973	US80230105	2010	Refurbished
GC/MS – "Z" GC System	Hewlett Packard	6890	US00009101	2010	Refurbished
GC/MS – "Z" Concentrator	IO	Eclipse 4660	E002466503P	2010	NEW
GC/MS – "Z" Autosampler	Varian	Archon	MS1003W019	2010	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" HPLC – "Q" ALS Therm	Hewlett Packard	G1330A	DE13201124	1999	NEW
LC/MS/MS – "T" HPLC – "Q" Quat Pump	Hewlett Packard	G1311A	DE14916965	1999	NEW
LC/MS/MS – "X" Liquid Chromatograph	Waters	Xevo	VBA453	2010	NEW
LC/MS/MS – "X" Liquid Chromatograph	Waters	Acquity Sample Manager	H07UPB932M	2010	NEW
LC/MS/MS – "X" Liquid Chromatograph	Waters	Acquity Binary Solvent Manager	H07UPa802M	2010	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 – "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
GC – "V"	Agilent	6890	US00008573	2009	USED
GC – "V" (Auto Sampler)	Agilent	G1530A	US8090377	2009	USED
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	JP73061316	2010	USED
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" 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" FLD	Hewlett Packard	G1321A	DE92001122	1999	NEW
HPLC – "E" (DAD)	Agilent	G1315D	DE64263751	2011	NEW
HPLC – "E" (COL)	Agilent	G1316A	DE63065337	2010	USED
HPLC - "E" (Auto Sampler)	Agilent	G1329A	DE64764168	2010	USED
HPLC – "E" (Pump)	Agilent	G1311A	DE62962744	2010	USED
HPLC – "E" (Degasser)	Hewlett Packard	G1322A	JP73016399	1999	NEW
GPC-1	O-I Analytical	Autoprep 2000	E427330254	2011	NEW
ICP-MS – "6100"	Perkin Elmer	ELAN 6100	0859907	1999	NEW
ICP-MS – "6100" Autosampler	Perkin Elmer	AS-91	4123	1999	NEW
ICP-MS – "7500"	Agilent	7500CX	JP82802890	2009	NEW
ICP-MS – "7700"	Agilent	7700	JP10110271	2011	NEW
ICP – "61E"	Thermo Jarrell Ash	61E	30083	1987	NEW
ICP – "61T"	Thermo Jarrell Ash	61E trace	247390	1994	NEW
ICP – "6500 Duel View"	Thermo Fisher	6000 Series	20105013	2011	NEW
CVAA	Leeman Labs	Hydra AA	204112000641	2002	NEW

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
CVAA	Leeman Labs	Hydra AA 2	0035	2011	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
TOC	Shimadzu	TOC-VCPN	H51404635090	2010	NEW
Solid Sample Module	Shimadzu	SSM-5000A	H52504700582NK	2010	NEW
Discrete Analyzer	Systea	Easy Chem-Plus	0901262	2010	NEW
UV Spec	Thermospectronic	Genysis	3SGF211001	2003	NEW
TRAACS – "1"	Technicon	Traacs 800	0103011	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
Multimeter	Thermo	5 Star	B15814	2009	NEW
Multimeter	Thermo	25 Star	015748	2009	NEW
IC Auto Sampler (Wet Chem)	Dionex	AS40	00090205	2009	USED
Alpha Spectrometer – "AV1 - AV24" "AV43 - AV122" "AV123 - AV226" "AV227 – AV247"	Ortec	Multi-Component	Multiple*	1987-2011	NEW
Gamma Spectrometer Intrinsic Germanium Detector "GE1 - GE10" "GE11 – GE19"	Tennelec / Ortec	Multi-Component	Multiple*	1991-2011	NEW
GFPC – "Red"	Tennelec	LB4100	24645	1993	NEW
GFPC – "Protean"	Protean	MPC-9604	233126-BO 236534-BO 236532-BO 236533-BO	2003	NEW
GFPC – "Orange"	Protean	MPC-9604	08217155 08217156 08217154 08217153 10181186 10181187	2008-2010	NEW

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GFPC – "Purple"	Protean	MPC-9604	10181185 10181184 10029177 10029178 10029179 10029180	2010	NEW
GFPC -Green	Tennelec	LB5100	31360	2000	NEW
LSC – "3180" Pink Teal Aqua Brown	Packard	Tricarb 3180	DG06095123 DG01117382 DG01117385 DG01117384 DG01117383	2009- 2011	NEW
LSC – "2550"	Packard	Tricarb 2550	400749	2000	NEW
LSC – "3170"	Packard	Tricarb 3170	429670/429774	2002	NEW

Table 20-2.

Schedule of Routine Maintenance

Inductively Coupled Plasma

DAILY OR AS NEEDED - CHECK

-
- Gas supply
- Waste and rinse solution levels

- Droplet size (nebulizer)

- Vacuum system pressure (61T, 61E)
- Replace orange/orange tubing (61T, 61E)
- Replace orange/green tubing

WEEKLY

- Check water level in cool flow
- HF nebulizer rinse
- Replace waste line: black/black (6500)
- Replace red/red tubing (61T, 61E)
- Clean injector tip
- Check /Clean plasma torch assembly
- Replace sample tubing orange/white (6500)

MONTHLY

- Check /Clean air filter of power unit (61T,61E)

ANNUALLY

- Check vacuum system oil (61T, 61E)
- Check /Replace coolant water filter

Inductively Coupled Plasma/Mass Spectrometer

DAILY OR AS NEEDED

- Check Waste and rinse water container levels
- Check/ Replace sample, internal and waste lines
- Clean cones (7500, 7700)

WEEKLY

- Check /Clean interface cones (6100)
- Clean ion lenses (7500, 7700)
- Check Roughing pump oil level and color
- Replace Waste Tubing

MONTHLY

- Check /Change pump oil (6100)
- Check /Clean auto lens (6100)
- Clean torch & injector tip (6100)
- Clean auto lense (6100)

- Clean torch (7500, 7700)
- Move data set files (7500, 7700)

Cold Vapor Automatic Analysis

DAILY OR AS NEEDED
- Check /Pump and drain tubing
- Check Gas pressure
- Instrument parameter check

MONTHLY
- Check /Change sample, reductant and draining tubings

QUARTERLY
- Check /Change drying tube

TOX

DAILY OR AS NEEDED
- Cell Performance Test
- Electrodes
- Cell Fluid, Dehydrating Fluid and Electrolyte
- Adsorption module (cleaned at end of use)

Autoanalyzer Traacs- 1

DAILY
- Washout procedure (at end)

AS NEEDED
- Check /Change tubing
- Lubricate Probe shaft
- Lubricate oil rollers

TOC

DAILY OR AS NEEDED
- Air Supply and Gas Flow Rate (150mm)
- Humidifier
- A/LS Rinse Tank

MONTHLY

- Check /Inspect SO_3 scrubber – change if crystals at inlet are not white.
- Check /Inspect halogen scrubber – change if black color approaches outlet end.

ANNUALLY
- Check /Change CO_2 absorber

Ion Chromatography

DAILY OR AS NEEDED
- Plumbing for leaks
- Gases and Pump Pressure
- Conductivity meter
- Fill eluent

UV Spec

DAILY OR AS NEEDED
- Rinse out Sample Cuvettes (after each use)

BOD

DAILY
- Calibration

As Needed
- Change membrane

Discrete Analyzer

DAILY
- Auto zero
- Perform rinse at completion of analysis
- Check DI water bottle/refill

Alpha Spectrometer

DAILY
- Pulsars

MONTHLY
- Backgrounds
- Clean detectors
- Continuing calibration verifications

ANNUALLY
- Calibrations

Gamma Spectrometer

DAILY
- Continuing calibration blank/continuing calibration verification

MONTHLY
- Clean/Long Backgrounds

ANNUALLY

- calibration checks

Gas Flow Proportional Counting

DAILY OR AS NEEDED
- Gas level
- Calibration verifications

MONTHLY
- Clean/Long Backgrounds

ANNUALLY
- Calibrations

Liquid Scintillation Counter

WEEKLY OR AS NEEDED
- Clean Fan

YEARLY
- Serviced by vendor

Semi-volatile Gas Chromatography / Mass Spectrometer

DAILY OR AS NEEDED
- Gas supply, column flow and inlet pressure
- Fill solvent rinse vials
- Check /Injection Port Cleaning
- Check /Change Septum, injection port liner, and seals
- Check /Trim Column
- Check/replace injection syringe

ANNUALLY
- Check /Replace pump oil

AS NEEDED
- Replace column
- Clean ion source
- Replace multiplier
- Replace electronic circuit board
- Replace detector
- Replace transfer lines

Volatile Gas Chromatography / Mass Spectrometer

DAILY OR AS NEEDED
- Gas supply, column flow and inlet pressure

QUARTERLY
- Check Trim Column

- Check/Change Trap

SEMI-ANNUALLY
- Check/Replace Column
- Check/Clean Source
- Check/Injection port maintenance

ANNUALLY
- Check/ 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
- Check/Change Purge Valve Frit

SEMIANNUALLY
- Check/Change Guard Cartridge and Frit Cap

BIANNUALLY
- Check/Replace Column
- Check/Replace UV Source
- Check/Replace Visible Source

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
- Check/Replace injection port septum
- Visibly inspect injection port liner; replace if contaminated
- Check /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
- Check/Replace septum, injection port liner and seals
- Check/ Trim Guard Column

SEMIANNUALLY
- Check/ Replace Column

Volatile Gas Chromatograph

DAILY OR AS NEEDED
- Check gas supply, column flow and inlet pressure
- Change trap
- Trim column

SEMIANNUALLY
- Check/Replace Column
- Check/Injection port maintenance

ANNUALLY
- Check /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
- Sonicate inlet check values
- Clean ionization probes/corona pin
- Ballast Rough Pump

SEMIANNUALLY
- Check/Replace Column
- Check/Clean source
- Check/Injector maintenance

