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LAURIE A. CAHILL

August 29, 1997

Site: Mid-America Tanning
ID #: IAD085824688
Break: 6.3
Other: Core Lab.
8-29-97

By Overnight Mail

Ms. Debi Morey
ARCS Project Officer
Waste Management Division
U.S. Environmental Protection Agency
726 Minnesota Avenue
Kansas City, Kansas 66101

Re: Mid-America Tanning Site - Appendix C Groundwater Sampling Plan

Dear Debi:

Following-up on my August 29, 1997 letter, enclosed please find two copies of Appendix C of the Ground-Water Sampling and Analysis Plan for the Mid-America Tanning site. Appendix C is the Quality Assurance Manual for Core Laboratories.

Please contact me if you have any questions regarding Appendix C.

Sincerely,

Laurie Cahill

Laurie A. Cahill

HALE PRATT MIDGLEY LAITOS
GREEN & HACKSTAFF, P.C.

Enclosure

pc: Phillip Chambers, Esq. (w/encl.)
Michael Romita, Esq. (w/encl.)

pc: Michael O'Dowd (w/o encl.)
Bob Sterrett (w/o encl.)
John Mahoney (w/o encl.)
Barbara Peterson, Esq. (w/o encl.)

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Quality Assurance Manual

Environmental Testing Services Division

"Providing Solutions for the Future"

Core Laboratories
5295 Hollister Road, Houston, TX 77040
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CORE LABORATORIES
ENVIRONMENTAL TESTING SERVICES

QUALITY ASSURANCE MANUAL

Document Control No. QAM-727

The recipient of this Quality Assurance Manual, in consideration of being given access to this copy of the QA Manual, hereby acknowledges and agrees that this manual is a controlled copy of the Core Laboratories' Environmental Testing Services Division Quality Assurance Manual; that this manual is the property of Core Laboratories and it must be returned to the Corporate Quality Assurance Department immediately upon request; and that this manual is not to be copied or provided to anyone who is not a Core Laboratories' employee without the written consent of the Environmental Testing Services Division Corporate Quality Assurance Director.

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TITLE

ENVIRONMENTAL TESTING SERVICES DIVISION QUALITY ASSURANCE MANUAL
DOCUMENT CONTROL PAGE

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DOCUMENT CONTROL PAGE

PREPARED BY:

LaDonna Kibler _____ Ann Rosecrance _____

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LaDonna Kibler _____

APPROVED BY:

Ann Rosecrance _____ 4/11/97 _____
Corporate Quality Assurance Director
Environmental Testing Services Division — Date

_____ 4/11/97 _____
Vice President
Environmental Testing Services Division — Date

DISTRIBUTION TO:

All laboratories in the Environmental Testing Services Division of Core Laboratories

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TITLE

ENVIRONMENTAL TESTING SERVICES DIVISION QUALITY ASSURANCE MANUAL

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LIST OF FIGURES*

*All Figures are provided in the Appendix

1.0 INTRODUCTION AND QUALITY COMMITMENT

1.1 SCOPE AND APPLICATION

This Quality Assurance (QA) Manual specifies the corporate QA policies and procedures for laboratories in the Environmental Testing Services (ETS) Division of Core Laboratories. All figures referenced in this manual are provided in the appendix. This manual represents the first tier in the QA program documentation hierarchy. The second tier is the Laboratory Documentation Manual which includes laboratory specific quality control procedures and documentation. The Corporate QA Manual and the Laboratory Documentation Manual combine to serve as the laboratory quality assurance/quality control (QA/QC) manual.

This manual and the associated QA program is designed to comply with industry standards and government regulations for environmental and petroleum testing laboratories. This manual meets the requirements of ISO/IEC Guide 25, General Requirements for the Competence of Calibration and Testing Laboratories, the API Petroleum Testing Accreditation Program, and the proposed EPA National Environmental Laboratory Accreditation Program.