ANNUALLY
- Check/Replace pump oil

Table 20-3
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 ±0.5 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	± 2.0% (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 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.	103 ± 2 °C (moisture determination) 180 ± 2°C (TDS) (DoD: ±5% of set temp)	Adjust. Replace.
Incubator	Temperature checked using NIST-traceable thermometer.	When in use. For microbiology, 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	On 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	± 2% bias Precision RSD ≤ 1%	Adjust. Replace.
Non-volumetric labware (applicable only when measuring initial sample vol. or final extract/digest ate volume	Gravimetric – 10 reps before use	By lot before first use or upon evidence of deterioration	Bias: Mean within ± 3%of nominal volume Precision RSD ≤ 3% of stated value (based on 10 replicate measures)	replace
Volumetric glassware	The laboratory uses only Class A volumetric glassware. Calibration not required	N/A	Check for deterioration	Replace

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Glass Microliter Syringes	None	Accuracy must be initially demonstrated 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.	$r \geq 0.99$	Recalibrate.
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 Department

Table 20-4 Radiochemistry Calibration, Verification & Background Criteria

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria
Gamma Spectroscopy	Initial Calibration	Energy, FWHM and 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 0.05% for all points or with 2 keV for calibration points. Computed efficiency test for all points should have a percent difference less than 8%. The FWHM must be less than 3.0 keV at 1332 keV. FWHM difference should be less than 8% 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 (2σ to 3σ 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 **yearly**, 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 **yearly**, 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 keV of expected energy. Efficiency should fall between 20 and 32%.

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 be 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 10,000 counts in 90 minutes of count time for the most highly attenuated source. The count rate shall not exceed 5,000 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 1,000 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 21. MEASUREMENT TRACEABILITY

21.1 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. (Refer to Section 20.3). With the exception of Class A Glassware and glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices that are used to deliver volume critical measurements. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 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 liquid thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by A2LA, NVLAP, and NIST with an accompanying 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 Reagents Log Identification Number generated by LIMS and an expiration date. All documentation received with the reference standard is retained as a QC record and references the Standards Log Standard Identification Number. Reference standards that are used in the radiochemical laboratory shall be obtained from NIST, or suppliers who participate in supplying NIST standards or NIST traceable radionuclides. When traceable standards are not available, written approval for 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 & Safety Manual and the analytical method SOP's "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.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 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. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.] Purchased stock mixtures and reagents are labeled to indicate the date they are opened.

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 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, "Standard 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 material.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS, 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.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID (assigned by the LIMS)

- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained in the MSDS documents available on the TestAmerica intranet site).

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

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 as specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

The laboratory 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

22.2 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.

22.2.1 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

22.3 Definition of Holding Time

The date and time of sampling documented on the 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.) is 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.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs 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.

22.5 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.

Guidelines on taking sample aliquots & sub-sampling are located in SOP ST-QA-0038, "Procedure for Compositing and Sub-sampling".

NOTE: *Unless otherwise noted by individual preparation SOPs, the following statements apply to sample aliquots of volume (liquid) for testing analysis.*

- Density Requirement – If a sample is known or suspected (based upon client knowledge, project scope, or site history) to have a high density (>1.2 g/mL, e.g. a brine or waste) or a low density (<0.98 g/mL, e.g. mixed solvent), the sample density will be measured and the volume determined arithmetically (sample mass divided by the density equals the volume).

- Volume Determination – Aliquot volume is calculated by gravimetric determination assuming a sample density of 1. Samples that are not aqueous, or suspected of having a density greater than 1.2, will have aliquots taken for density analysis to correct volume for density

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 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 23-1.

23.1.1 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 23-1). 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.

When the sampling personnel deliver the samples directly to TestAmerica personnel, 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 personnel. 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. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the COC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored with the other login paperwork.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal, retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 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 are described in SOP ST-PM-0002, “Sample Receipt and Chain of Custody”.

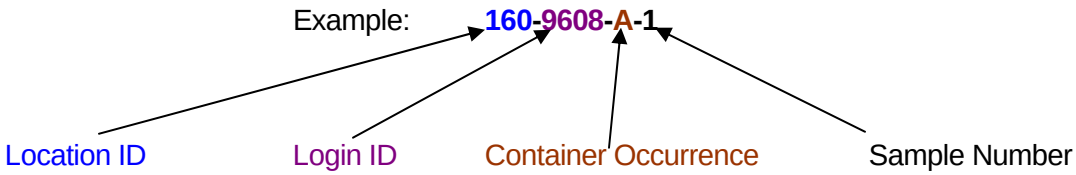
23.2.1 Laboratory Receipt

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 (CUR) 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.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following four pieces of information:



The above example indicates TestAmerica St. Louis (location 160), Login ID 9608 (unique to a particular job/client), container "A" of sample number 1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. For example, when a 1-liter amber bottle is sent through a Liquid/Liquid Extraction and extraction vial is created from the prep step. The vial would be a secondary container and would be labeled as follows:

160-9608-A-1-**A**
Secondary Container Occurrence - the Secondary ID has five components

The IDs are 'bar-coded' on the LIMS generated laboratory sample label attached to each container.

These steps allow the samples to be tracked through the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);
- the Project Manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined and noted in the Case Narrative..

23.3.1 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.

23.3.2 For samples received from a potentially radioactive site, an aliquot is removed from the container to perform a "rad screen."

23.3.3 Any deviations from these checks that question 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 SOP ST-PM-0002.

23.4 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, freezers or protected locations suitable for the sample matrix. 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 are 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 a 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 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.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only. The sample itself is clearly "HAZARDOUS" or "FOREIGN SOIL". Any sample that is known to be hazardous at the time of receipt or, if after completion of analysis the result exceeds the acceptable regulatory levels, the sample is labeled as such. Potentially radioactive samples are "screened" prior to release to the laboratory. The RAD category is entered into the LIMS and alerts the analyst to the radiation level associated with the sample. 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.

23.6 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 (see Note). 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.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 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, and 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 should be completed.

Figure 23-1. Example: Chain of Custody (COC)

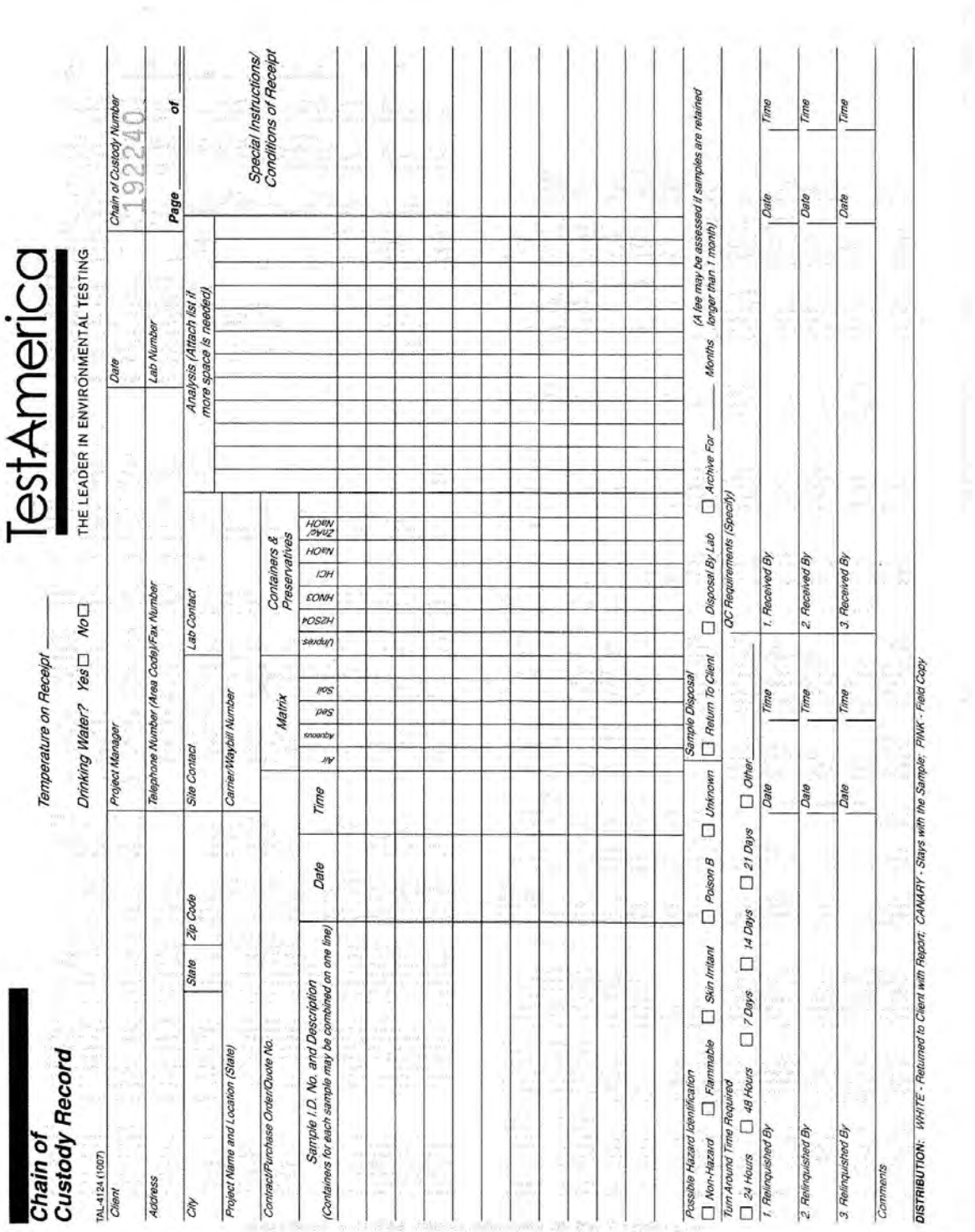


Figure 23-2. Example: Sample Acceptance Policy

TestAmerica St. Louis
Sample Acceptance Policy

NELAC specifies requirements under which any NELAC accredited laboratory will accept samples. STL 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.

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.

If the conditions listed on the Acceptance Policy are not satisfactory and when lacking direction from the client to the contrary, the sample will be rejected.

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.

Figure 23-3. Example: Cooler Receipt Form

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

CUR Form #: _____ Lot #(s): _____ _____

CONDITION UPON RECEIPT FORM

Client: _____

Quote No: _____

COC/RFA No: _____

Initiated By: _____ Date: _____ Time: _____

Shipping Information

Shipper: FedEx UPS DHL Courier Client Other: _____ Multiple Packages: Y N

Shipping # (s):*				Sample Temperature (s):**			
1.		6.		1.		6.	
2.		7.		2.		7.	
3.		8.		3.		8.	
4.		9.		4.		9.	
5.		10.		5.		10.	

*Numbered shipping lines correspond to Numbered Sample Temp lines

**Sample must be received at 4°C ± 2°C- If not, note contents below. Temperature variance does NOT affect the following: Metals-Liquid; Rad tests- Liquid or Solids; Perchlorate

Condition (Circle "Y" for yes, "N" for no and "N/A" for not applicable):

1.	Y N	Are there custody seals present on the cooler?	8.	Y N	Are there custody seals present on bottles?
2.	Y N N/A	Do custody seals on cooler appear to be tampered with?	9.	Y N N/A	Do custody seals on bottles appear to be tampered with?
3.	Y N	Were contents of cooler frisked after opening, but before unpacking?	10.	Y N N/A	Was sample received with proper pH[1]? (If not, make note below)
4.	Y N	Sample received with Chain of Custody?	11.	Y N N/A	Containers for C-14, H-3 & I-129/131 marked with "Do Not Preserve" label?
5.	Y N N/A	Does the Chain of Custody match sample ID's on the container(s)?	12.	Y N	Sample received in proper containers?
6.	Y N	Was sample received broken?	13.	Y N N/A	Headspace in VOA or TOX liquid samples? (If Yes, note sample ID's below)
7.	Y N	Is sample volume sufficient for analysis?	14.	Y N N/A	Was Internal COC/Workshare received?

[1] For DOE-AL (Pantex, LANL, Sandia) sites, pH of ALL containers received must be verified, EXCEPT VOA, TOX, Oil & Grease and soils

Notes: _____

Corrective Action:

☐ Client Contact Name: _____ Informed by: _____

☐ Sample(s) processed "as is"

☐ Sample(s) on hold until: _____ If released, notify: _____

Project Management Review: _____ Date: _____

THIS FORM MUST BE COMPLETED AT THE TIME THE ITEMS ARE BEING CHECKED IN. IF ANY ITEM IS COMPLETED BY SOMEONE OTHER THAN THE INITIATOR, THEN THAT PERSON IS REQUIRED TO APPLY THEIR INITIAL AND THE DATE NEXT TO THAT ITEM.

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SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 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 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS), tracers and carriers). 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.

24.2 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.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

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.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than $^{1}/_{10}$ of the amount measured in the sample.
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 24-1. Example – Negative Controls

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 (or as specified in the client's project plan). 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.

24.4 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.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

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.

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.

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.).

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.

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.

- For methods that have 1-10 target analytes, spike all components.

- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.

- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

- 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.

24.5 Sample Matrix Controls

Table 24-2. 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, method 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 solid samples 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] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established 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 precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

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.

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.

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).

- 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).

- 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 laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- 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.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- 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.

24.6.1 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. The QA department can generate a Quality Control Limit summary that contains tables that summarize the precision and accuracy acceptability limits for the analyses performed at TestAmerica St. Louis. The information is stored in the LIMS and includes an effective date and is updated each time new limits are generated. Unless otherwise noted, these limits are laboratory generated. The limits are approved in the LIMS system after review by the QA department. The LIMS maintains an archive of all limits used in the laboratory. Historical limits can be found in the LIMS program . See laboratory SOP ST-QA-0014, "Evaluation of Analytical Accuracy and Precision through the Use of Control Charts".

24.6.2 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 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

Or, for NELAC and Department 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

- Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (NELAC).

- 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.

Though marginal exceedances may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.3 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 lab's method SOPs and in Section 12.

24.6.4 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.

24.6.5 If radiochemical tracer or carrier recovery is outside limits the sample is re-analyzed to confirm matrix interference. If recoveries confirm, or there was obvious interference, results are reported from the original run and a note is included with the case narrative. If the re-analysis meets the 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 re-run unless required by the client.

24.7 Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method; including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 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 conflict between 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. Refer to Section 7.

A variety of report formats are available to meet specific needs.

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 19.

25.2 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:

25.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. job 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.

25.2.4 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 (e.g., Sampling information).

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 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.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Practical quantitation limits or reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 regarding additional addenda).

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory.

25.2.19 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.

25.2.20 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.21 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.

25.2.22 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.23 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.24 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 of the work has been completed.

25.2.25 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.

25.2.26 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory's accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

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.

25.3 Reporting Level or Report Type

The laboratory 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 25.2 above.
- Level II is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, 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, 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 and as an electronic (pdf) file. 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 25.6.

25.3.1 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.

25.4 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.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

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.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

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.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by 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.

25.5 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 the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

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 TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 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.

25.6.1 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:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. If you are not the intended recipient, or the employee or agent responsible for delivering this material 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 us immediately by telephone at the 1-800-765-0980 (or for e-mails: please notify us immediately by e-mail or by phone (1-800-765-0980) and delete this material from any computer).

25.7 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.

25.8 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 12).

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 job number/SDG 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 at the top of the narrative page* with a brief explanation of reason for the re-issue.

25.9 Policies on Client Requests for Amendments

25.9.1 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.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order 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 26. REVISION HISTORY

26.1 CHANGES TO REVISION 0

26.1.1 Updated to conform to new corporate Template. Information that was specific to the company at large and less specific to the individual laboratory was removed from the template and is now found in the Corporate Quality Management Plan (CQMP).

26.1.2 The Quality Policy Statement was updated to include compliance with NELAC standards.

26.1.3 Section 10 (Services to Client) was merged with Section 7 (renamed)

26.1.4 Section 10 was left intentionally blank.

26.1.5 Section 16 (Audits) was given new text.

26.1.6 Section 17 (Management Reviews) revised QA report section, some tables were removed

26.1.7 Section 21 (Calibrations) removed information that can be found in method SOPs

26.1.8 Radiochemistry calculations in Appendix 6 were updated

26.1.9 Tables, figures and appendices were updated and re-numbered

26.2 CHANGES TO REVISION 1(06/02/09)

26.2.1 Added reference to ASME NQA-1-2000 to Section 3.1

26.2.2 Updated Ethics Agreement in Appendix 1

26.2.3 Updated radiochemistry calculations in Appendix 6.

26.3 **CHANGES TO REVISION 2 (08/31/09)**

26.3.1 Added reference to DoD QSM 4.1 to Section 3.1

26.3.2 Updated QA Manager job description in Section 4.2.3

26.3.3 Updated laboratory organizational chart

26.3.4 Added Quality Program objectives to Section 5.1; clarified staff responsibilities regarding QA documents

26.3.5 Added QAM review cycle to Table 16-1

26.3.6 Added freezer temperature criteria to Section 21.3.4

26.3.7 Updated Calibration information in Table 21-3

26.3.8 Added current Florida NELAC cert to Appendix 3

26.3.9 Signatures moved from Title Page to Cover per DoD Requirements

26.4 **CHANGES TO REVISION # (08/31/10)**

26.4.1 Section 2: list of Cross-walk references to the ISO 17025 requirements added

26.4.2 Section 4.2: QA Manager responsibilities updated

26.4.3 Section 4: Organizational Charts updated in figure 4-1

26.4.4 Section 5.1: Addition to quality Policy Statement regarding continuous improvement

26.4.5 Section 7: Figure 7-1 removed

26.4.6 Section 13: Table 13-3 “General Corrective Actions” added

26.4.7 Section 13.3.3: Root cause analysis added

26.4.8 Sections 3.1 & 20.4: Source methods references updated

26.4.9 Section 18.3: Evidence of successful training added

26.4.10 Section 20.15.5: text on manual integrations and Mint Miner© expanded

26.4.11 Section 21: Table 21-1 “instrument List”, updated

26.4.12 Section 21.3.5: requirement for non-volumetric labware added

26.4.13 Section 21.4: calibration standards section expanded

26.4.14 Section 24.2.2: Unique sample ID section added

26.4.15 Section 24.3: Sample Acceptance Policy moved to appear in Table of Contents
26.4.16 Section 24.6: added note on Trip blanks
26.4.17 Section 26.2.18: added narrative requirement reproduction of laboratory reports
26.4.18 Information in Appendices 1,2,3,5 & 7 updated
26.4.19 Added "End of Document" statement
26.4.20 General grammatical edits and corrections

26.5 **CHANGES TO REVISION 4**

26.5.1 10/08/10: Added Section 20.4.2.4 to address DOCs for tests without analyte spikes
26.5.2 8/31/11: Removed the 'effective date' by section and applied it to the entire document. Continuous document pagination implemented.
26.5.3 2009 TNI Standard references added to the Table of Contents only – citations removed from the section titles within the document. Updated all references from the 2003 NELAC Standards to the 2009 TNI standard
26.5.4 Use of the title 'Technical Manager' from the TNI Standard is defined and implemented.
26.5.5 Section 10 (previously left empty) removed. Other section numbers adjusted accordingly.
26.5.6 Section 4: Additional Quality Assurance and Technical Manager (a.k.a., Supervisors) responsibilities assigned based on the TNI Standard
26.5.7 Section 8: Clarification of subcontracting procedures
26.5.8 Table 12-1: Updated for additional corrective action procedures
26.5.9 Section 15: Updates reflect current internal audit process as defined in CA-Q-S-004. Table 15-1 updated.
26.5.10 Section 19: Verification of MDLs/RLs updated to TNI Standard
26.5.11 Section 25: added statement regarding the listing of non-accredited methods in the lab report
26.5.12 Appendix 2: updated laboratory floor plan
26.5.13 Appendix 4: added/removed glossary terms/acronyms
26.5.14 Appendix 5: Certification table updated
26.5.15 Appendix 6: updated and clarified calculations
26.5.16 Appendix 7: updated SOP list