The QA Manual is distributed to all laboratories in the Environmental Testing Services Division of Core Laboratories and is available to clients and regulatory agencies for their review and use in preparing QA project plans. Controlled copies of the QA Manual are provided to the laboratory managers, laboratory supervisors, and QA/QC coordinators at all laboratory locations. The QA Manual is posted in each laboratory section and available for use by all employees. All Core Laboratories' employees are required to comply with the requirements specified in this manual.

1.2 QUALITY POLICY

Core Laboratories' quality policy is to provide clients with technically and legally defensible analytical data of known and documented quality. Core Laboratories' Quality Policy is stated as follows:

- We will provide on-time, error-free service, data, reports, and products which meet or exceed our customer's requirements and/or applicable industry standards.

- We will practice error prevention rather than error correction.
- We will perform each task right the first time.

1.3 ETHICS POLICY

Core Laboratories' ethics policy is to require high standards of integrity from all employees with regard to the duties they perform and data they report in connection with their employment at Core Laboratories. In order to ensure that employees are aware of the high standards of integrity that are expected of them as Core Laboratories' personnel, a written Ethics Agreement must be reviewed by and signed by each employee. A copy of Core Laboratories' Ethics Agreement is provided in Figure 1-1.

1.4 QUALITY ASSURANCE OBJECTIVES

Core Laboratories' Quality Assurance (QA) Program is designed to ensure that all analytical testing performed and services provided by our laboratories conform to client requirements, regulatory specifications, and internal quality assurance and quality control (QA/QC) policies and procedures. The QA program objectives are as follows:

- Define the requirements for laboratory performance,
- Train laboratory staff on the requirements, and
- Assess laboratory compliance to the requirements.

The first objective is accomplished through the Corporate QA Manual, Quality Assurance Alerts, Regulatory Alerts, technical and general SOPs, SOP Summaries, SOP addendums, QC summaries, laboratory documentation and procedures, data review checklists, and standardized forms. The second objective is accomplished through the conduction of training programs. The third objective is accomplished through single and double blind performance evaluation studies, round robin studies, blind duplicate and QC sample analyses, QA audits, facility audits, data audits, and internal assessments of the laboratory for compliance with the QA Manual and SOPs.

1.5 ANALYST'S COMMITMENT TO QUALITY

Each laboratory staff member must adhere to and practice Core Laboratories' Analyst's Commitment to Quality. The Analyst's Commitment to Quality is as follows:

- To produce results that are accurate and defensible.
- To use approved methodology and procedures. Deviations from methodology or procedures must be approved and documented.
- To acquire a full understanding and knowledge of the methodology used and the associated requirements.
- To apply the necessary quality control measures to ensure the accuracy, precision, and completeness of all analyses and resulting data.
- To document all test findings and details in such a way that results can be regenerated at a later date by another person.
- To utilize good laboratory practices throughout all phases of the analysis process.
- To act on identified nonconformances and out of control events in a timely manner and to apply the necessary corrective action.
- To provide the client with data of known and documented quality and to advise the client of data that does not meet the method specifications or the client requirements.
- To provide accurate and complete information to management and auditors that is verifiable and traceable to associated documentation.

2.0 ORGANIZATION AND RESPONSIBILITY

2.1 CORPORATE STRUCTURE

Core Laboratories was established in 1936 and currently operates 46 facilities in 16 countries. Core Laboratories consists of two operating units: Laboratory Services and Technology Products. The Environmental Testing Services (ETS) Division consists of environmental and petroleum testing laboratories located within the United States. Core Laboratories' worldwide organizational chart is provided in Figure 2-1; the organizational chart for the Environmental Testing Services Division is provided in Figure 2-2.

The quality of Core Laboratories' Environmental Testing Services Division is a top priority of the senior vice-president and corporate QA department. The corporate QA department which is directed by the corporate QA director consists of a strong multi-disciplined technical staff available to each of the laboratory facilities for technical support, service and evaluation. The corporate QA director reports directly to the senior vice-president. The corporate QA administrator and staff report directly to the corporate QA director.