26.6 CHANGES TO REVISION 5

26.6.1 Grammatical and format corrections made throughout entire document
26.6.2 Updated signature page
26.6.3 REFERENCED CORPORATE SOPs AND POLICIES updated
26.6.4 Section 4.3: Deputies updated
26.6.5 Figure 4-1 Corporate and Laboratory Organization Charts updated
26.6.6 Section 5.5: Criteria for Quality Indicators updated
26.6.7 Changed TNI to NELAC where applicable
26.6.8 Section 9.3.3: Specifications: updated compressed gasses paragraph
26.6.9 Replaced Clouseau with LIMS where applicable
26.6.10 Section 11.2: Responsibilities and Authorities removed COO
26.6.11 Section 12: Removed Clouseau screen shots
26.6.12 Section 14: Replaced reference to standards log program with LIMS
26.6.13 Section 15: updated reference to Internal Auditing SOP to CA-Q-S-003
26.6.14 Section 15: Added Audit Planning/Reporting section
26.6.15 Sections 19.15.2 & 19.15.3: updated

26.6.16 Section 20.2: Added "tagged-out" requirements
26.6.17 Table 20-1, 20-2, 20-4 updated
26.6.18 Section 22.5: Addition of aqueous sample aliquot density requirement and volume determination
26.6.19 Section 23.2.1.1: Replaced QuantIMS with TALS unique sample identification.
26.6.20 Section 23.3: Updated to indicate that variation from policy to be noted in case narrative
26.6.21 Section 24.6.1: updated to reference LIMS instead of QC Browser
26.6.22 Appendix 3: updated NELAC certification
26.6.23 Appendix 4: added new glossary terms and acronyms
26.6.24 Appendix 5: updated St. Louis certifications
26.6.25 Appendix 6: added organic calculation “On column concentrations”
26.6.26 Appendix 7: updated laboratory SOP listing

Appendix 1. Ethics & Confidentiality Agreements

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

EMPLOYEE ETHICS STATEMENT

I understand that TestAmerica Laboratories, Inc. and its affiliates ("TestAmerica"), are 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 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 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 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 will not intentionally report 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 facility's Standard Operating Procedures, EPA Manual, 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 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 facility , prior to the required submission date of the results to the person, organization, or entity supplying the PT sample.*
- *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 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 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 Facility Director and Quality Assurance Officer/Manager (where applicable). The Facility Director or Quality Assurance Officer/Manager (where applicable) will initial and date the information and return a copy to me; I shall*

Page 1 of 2 Form No. CW-L-WI-002, dated 4/20/2010

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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 Facility Director, all supervisors and managers with direct line reporting relationship between me and the Facility Director, and the local Quality Assurance representative (where applicable), 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.*
- *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_____

EMPLOYEE SIGNATURE _____ Date _____

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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, _____(printed name), 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 through no act of my own. 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). In the event that any provision of this Agreement is held to be unenforceable because of the scope, duration or area of its applicability, the court making such determination shall have the power to modify any or all such terms, and those terms shall then be applicable in such modified form and the other provisions of this Agreement shall remain in force.

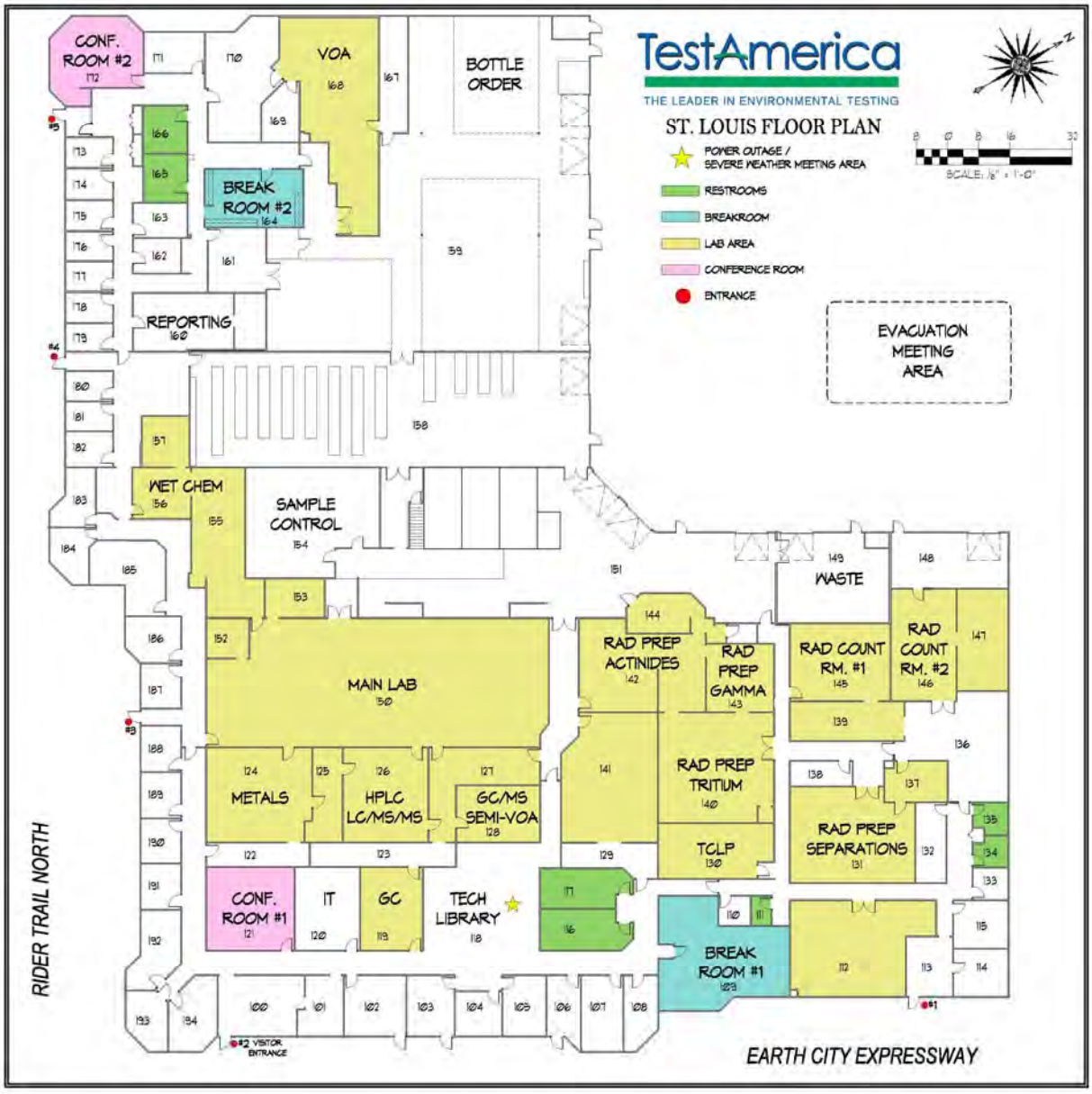
6. I further acknowledge that the willingness of TestAmerica to hire me or to continue my employment constitutes full and adequate consideration for the agreements, and obligations to which I have agreed as set forth in this document.

I have executed this Agreement, intending to be legally bound.

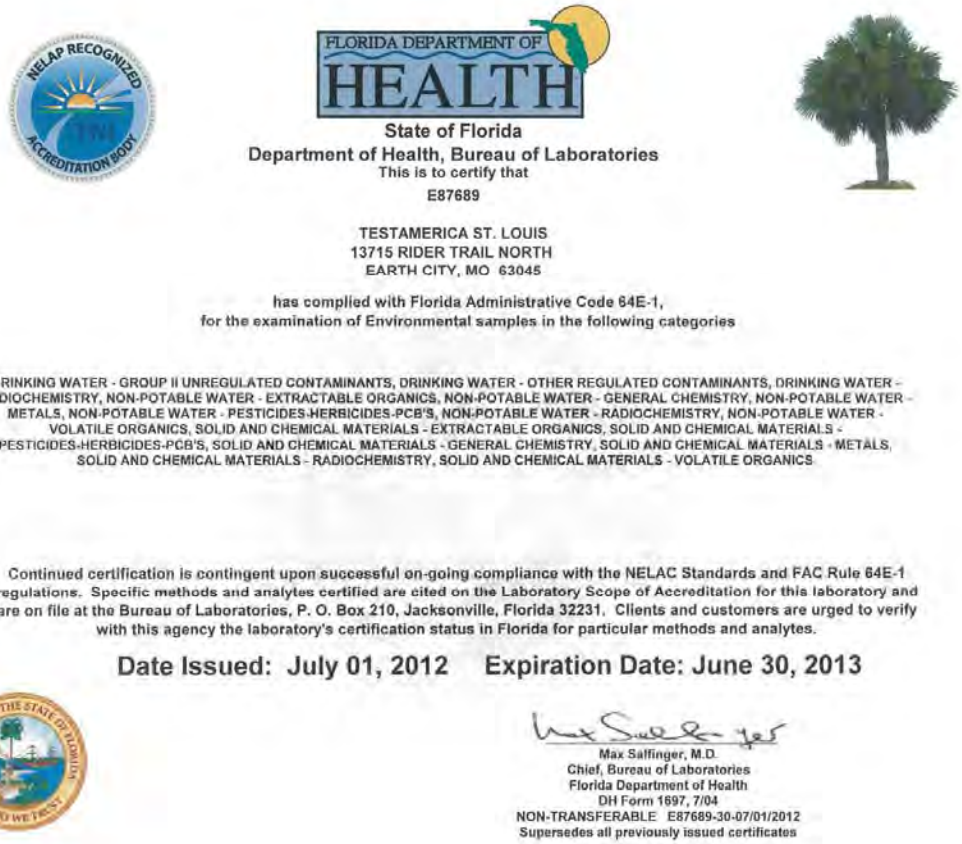
_____	_____	_____
Printed Name	*Signature*	*Date*

Page 1 of 1 Form No. CW-L-WI-006, dated 11/9/2010

Appendix 2. Laboratory Floor Plan



Appendix 3. NELAC/TNI 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.

Date Issued: July 01, 2012 Expiration Date: June 30, 2013

Max Saffinger, M.D.
Chief, Bureau of Laboratories
Florida Department of Health
DH Form 1697, 7/04
NON-TRANSFERABLE E87689-30-07/01/2012
Supersedes all previously issued certificates

Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-30, expiration date June 30, 2013. 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

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 7/1/2012** **Expiration Date: 6/30/2013**

Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-30, expiration date June 30, 2013. 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
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
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-Dichloropropene	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
Uranium	EPA 200.8	Radiochemistry	NELAP	6/5/2009

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 7/1/2012** **Expiration Date: 6/30/2013**

Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-30, expiration date June 30, 2013. 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
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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Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
State Surgeon General

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Attachment to Certificate #: E87689-30, expiration date June 30, 2013. 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
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 (Freon 113)	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
1,3,5-Trinitrobenzene (1,3,5-TNB)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	2/13/2002

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 7/1/2012** **Expiration Date: 6/30/2013**

Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
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: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	2/13/2002
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
1,3-Dinitrobenzene (1,3-DNB)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
2,4,6-Trinitrotoluene (2,4,6-TNT)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/22/2011
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-Diamino-6-nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	2/13/2002

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Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
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: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
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
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
2,4-Dinitrotoluene (2,4-DNT)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Diamino-4-nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
2,6-Dinitrotoluene (2,6-DNT)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Amino-4,6-dinitrotoluene (2-am-dnt)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
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
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
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-Nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
3,5-Dinitroaniline	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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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
3-Nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Amino-2,6-dinitrotoluene (4-am-dnt)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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
4-Nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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E87689
TestAmerica St. Louis
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Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
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
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

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
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
Benzene	EPA 624	Volatile Organics	NELAP	2/13/2002
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

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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
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
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

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Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-30, expiration date June 30, 2013. 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
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
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

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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
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	3/22/2011
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
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

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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
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	3/22/2011
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 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
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

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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
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
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

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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
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	4/25/2011
Manganese	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 6020	Metals	NELAP	4/25/2011
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
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

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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
Nitrate as N	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
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
Nitrobenzene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
Nitroglycerin	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Nitroglycerin	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	2/13/2002
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
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
Oil & Grease	EPA 1664A	General Chemistry	NELAP	2/13/2002
Orthophosphate as P	EPA 300.0	General Chemistry	NELAP	3/22/2011
Orthophosphate as P	EPA 9056	General Chemistry	NELAP	3/22/2011
o-Toluidine	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
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 (Quintozene)	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
Pentaerythritoltetranitrate (PETN)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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

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Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
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: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
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
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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

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Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
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 (19th/20th/21st Ed.)/TITR	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
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
Tin	EPA 200.7	Metals	NELAP	7/24/2006
Tin	EPA 6010	Metals	NELAP	7/1/2003
Tin	EPA 6020	Metals	NELAP	3/22/2011
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 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	3/22/2011
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 5310 B	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

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TestAmerica St. Louis
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Earth City, MO 63045

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
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-Dichloropropene	EPA 624	Volatile Organics	NELAP	2/13/2002
trans-1,3-Dichloropropene	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
Tri-o-cresylphosphate (TOCP)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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 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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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 (Freon 113)	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
1,3,5-Trinitrobenzene (1,3,5-TNB)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
1,3-Dinitrobenzene (1,3-DNB)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	2/13/2002
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/26/2005

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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
1,4-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
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
2,4,6-Trinitrotoluene (2,4,6-TNT)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Diamino-6-nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
2,4-Dinitrotoluene (2,4-DNT)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Diamino-4-nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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Analyte	Method/Tech	Category	Certification Type	Effective Date
2,6-Dinitrotoluene (2,6-DNT)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Amino-4,6-dinitrotoluene (2-am-dnt)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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-Nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
3,5-Dinitroaniline	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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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
3-Nitrotoluene	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
3-Nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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-Amino-2,6-dinitrotoluene (4-am-dnt)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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
4-Nitrotoluene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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Earth City, MO 63045

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
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
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 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

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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
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

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Analyte	Method/Tech	Category	Certification Type	Effective Date
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
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 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

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
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
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

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Analyte	Method/Tech	Category	Certification Type	Effective Date
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 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
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
Nitrobenzene	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
Nitroglycerin	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Nitroglycerin	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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

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Analyte	Method/Tech	Category	Certification Type	Effective Date
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
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pentachloroethane	EPA 8260	Volatile Organics	NELAP	2/13/2002
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	2/13/2002
Pentaerythritoltetranitrate (PETN)	ST-LC-0005 Rev. 0 (12/07/07)[EPA 8321A]/LC-MS-MS	Extractable Organics	NELAP	12/10/2008
Pentaerythritoltetranitrate (PETN)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 7/1/2012** **Expiration Date: 6/30/2013**

Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

John H. Armstrong, MD
State Surgeon General

Laboratory Scope of Accreditation

Attachment to Certificate #: E87689-30, expiration date June 30, 2013. 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
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
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
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
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
Thallium	EPA 6010	Metals	NELAP	2/13/2002
Thallium	EPA 6020	Metals	NELAP	2/13/2002

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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
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 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
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-Dichloropropene	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
Tri-o-cresylphosphate (TOCP)	ST-LC-0005(EPA 8321A)/LC-MS-MS	Extractable Organics	NELAP	7/6/2011
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
Vinyl chloride	EPA 8260	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.

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)

Activity, of radionuclides: The expected number of spontaneous nuclear decays (transformations) in unit time from a specified energy state (excluding prompt decays from a lower nuclear level) for a given amount of a radionuclide. Its standard unit (SI) is the Becquerel (Bq), where one Bq equals one decay per second. Activity has often been expressed in curies (Ci), where 3.7 X 1010 Bq equals 1 Ci, exactly. (ANSI)

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.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (NELAC)

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (NELAC)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (NELAC)

Background: Ambient signal response recorded by measurement instruments that are independent of radioactivity contributed by the radionuclides being measured in the sample. (ANSI

Batch: Environmental samples that 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 (1) to twenty (20) environmental samples of the same quality systems 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 twenty-four (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. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (NELAC)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (NELAC)

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)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (NELAC)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Standard (Source): 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 data calculation to correct for all sources of analytical losses. The term carrier can also be used for a non-radioactive compound added to assist in the isolation of the target analyte(s).

Certified Reference Material (CRM): A reference material

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (NELAC)

Check source: a radioactive source, not necessarily traceable to a national standards body such as NIST in the USA that is used to confirm the continuing satisfactory operation of an instrument. (ASTM)

Clouseau: TestAmerica custom software developed to document, track and trend non-conformances throughout the laboratory. The software interfaces with the laboratory information management system, QuantIMS and the report narrative generating software, KATO, to provide the laboratory with a corrective action system.

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.

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 safe-guarding 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; Alternative detectors or Additional Cleanup procedures. (NELAC)

Conformance: An affirmative indication or judgment 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 representation of data taken from a repetitive measurement or process. Control charts may be developed for various characteristics, (e.g., mean, standard deviation, range, etc.) of the data.

"A control chart has two basic uses: (1) as a tool to judge if a process was in control, and (2) as an aid in achieving and maintaining statistical control. For applications related to radiation detection instrumentation or radiochemical processes, the mean (center line) value of a historical characteristic (e.g., mean detector response), subsequent data values and control limits placed symmetrically above and below the center line are displayed on a control chart." (MARLAP)

Count rate: The rate at which detector pulses are being registered in a selected voltage interval. The unit is reciprocal seconds (i.e., s^{-1}). Generally the count rate is uncorrected for detector efficiency. The count rate divided by the detector efficiency for a specific particle and energy will yield the source activity.

Count time: The time interval for the counting of a sample or source by a radiation detector. Depending upon the context used, this can be either the "clock" time (the entire period required to count the sample), or "live" time (the period during which the detector is actually counting). Live time is always less than or equal to clock time. (MARLAP)

Correction: Actions necessary to correct or repair analysis specific non-conformances (e.g. the acceptance criteria for method specific QC and protocols as well as the associated corrective actions). The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

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).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (NELAC)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (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 sub-samples 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)

Energy Calibration: The correlation of the multi-channel analyzer (MCA) channel number to decay photon energy, obtained from the location of peaks from known radioactive standards.

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

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 Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time 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 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 $\pm$ 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

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 of the procedure unless otherwise noted in a reference method. 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.

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(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (NELAC)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (NELAC)

(QS) 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 or Saline/Estuarine. 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, 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 & Emissions: 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 Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result 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 Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

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.

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/concentration 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/concentration and a 5% chance that the true activity/concentration 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.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

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.

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.

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)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (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)

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 laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (NELAC)

Operator Aid: A technical posting, other than formal procedures, rules, instructions, etc., that assists workers in accomplishing specific tasks and are not required to be posted or displayed by any organization or procedure. All operator aids must be controlled by the facility.

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item or service is of the type of quality needed and expected by the client. (NELAC)

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 that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (NELAC)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (NELAC)

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 activities. (NELAC)

RadCapture: Software used to process and report radiochemical data.

Radioactive: exhibiting radioactivity or containing radionuclides. (MARLAP)

Radioactive decay: Process by which a spontaneous change in nuclear state takes place. This process is accompanied by the emission of energy and subatomic particles.

Radioactivity: spontaneous emission of radiation, either directly from unstable atomic nuclei or as a consequence of a nuclear reaction.