2.2 CORPORATE MANAGEMENT AUTHORITY

The corporate management staff is responsible for setting laboratory policies and procedures, providing the necessary financial resources, and resolving conflicts. The corporate QA director is responsible for establishing the QA policies and procedures for implementation at each laboratory and for directing the QA Program. The corporate QA administrator is responsible for administering the QA Program at each laboratory. The division vice-president, regional managers and laboratory managers are responsible for ensuring that the corporate QA policies and procedures are implemented and enforced at each laboratory.

2.3 LABORATORY ORGANIZATION

The laboratories are under the direction of the division vice-president who reports to the senior vice-president. The division QA Program is under the direction of the corporate QA director who reports to the senior vice-president. Regional managers report to the division vice-president and are

responsible for the operation of multiple laboratories. Each laboratory is managed by a laboratory manager who is responsible for the laboratory performance. The site-specific laboratory QA/QC program is managed by the laboratory QA/QC coordinator. The QA/QC coordinators are directed in their work by the corporate QA director and supervised by the laboratory manager. Each laboratory section is supervised by a laboratory supervisor. The laboratory staff reports to either the laboratory manager or a designated laboratory supervisor. Deputy assignments are made by the appropriate party in the event of absence of the laboratory management or QA staff. A site-specific organizational chart shall be provided in the Laboratory Documentation Manual.

Core Laboratories' Laboratory Locations Directory is provided in Figure 2-3.

2.4 LABORATORY STAFF ROLES AND RESPONSIBILITIES

The following section is a summary of the QA responsibilities of the laboratory managers, laboratory section supervisors, QA/QC coordinators, and laboratory staff.

2.4.1 Laboratory Managers

2.4.1.1 Adhere to and practice Core Laboratories' Analyst's Commitment to Quality and Ethic's Agreement.

2.4.1.2 Support the policy that quality is first among equals with schedule and cost.

2.4.1.3 Maintain a work environment which emphasizes the importance of data quality and provide adequate resources to ensure that the QA policies and procedures can be met.

2.4.1.4 Ensure that sample holding times, project turnaround times, and other contractual obligations are met and take appropriate corrective action if nonconformances or out of control events occur.

2.4.1.5 Resolve issues associated with conflicts between quality objectives and operational demands and document decisions to

deviate from standard quality control criteria due to project specifications.

2.4.1.6 Designate and supervise a QA/QC coordinator who has the capability, lack of conflict-of-interest, and time to meet the designated responsibilities.

2.4.1.7 Allow the QA/QC coordinator to freely interact with the staff and receive full direction from the corporate QA director on QA/QC activities.

2.4.1.8 Ensure that the laboratory staff is adequately trained and that analytical methods and laboratory SOPs are consistently followed and that quality control requirements are met.

2.4.2 Laboratory Section Supervisors

2.4.2.1 Adhere to and practice Core Laboratories' Analyst's Commitment to Quality and Ethic's Agreement.

2.4.2.2 Maintain a work environment which emphasizes the importance of data quality.

2.4.2.3 Ensure that sample holding times, project turnaround times, and other contractual obligations are met and take appropriate corrective action if nonconformances or out of control events occur.

2.4.2.4 Assist in resolving issues associated with conflicts between quality objectives and operational demands and document decisions to deviate from standard quality control criteria due to project specifications.

2.4.2.5 Actively participate in the development, implementation, and enforcement of SOPs and SOPs addendums used in the laboratory.

2.4.2.6 Ensure that the laboratory staff is adequately trained and that analytical methods and laboratory SOPs are consistently followed

and that quality control requirements are met.

2.4.2.7 Ensure that instruments are properly operated, calibrated, and maintained and that adequate documentation is kept for all instruments.

2.4.2.8 Assist the laboratory staff in determining and implementing the corrective action required for resolving any out of control events or nonconformances.