Radionuclide: a nuclide that is radioactive (capable of undergoing radioactive decay). (MARLAP)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (NELAC)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (NELAC)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (NELAC)

Sample Transfer Utility (STU): TestAmerica custom software developed to document and track samples through the laboratory. The software interfaces with the 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.

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved 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 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: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (NELAC)

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.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (NELAC)

Standard Deviation: the square root of a variance of a random variable. The variance is a measure of the variation of the observations within a measurement set. The standard deviation is often estimated using a set of measurements of the random variable. The standard deviation has the same units as the measured quantity and therefore, is particularly convenient when describing the variability of the measured quantity. (ANSI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (NELAC)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

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)

Systematic error: An error component that produces a fixed bias in the underlying expected value of a determination, from measurement to measurement. (ANSI)

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)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (NELAC)

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 data calculations to correct for and all sources of analytical loss.

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.

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:

%R	Percent Recovery
CAR	Corrective Action Report
CCV	Continuing Calibration Verification
CF	Calibration Factor
CFR	Code of Federal Regulations
COC	Chain of Custody
cpm	Counts per minute
cps	Counts per second
DER	Duplicate Error Ratio
DOC	Demonstration of Capability
DOD	Department of Defense
DOE	Department of Energy
DOECAP	DOE Consolidated Audit Program
DOT	Department of Transportation
dpm	Disintegrations per minute
DQO	Data Quality Objectives
DUP	Duplicate
EDD	Electronic data deliverable
EHS	Environment, Health and Safety
EPA	Environmental Protection Agency
FWHM	Full width half maximum
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GFPC	Gas-flow Proportional Counter
HPGe	High-purity germanium
HPLC	High Performance Liquid Chromatography
ICP	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP-MS	ICP/Mass Spectrometry
ICV	Initial Calibration Verification

IDL	Instrument Detection Limit
IH	Industrial Hygiene
IS	Internal Standard
ISO	International Organization of Standardization
keV	Kilo electron volts
LCL	Lower control limits
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantitation
MAPEP	Mixed Analyte Performance Evaluation Program
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocol
MDA/MDC	Minimum Detectable Activity/Concentration
MDL	Method Detection Limit
MDLCK	MDL Check Standard
MDLV	MDL Verification Check Standard
ME	Marginal exceedance
MeV	Mega electron volts
MQO	Measurement quality objective
MRL	Method Reporting Limit Check Standard
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
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program
PT	Performance Testing
TNI	The NELAC Institute
QAM	Quality Assurance Manual
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RDL	Required detection limit
RF	Response Factor
ROI	Region of interest
RPD	Relative Percent Difference
RPP	Radiation Protection Plan
RSD	Relative Standard Deviation
SD	Standard Deviation
SOP	Standard Operating Procedure
SOW	Statement of work
SRM	Standard reference material
TAT	Turn-Around-Time
TCLP	Toxicity characteristic leaching procedure
VOA	Volatiles
VOC	Volatile Organic Compound

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Appendix 5. Laboratory Certifications, Accreditations, Validations

TestAmerica **St. Louis** maintains accreditations, certifications, and approvals 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:

TestAmerica
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TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica St. Louis	DoD ELAP	L-A-B	L2305	01/10/2013
TestAmerica St. Louis	Federal	USDA	P330-07-00122	01/03/2014
TestAmerica St. Louis	Federal	USEPA Reg V SDWA	N/A	08/30/2014
TestAmerica St. Louis	NELAC	California	2542	03/31/2013
TestAmerica St. Louis	NELAC	Florida	E87689	06/30/2013
TestAmerica St. Louis	NELAC	Illinois	200023	11/30/2012
TestAmerica St. Louis	NELAC	Kansas	E-10236	10/31/2013
TestAmerica St. Louis	NELAC	Louisiana	106151	06/30/2013
TestAmerica St. Louis	NELAC	Louisiana	LA070016	12/31/2012
TestAmerica St. Louis	NELAC	New Jersey	MO002	06/30/2013
TestAmerica St. Louis	NELAC	New York	11616	04/01/2013
TestAmerica St. Louis	NELAC	Pennsylvania	68-00540	02/28/2013
TestAmerica St. Louis	NELAC	Texas	T104704193	07/31/2013
TestAmerica St. Louis	NELAC	Utah	MO000542012-4	06/30/2013
TestAmerica St. Louis	NELAC	Virginia	460230	06/14/2013
TestAmerica St. Louis	NRC	NRC	24-24817-01	02/28/2013
TestAmerica St. Louis	State Program	Alaska	MO00054	06/30/2013
TestAmerica St. Louis	State Program	Connecticut	PH-0241	03/31/2013
TestAmerica St. Louis	State Program	Iowa	373	12/01/2012
TestAmerica St. Louis	State Program	Kentucky	90125	12/31/2012
TestAmerica St. Louis	State Program	Maryland	310	09/30/2013
TestAmerica St. Louis	State Program	Missouri	780	06/30/2012 *
TestAmerica St. Louis	State Program	Nevada	MO000542009A	07/31/2013
TestAmerica St. Louis	State Program	South Carolina	85002	06/30/2013
TestAmerica St. Louis	State Program	Washington	C1310	08/31/2013
TestAmerica St. Louis	State Program	West Virginia DEP	381	08/30/2013

Page 1 of 1 11/26/12

* Certification Valid - Laboratory is Pending Renewal with the Program Authority
For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

The certificates and parameter lists (which may differ) are available, upon request, from a laboratory representative. For each organization or may be found on the corporate web site, the laboratory's public server, the final report review table, and in the following offices: QA, marketing, and project management.

Appendix 6: Calculations

Common Calculations

- Percent Recoveries *(ICV, CCV, LCS, Surrogates, Tracers, and Carriers) 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)

- *On column concentration*

On Column Concentration (µg/mL):

$$[OC] = \frac{A_x}{CF}$$

Where:

$[OC]$ = *On Column Concentration [typically expressed in µg/mL (ppm)]*

Then substitute/derive

$$[C] = [OC]\left(\frac{V_t * D}{V_i * V_s}\right)$$

When *on column concentration* $[OC]$ is equal to the *CAL-AMT (calibration amount)* of the low level standard needed to support the *reporting limit (µg/L)* and we solve the equation for *concentration (µg/L)*

Then

$$[C] \equiv RL \equiv [OC]\left(\frac{V_t * D}{V_i * V_s}\right)$$

Where:

RL = Reporting Limit

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

The Percent Difference is calculated as follows:

$$\%\ \text{Difference} = \frac{\text{(CF(v) or RF(v)) - (Avg. CF or RF)}}{\text{(Avg. CF or RF)}} \times 100$$

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:

$$\%\ \text{Drift} = \frac{\text{Result - True Value}}{\text{True Value}} \times 100$$

The Percent Recovery is calculated as follows:

$$\%\ \text{Recovery} = \frac{\text{Result}}{\text{True Value}} \times 100$$

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 examining 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
Δε	=	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 concentration 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

Additional Information for Radiochemistry Calculations:

Zero Count Uncertainty

Certain analyses with intrinsic low background may lead to instances where both the background and the sample count results may be zero (e.g. alpha spec, Ni-59). In such circumstances, the counting uncertainty (CU) and total propagated uncertainty (TPU) will evaluate to zero. To provide a non-zero estimate of the counting uncertainty (and thus a non-zero TPU) in such an occasion, a value of one (1) will be substituted for the sample counts in the counting uncertainty and critical level equations.

Cross Talk Calculation

Alpha into Beta Crosstalk

$$\alpha >> \beta \ crosstalk = \frac{CPM_{XT}}{CPM_{\alpha} + CPM_{XT}} = y$$

$$yCPM_{\alpha} + yCPM_{XT} = CPM_{XT}$$

$$CPM_{XT} = \frac{y}{(1-y)}\ CPM_{\alpha} \quad where\ CPM_{\alpha}\ is\ net\ alpha\ CPM$$

$$Activity = \frac{CPM_S - CPM_{XT} - CPM_B}{2.22 * E * V}$$

$$CU = \frac{\sqrt{\frac{CPM_S}{T_S} + \frac{CPM_{XT}}{T_S} + \frac{CPM_B}{T_B}}}{2.22 * E * V}$$

$$TPU = \sqrt{CU^2 + (UF * Act)^2}$$

$$MDC = \frac{3.29\sqrt{\frac{CPM_B}{T_S} + \frac{CPM_{XT}}{T_S} + \frac{CPM_B}{T_B}}}{2.22 * E * V} + \frac{2.71}{T_S}$$

$$DLC = \frac{1.645\sqrt{\frac{(2)CPM_B + CPM_{XT}}{T_S}}}{2.22 * E * V}$$

CPM	=	counts per minute (S=Sample, B=Background, XT=crosstalk, α=alpha)
T	=	count duration in minutes (S=Sample, B=Background)
E	=	Efficiency
V	=	aliquot volume
UF	=	uncertainty factor (e.g. 0.05)
Act	=	activity

TestAmerica
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Equations for
Americium, 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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

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=0.055

TestAmerica
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Equations for *Carbon-14 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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: R=1, A=1, P=0.054

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for *Chlorine-36 by GFPC*

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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: R=1, A=1, P=0.040

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Curium, 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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

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

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for *Gamma 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Gross Alpha-Beta Solid, Direct Count

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

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 uncertaintles.

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=0.057 for alpha, P=0.050 for beta

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Gross Alpha-Beta, Total Dissolution

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)

$$\text{abs}\left(\frac{(\text{SampleActivity} - \text{SampleDuplicateActivity})}{\sqrt{(\text{SampleUncertainty})^2 + (\text{SampleDuplicateUncertainty})^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (\text{CPM}_b \times T_s)}}{\text{DEIVTRA}}\right) \times \text{UnitCorrectionFactor}$$

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

$$\left(\left(3.29 \times \sqrt{\frac{\frac{\text{CPMb}}{\text{Ts}} + \frac{\text{CPMb}}{\text{Tb}}}{\text{D} \times \text{E} \times \text{I} \times \text{V} \times \text{R} \times \text{A}}}\right) + \frac{2.71}{\text{D} \times \text{E} \times \text{I} \times \text{V} \times \text{Ts} \times \text{R} \times \text{A}}\right) \times \text{DilutionFactor} \times \text{UnitConversionFactor}$$

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

$$\frac{\sqrt{\frac{C_s}{(T_s)^2}+\frac{C_b}{(T_b)^2}}}{DEIVRA} \times UnitCorrectionFactor \times DilutionFactor \times Sigma$$

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=0.057 for alpha, P=0.050 for beta

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

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:

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

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

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:

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=0.054

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

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:

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=0.045

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Neptunium, 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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

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

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\left(\left(3.29 \times \frac{\sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

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 = 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: I=1, A=1, P=0.065 for Ni-59, P=0.052 for Ni-63

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Plutonium, 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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

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

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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=0.045

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Polonium, 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

MDA

$$\left(\left(3.29 \times \sqrt{\frac{CPMb}{Ts} + \frac{CPMb}{Tb}}\right) + \frac{2.71}{D \times E \times I \times V \times R \times A}\right) \times DilutionFactor \times UnitConversionFactor$$

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 = 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, A=1, P=0.042

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

Where:
U_c = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError 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=0.054

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Radium, Total Alpha-Emitting

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

Ingrowth Factor

$$1 + \left[3 \times \left[1 - E^{\left(\frac{-0.6931}{Rn222Halflife}\right) \times \left(\left(CountDateTime + \left(\frac{T_s}{2880}\right)\right) - BaPrecipitationTime\right) \times 1440}\right]\right]$$

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

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=0.045

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for *Radium-226*

Activity

$$\left(\frac{(\text{SampleCPM} - \text{BkgCPM})}{\text{DEIVRA}}\right) \times \text{UnitCorrectionFactor}$$

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

$$1 + \left(3 \times \left(1 - E^{\left(\frac{-0.6931}{\text{Rn222 Halflife}}\right) \times \left(\left(\text{Count DateTime} + \left(\frac{T_s}{2880}\right)\right) - \text{Ba Precipitation Time}\right) \times 1440}\right)\right)$$

Corrects for ingrowth of Ra-222

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{\text{CPMb}}{\text{Ts}} + \frac{\text{CPMb}}{\text{Tb}}}}{D \times E \times I \times V \times R \times A}\right) + \frac{2.71}{D \times E \times I \times V \times Ts \times R \times A}\right) \times \text{DilutionFactor} \times \text{UnitConversionFactor}$$

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 = 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: I=1, A=1, P=0.045

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Radium-226 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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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, A=1, P=0.042

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Radium-226 by Ba-133 Tracer

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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, A=1, P=0.045

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Radium-228

Activity

$$\frac{(CPM_s - CPM_b)}{V \times E \times R} \times \frac{\lambda \times t_2}{1 - EXP(-\lambda \times t_2)} \times \frac{1}{1 - EXP(-\lambda \times t_3)} \times \frac{1}{EXP(-\lambda t_1)} \times \text{Unit Correction Factor}$$

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)

$$abs\left(\frac{(\text{Sample Activity} - \text{Sample Duplicate Activity})}{\sqrt{(\text{Sample Uncertainty})^2 + (\text{Sample Duplicate Uncertainty})^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\frac{\left(1.645 x \sqrt{2 x CPM_b x T_s}\right) x (\lambda t_2)}{V x E x R x T_s x (1 - EXP(-\lambda t_2)) x (1 - EXP(-\lambda t_3)) x EXP(-\lambda t_1)} x \text{Unit Correction Factor}$$

Where:
t_1 = Count Start Time x Y precipitation Time
t_2 = Sample Count Duration
t_3 = Y precipitation Time − Y Ingrowth Start Time
λ = Ac − 228 Halflife
Note: Recovery (R) is product of Ba Yield x Y Yield

MDA

$$\frac{\left(\left(3.29 x \sqrt{\frac{CPM_b}{T_s} + \frac{CPM_b}{T_b}}\right) + \frac{2.71}{T_s}\right) x (\lambda t_2)}{V x E x R x (1 - EXP(-\lambda t_2)) x (1 - EXP(-\lambda t_3)) x EXP(-\lambda t_1)} x \text{Unit Correction Factor}$$

Where:
t_1 = Count Start Time x Y precipitation Time
t_2 = Sample Count Duration
t_3 = Y precipitation Time − Y Ingrowth Start Time
λ = Ac − 228 Halflife
Note: Recovery (R) is product of Ba Yield x Y Yield

RER (DOE Alberqueque)

$$abs\left(\frac{(\text{Sample Activity} - \text{Sample Duplicate Activity})}{(\text{Sample Uncertainty} + \text{Sample Duplicate Uncertainty})}\right)$$

As Defined by the DOE Alberqueque SOW. This value is determined from 2 sigma propogated uncertainties.

Uncertainty, Count

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{DEIVRA} \times \text{Unit Correction Factor} \times \text{Dilution Factor} \times \text{Sigma}$$

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: A=1, P=0.046

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Strontium, Total by GFPC

DER (Normalized Absolute Difference)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2\times(CPM_b \times T_s)}}{DEIVTRA}\right)\times UnitCorrectionFactor$$

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

$$\left(\left(3.29\times\frac{\sqrt{\frac{CPMb}{Ts}+\frac{CPMb}{Tb}}}{D\times E\times I\times V\times R\times A}\right)+\frac{2.71}{D\times E\times I\times V\times Ts\times R\times A}\right)\times DilutionFactor\times UnitConversionFactor$$

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

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 (0.048 w/ Metals recovery)

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THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Strontium-89 by GFPC

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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 = 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

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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

$$\left(\frac{1.645\sqrt{2\times(CPM_b \times T_s)}}{DEIVTRA}\right) \times DilutionFactor \times UnitCorrectionFactor$$

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

$$\sqrt{\left(\frac{U_o}{S}\right)^2 + (A \times P)^2} \times S$$

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=0.041

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

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, A=1, P=0.048

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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

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

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Total Activity by LSC

Activity

$$\left(\frac{\text{SampleDPM} - \text{BkgDPM}}{\left(\frac{\text{VolumeCounted}}{\text{VolumeCollected}}\right) \times \text{Aliquot}}\right) \times \text{UnitConversionFactor}$$

Aliquot, Adjusted

$$\text{SampleAliquot} \times \left(\frac{\text{VolumeCounted}}{\text{FinalVolume}}\right)$$

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)

$$\text{abs}\left(\frac{(\text{SampleActivity} - \text{SampleDuplicateActivity})}{\sqrt{(\text{SampleUncertainty})^2 + (\text{SampleDuplicateUncertainty})^2}}\right)$$

As defined by DOE QSAS, Revision 2

DLC

$$\left(\frac{1.645\sqrt{2 \times (\text{CPM}_b \times T_s)}}{\text{DEIVTRA}}\right) \times \text{UnitCorrectionFactor}$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{\text{CPMb}}{\text{Ts}} + \frac{\text{CPMb}}{\text{Tb}}}}{\text{D} \times \text{E} \times \text{I} \times \text{V} \times \text{R} \times \text{A}}\right) + \frac{2.71}{\text{D} \times \text{E} \times \text{I} \times \text{V} \times \text{Ts} \times \text{R} \times \text{A}}\right) \times \text{DilutionFactor} \times \text{UnitConversionFactor}$$

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

$$\frac{\sqrt{\frac{C_s}{(T_s)^2} + \frac{C_b}{(T_b)^2}}}{\text{DEIVTRA}} \times \text{UnitCorrectionFactor} \times \text{DilutionFactor} \times \text{Sigma}$$

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

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

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

$$\left(\frac{1.645\sqrt{2 \times (CPM_b \times T_s)}}{DEIVTRA}\right) \times UnitCorrectionFactor$$

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_o = Count Uncertainty
S = Sigma
A = Sample Activity
P = PropogatedError 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=0.044

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

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=0.044

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

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=0.030

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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

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=0.044

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Tritium in Silica Gel, INEL

Activity

$$\left(\frac{(SampleDPM - BkgDPM)}{DIVRA}\right) \times UnitCorrectionFactor$$

Aliquot, Adjusted

$$SampleAliquot \times \left(\frac{VolumeCounted}{EndCollectVolume - BeginCollectVolume}\right)$$

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

$$\sqrt{\left(\frac{U_c}{S}\right)^2 + (A \times P)^2} \times S$$

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=0.044

TestAmerica
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)

$$abs\left(\frac{(SampleActivity - SampleDuplicateActivity)}{\sqrt{(SampleUncertainty)^2 + (SampleDuplicateUncertainty)^2}}\right)$$

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

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=0.044

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Equations for
Uranium, Isotopic by Alpha Spectroscopy

Activity

$$\left(\frac{(\text{SampleCPM} - \text{BkgCPM})}{\text{DEIVRA}}\right) \times \text{UnitCorrectionFactor}$$

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

$$\left(\frac{1.645\sqrt{2 \times (\text{CPM}_b \times T_s)}}{\text{DEIVTRA}}\right) \times \text{UnitCorrectionFactor}$$

MDA

$$\left(\left(3.29 \times \frac{\sqrt{\frac{\text{CPMb}}{\text{Ts}} + \frac{\text{CPMb}}{\text{Tb}}}}{\text{D} \times \text{E} \times \text{I} \times \text{V} \times \text{R} \times \text{A}}\right) + \frac{2.71}{\text{D} \times \text{E} \times \text{I} \times \text{V} \times \text{Ts} \times \text{R} \times \text{A}}\right) \times \text{DilutionFactor} \times \text{UnitConversionFactor}$$