2.4.2.9 Review data for samples, standards, and quality control samples and ensure that the data is accurate, complete, and in conformance with the specified quality control criteria.

2.4.2.10 Verify that sample and quality control data were correctly entered in LIMS and that the reported data is traceable to the raw data.

2.4.3 Quality Control/Quality Assurance (QA/QC) Coordinator

2.4.3.1 Adhere to and practice Core Laboratories' Analyst's Commitment to Quality and Ethic's Agreement.

2.4.3.2 Ensure that Core Laboratories' corporate QA policies and procedures are applied and followed in the specific laboratory.

2.4.3.3 Monitor the laboratory for adherence to the corporate quality policy, this QA Manual, the Laboratory Documentation Manual, and all associated quality control procedures.

2.4.3.4 Assist the corporate QA department in developing and implementing quality policies and procedures and in performing related QA/QC activities.

2.4.3.5 Report the status of the laboratory QA/QC program to the corporate QA department with formal and informal communications. Submit monthly QA reports in accordance with SOP No. HC-QAC-G005, including findings from internal audits, external laboratory audits, results of performance evaluation analyses, areas which are identified as needing corrective action,

and corrective action which was taken.

2.4.3.6 Assist in developing and implementing a laboratory-specific documentation manual and required QA project plans for the laboratory which meet the client's and method-specified requirements and are in conformance with corporate QA policies and procedures.

2.4.3.7 Assist the laboratory manager and technical staff in the development and implementation of laboratory standard operating procedures (SOPs). Maintain document control on SOPs and ensure that the laboratory staff has access to the most current SOPs and that outdated SOPs are not in use in the laboratory.

2.4.3.8 Conduct QA orientation for all new employees and assist in training laboratory personnel on QA/QC policies and procedures.

2.4.3.9 Conduct regular internal audits to assess the laboratory's compliance with the QA Manual and written SOPs and to identify and resolve potential problems. Internal audits shall include checking logbooks, reviewing data, observing laboratory activities, and questioning laboratory personnel.

2.4.3.10 Assist the laboratory manager or supervisor in reviewing data and preparing case narratives on out of control events or nonconformances.

2.4.3.11 Conduct data audits and document any out of control events or nonconformances that are identified and the corrective action that is required.

2.4.3.12 Maintain records on internal laboratory audits, client and third party audits, performance evaluation results, and responses on audits or performance evaluation studies. Submit audit reports and responses to the laboratory manager, laboratory supervisors, corporate QA department, and regional managers.

2.4.3.13 Inform the laboratory manager, laboratory supervisors, or

corporate QA director of any nonconforming actions or activities which compromise QA policies and procedures. Ensure that any laboratory activity or problem which requires corrective action is documented on an Out of Control Event Report or a Nonconformance and Corrective Action Report and that it is adequately resolved.

2.4.3.14 If a nonconformance, deficiency, or unsatisfactory condition (item of concern) occurs in the laboratory, the QA/QC coordinator shall have full authority to control such use until proper resolution has occurred. This control may involve stopping work, removing the defective item or condition, or flagging non-conforming or unsatisfactory data until the item of concern is resolved. The QA/QC coordinator shall have full access to management staff which are responsible for the item of concern, and the management staff shall provide full support and assistance in resolving the item of concern.

2.4.4 Laboratory Staff

2.4.4.1 Adhere to and practice Core Laboratories' Analyst's Commitment to Quality and Ethic's Agreement.

2.4.4.2 Be informed and knowledgeable of corporate QA policies and procedures, site-specific policies and procedures located in the Laboratory Documentation Manual, and all associated quality control procedures. Ensure that all laboratory activities are conducted in accordance with documented QA policies and procedures and this QA Manual.

2.4.4.3 Conduct all analyses and related activities according to written and approved SOPs and method-specific documentation.

2.4.4.4 Ensure that instruments are properly operated, calibrated, and maintained and that adequate documentation is kept for all instruments.

2.4.4.5 Introduce the required quality control samples into all sample preparation and analysis activities and thoroughly document

quality control activities. Ensure that quality control sample checks meet the acceptance criteria and take appropriate corrective action if the criteria are not met.

2.4.4.6 Review data for samples, standards, and quality control samples and ensure that the data is accurate, complete, and in conformance with the specified quality control criteria.

2.4.4.7 Issue an Out of Control Event Report or Nonconformance and Corrective Action Report for any results that do not meet the quality control specifications.

2.4.4.8 Promptly inform an appropriate member of the management staff if there are problems in meeting quality control criteria that cannot be resolved at the bench level. Participate in the documentation and resolution of nonconformances and out of control events.

2.4.4.9 Ensure that analysis documentation and all data entered into the laboratory information management system (LIMS) or other report formats are complete and accurate.

3.0 QUALITY ASSURANCE DOCUMENTATION

3.1 QUALITY ASSURANCE PROGRAM DOCUMENTATION

Core Laboratories maintains a thorough and efficient documentation hierarchy to ensure that all requirements are clearly documented and readily available to the laboratory staff.

- At the corporate level, the QA/QC policies and procedures are documented in the QA Manual, QA Alerts, Regulatory Alerts and standard operating procedures.

- At the operations level, each laboratory maintains a Laboratory Documentation Manual which defines the laboratory specific QA/QC procedures and documentation. Project or accreditation requirements are documented in Quality Assurance Project Plans.

3.2 QUALITY ASSURANCE MANUAL

The Environmental Testing Services Division Quality Assurance (QA) Manual is prepared by the corporate QA department and reviewed and approved by the corporate QA director and vice-president. The laboratory manager approves the QA Manual for use at their location by completing an acknowledgement form that documents their approval and agreement to implement the policies and procedures in the manual. Any deviations from the QA/QC policies and procedures in the manual must be documented on a SOP Addendum form and submitted to the corporate QA director for review and approval. The QA Manual is reviewed every two years to ensure its continued suitability and effectiveness and it is revised as needed.

The QA Manual is controlled and issued by the corporate QA department. A record of the distribution of controlled copies of the manual is maintained by the corporate QA department.

3.3 QUALITY ASSURANCE ALERTS

Quality Assurance (QA) Alerts are prepared and issued by the corporate QA department on quality items or issues. The QA Alerts include updates or revisions to test methods, QC summaries for the method requirements,

method specific checklists, and laboratory required procedures. The QA Alerts are policy statements that are to be implemented promptly and followed as specified. The preparation and dissemination of this bulletin assures company wide awareness of the latest developments in the industry.

An index and binder for QA Alerts is provided for maintaining the QA Alerts in each laboratory. The laboratory QA/QC coordinator may also issue laboratory-specific QA Alerts which are included in the Laboratory Documentation Manual.

3.4 REGULATORY ALERTS

Regulatory Alerts are prepared and issued by the corporate QA department on items of regulatory concern. The Regulatory Alerts include proposed or promulgated rules and regulations at the federal and state level. Regulatory Alerts are to be implemented promptly and followed as specified.

An index and binder for Regulatory Alerts is provided for maintaining the Regulatory Alerts in each laboratory. The laboratory QA/QC coordinator may also issue laboratory-specific Regulatory Alerts which are included in the Laboratory Documentation Manual.

3.5 STANDARD OPERATING PROCEDURES

Detailed standard operating procedures (SOPs) are prepared and approved by the corporate QA department for technical methods and general laboratory operations. Site-specific SOPs may also be prepared by each laboratory and approved by the laboratory manager for use at that location. An index of any site-specific SOPs prepared by the laboratory location shall be included in the Laboratory Documentation Manual.