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

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

Appendix 7 Laboratory SOP Listing

SOP Number	SOP Title
ST-GC-0005	Extractable Total Petroleum Hydrocarbons
ST-GC-0013	Extraction and analysis of Phenols
ST-GC-0014	Aromatic Volatiles and Volatile Petroleum Hydrocarbons by GC-PID/FID
ST-GC-0015	PCB GC Analysis
ST-GC-0016	Pesticide GC Analysis
ST-GC-0017	Herbicide GC Analysis
ST-GC-0018	Analysis of Water Miscible Non-Halogenated Organic Compounds by GC-FID
ST-GC-0019	RSK-175
ST-HS-0001	Waste Minimization Plan
ST-HS-0002	Facility Addendum to Corporate Safety Manual
ST-HS-0003	St. Louis Facility Contingency Plan
ST-HS-0004	Hazardous Waste Management Plan
ST-HS-0005	Laboratory Security Systems
ST-HS-0006	Quarantine Soils Procedure
ST-HS-0007	Fume Hood Calibration
ST-IP-0001	Reactive Cyanide & Sulfide
ST-IP-0002	Acid Digestion of soil
ST-IP-0004	Labware Prep for Inorganic & Trace Metal Analysis
ST-IP-0013	Acid Digestion of Aqueous Samples & Extracts for Total Metals Analysis for ICP or ICP/MS
ST-IP-0014	Alkaline digestion of Cr+6
ST-IP-0015	Filtration Procedure for Dissolved Metals Analysis
ST-IP-0019	Sulfide Distillation
ST-IP-0020	Distribution Coefficients of Inorganic Species by the Batch Method
ST-IS-0001	Software Change Management
ST-IS-0002	Software Testing, Validation & Verification
ST-IS-0003	Information Systems
ST-LC-0001	HPLC Analysis of PAH/PNA
ST-LC-0002	Analysis of Nitroaromatic & Nitroamine Explosives
ST-LC-0004	Analysis of Perchlorates by LC/MS/MS
ST-LC-0005	Analysis of Nitroaromatics by LC/MS/MS
ST-MS-0001	GC/MS Analysis based on 8270C and 625
ST-MS-0002	Volatile Organics by GCMS
ST-MT-0001	Metals by ICP/MS
ST-MT-0003	Metals by ICP-AES
ST-MT-0005	Mercury in Aqueous Samples by CVAA
ST-MT-0007	Mercury in Solid Samples by CVAA
ST-MT-0008	Total Uranium by Laser Induced Phosphorimetry (KPA)
ST-OP-0001	Labware Preparation for Organic Analysis
ST-OP-0002	Extraction & Cleanup of Organic Compounds from Waters and Soils
ST-OP-0007	Extraction of Herbicides - Water & Soil
ST-OP-0008	Extraction of Nitroaromatics & Nitroamine Explosives for Waters and Soils
ST-OP-0009	TCLP/SPLP and CWET Procedures
ST-PM-0001	Project Setup and Quote
ST-PM-0002	Sample Receipt & Chain of Custody

SOP Number	SOP Title
ST-PM-0003	Bottle Kit Preparation
ST-PM-0004	Data Review, Verification & Reporting
ST-QA-0002	Standard and Reagent Preparation
ST-QA-0005	Calibration & Verification Procedure for Thermometer, Weights, Balances & Pipettes
ST-QA-0014	Evaluation of Accuracy and Precision via Control Charts
ST-QA-0016	IDL/MDL, LOD/LOQ Determination
ST-QA-0021	Internal Surveillance
ST-QA-0023	Document Control
ST-QA-0024	Preventative Maintenance
ST-QA-0028	Water System Maintenance & Monitoring
ST-QA-0031	VOA Holding Blank Analysis
ST-QA-0035	Preparation and Management of SOPs
ST-QA-0036	Non-Conformance Memo (NCM)/Validation Request and Corrective Action Processes
ST-QA-0037	Procurement of Quality Related Items
ST-QA-0038	Procedure for Compositing and Subsampling
ST-QA-0039	Sample Transfer Utility
ST-QA-0040	Manual Integration Procedure
ST-QA-0041	Lead Auditor
ST-QA-0042	10CFR 21 Defects and Non-Compliances
ST-QA-0043	DoD QSM 4.X
ST-QA-0044	Training
ST-RC-0002	Planchet Prep for Radiochemistry & Radiological Screening
ST-RC-0003	Drying & Grinding of Soil & Solid Samples
ST-RC-0004	Prep of Soil, Sludge, Filter, Biota & Oil/Grease Samples for Radiochemical Analysis
ST-RC-0010	Screening Samples for Presence of Radioactive Material
ST-RC-0014	Bulk Drying and Grinding of Soil and Solid Samples
ST-RC-0015	Total Activity Screening Procedure by LSC
ST-RC-0020	Determination of Gross Alpha/Beta Activity
ST-RC-0021	Gross Alpha Radiation in Water - Coprecipitation
ST-RC-0025	Preparation of Samples for Gamma Spectroscopy
ST-RC-0030	Determination of Tritium in Water (and other Fluids) Soil & Silica Gels
ST-RC-0031	Tritium Determination by Cryogenic Distillation
ST-RC-0036	Chlorine-36
ST-RC-0039	Radium 226 by Alpha Spec
ST-RC-0040	Total Alpha Emitting Isotopes of Radium
ST-RC-0041	Radium-226 & Radium-228 by Chemical Separation
ST-RC-0042	Iodine-129 in Water
ST-RC-0050	Preparation of Strontium 89 & 90
ST-RC-0055	Determination of Fe55, Ni59 & Ni63 by LSC
ST-RC-0056	Carbon-14 by LSC
ST-RC-0057	Carbon -14/Inert Gas
ST-RC-0058	Soil Prep for Sr-89, Sr-90 & Total Sr using Extraction Chromatography
ST-RC-0100	Actinide Coprecipitation
ST-RC-0125	Determination of TC99 using Eichrom Teva Resin
ST-RC-0210	Determination of Po210 by Alpha Spectrometry
ST-RC-0211	Determination of Pb210 by LSC

SOP Number	SOP Title
ST-RC-0232	Isotopic Th/Np in Various Matrices by Eichrom TEVA
ST-RC-0238	Isotopic U by Eichrom UTEVA Resin for Various Matrices
ST-RC-0240	Isotopic Am/Cu/Pu/Th/U in Various Matrices Eichrom
ST-RC-0241	Am/Pu/Cu/U in Various Matrices by Eichrom UTEVA & TRU Resins (with Vacuum Box)
ST-RC-0242	Isotopic Th/Pu/U in Various Matrices by Eichrom Separation Resins
ST-RC-0245	Determination of Pu241 by LSC
ST-RC-0246	Isotopic Am/Cu/U in Various Matrices by Eichrom Separation Procedure
ST-RC-0247	Promethium247 & Samarium151 Lanthide Resin Separation
ST-RC-0300	NJ 48 Hour Gross Alpha Testing PWTA
ST-RC-5006	Decontamination of Lab Glassware, Labware & Equipment
ST-RD-0102	Gamma Vision Analysis
ST-RD-0210	Alpha spectroscopy
ST-RD-0302	Liquid Scintillation Counter Analysis
ST-RD-0403	Low Background Gas Flow Proportional Counting System Analysis
ST-RP-0001	Radiation Protection Program
ST-RP-0005	ALARA Program
ST-RP-0010	Internal Exposure Control
ST-RP-0020	External Exposure Control
ST-RP-0030	Radiological Contamination
ST-RP-0031	Radiation Work Permits
ST-RP-0032	Instrumentation and surveillance
ST-RP-0033	Radiological Areas and Posting
ST-RP-0034	Engineered Controls
ST-RP-0042	Handling of Sealed Sources
ST-RP-0050	Purchase, Receipt, Handling and ID of Radioactive
ST-RP-0051	Packaging/Transportation of Radioactive Material
ST-RP-0100	Radiation Protection Records
ST-RP-0110	Radiation Protection Training
ST-RP-0120	Emergency Response & notification
ST-RP-0140	Quality Assurance in Radiological Protection
ST-WC-0001	Turbidity
ST-WC-0002	Cyanide Analysis by Technicon TRAACS 800 Autoanalyzer
ST-WC-0003	Hardness
ST-WC-0004	Chemical Oxygen Demand
ST-WC-0005	Percent Solids Determination
ST-WC-0006	Total Organic Halides in Water (TOX) and Soil (EOX)
ST-WC-0011	Analysis of pH in Water & Soil
ST-WC-0012	Analysis of Sulfide in Water
ST-WC-0013	Phosphorus, all Forms
ST-WC-0014	Analysis of Ammonia as N in Water & Soil
ST-WC-0015	Biochemical Oxygen Demand
ST-WC-0016	Total Organic Carbon
ST-WC-0017	Phenolics, Total Recoverable
ST-WC-0018	Acidity of Water & Wastewater
ST-WC-0019	Alkalinity in Water & Soil
ST-WC-0020	Prep and determination of TKN

SOP Number	SOP Title
ST-WC-0023	Nitrate/Nitrite analysis by TRAACS
ST-WC-0025	Conductivity in Water & Soil
ST-WC-0026	Flashpoint by Pensky-Martens Closed Cup
ST-WC-0028	Anions by Ion Chromatography
ST-WC-0029	Residual Chlorine
ST-WC-0031	Paint Filter
ST-WC-0033	Hexavalent Chromium (Colormetric)
ST-WC-0034	Heat of Combustion (BTU)
ST-WC-0036	Determination of Solids in Water and Wastewater
ST-WC-0037	Perchlorate by IC
ST-WC-0039	Method 1664, N-Hexane Extractable Material
ST-WC-0042	Chlorophyll-a
ST-WC-0044	Potentiometric Determination Of F In Aqueous Samples With Ion-Selective Electrode
ST-WC-0045	Cation Exchange
ST-WC-0046	Reactivity to Air, Water, Physical Properties
ST-WC-0047	TOC in soil
ST-WC-0050	Standard Method for Moisture, Ash & Organic Matter