3.5.1 General Laboratory Standard Operating Procedures

Corporate issued SOPs for general laboratory operations are prepared by the corporate QA department and approved by the corporate QA director. The laboratory manager shall approve the SOPs for use at their location and issue a notification to the staff on their approval of the SOPs.

Master copies of all corporate approved general laboratory operations

SOPs are kept in designated binders which include the most recent index of general laboratory operations SOPs. The QA/QC coordinator is responsible for maintaining the master SOP binders, distributing copies of SOPs to the appropriate laboratory sections, and verifying that outdated SOPs are not in use in the laboratory.

The procedure for formatting and writing a general laboratory operations SOP is provided in SOP No. HC-RDC-G003. General laboratory operations SOPs include the following mandatory sections:

Section 1 Summary

Section 2 Scope and Application

Section 3 Definitions

Section 4 Responsibilities

Section 5 Safety

Section 6 Required Equipment and Materials

Section 7 Procedure

Section 8 Quality Control

Section 9 References

Section 10 Associated Records and Forms

3.5.2 Technical Methods Standard Operating Procedures

Corporate issued SOPs for technical methods are prepared by the corporate QA department and approved by the corporate QA director. The laboratory manager shall approve the SOPs for use at their location and issue a notification to the staff on their approval of the SOPs.

Master copies of all corporate approved technical methods SOPs are kept in designated binders which include the most recent index of technical

methods SOPs. The QA/QC coordinator is responsible for maintaining the master SOP binders, distributing copies of SOPs to the appropriate laboratory sections, and verifying that outdated SOPs are not in use in the laboratory. The procedure for formatting and writing technical methods SOPs is provided in SOP No. HC-RDC-G001.

3.5.2.1 Environmental Technical Methods SOPs

Environmental technical methods SOPs include the following mandatory sections:

Section 1 Scope and Application

Section 2 Summary

Section 3 Definitions

Section 4 Responsibilities

Section 5 Interferences, Comments, and Helpful Hints

Section 6 Sampling, Sample Preservation, and Holding Times

Section 7 Safety

Section 8 Quality Control

Section 9 Apparatus and Materials

Section 10 Reagents and Standards

Section 11 Analytical Procedure

Section 12 Data Generation and Calculations

Section 13 Data Reporting

Section 14 References

Section 15 Method Performance (optional)

Section 16 Associated Documents and Forms

3.5.2.2 Petroleum Technical Methods SOPs

Petroleum technical methods SOPs include the following mandatory sections:

Section 1 Scope and Application

Section 2 Summary

Section 3 Definitions

Section 4 Deviations from Method

Section 5 Responsibilities

Section 6 Interferences, Comments, and Helpful Hints

Section 7 Safety

Section 8 Quality Control

Section 9 Data Reporting

Section 10 References

Section 11 Method Performance (optional)

Section 12 Associated Documents and Forms

3.5.3 SOP Summaries

Summaries of technical methods SOPs are prepared and issued by the corporate QA department. The SOP Summaries are numbered with the same designation as the SOPs. These SOP Summaries are intended to be a reference to the full associated SOP and analytical method.

Master copies of all corporate issued SOP Summaries are kept in designated binders which include the most recent index of technical SOP Summaries. The QA/QC coordinator is responsible for maintaining the master SOP Summary binder, distributing copies of the SOP Summaries to the appropriate laboratory sections, and verifying that outdated SOP Summaries are not in use in the laboratory.

3.5.4 SOP Addendums

Laboratory specific procedures or practices which deviate from the approved corporate issued general or technical methods SOPs shall be documented in an addendum to the SOP and approved by the laboratory manager and corporate QA director. SOP addendums shall be included with the appropriate SOP in the SOP binder and included in the Laboratory Documentation Manual.

3.6 LABORATORY FORMS

Standardized laboratory forms are prepared and issued by the corporate QA department for general procedures and technical methods SOPs. The laboratory forms are identified by the corresponding SOP number, where applicable. Standardized laboratory forms should be used wherever possible, for efficiency and to allow consistent adherence to the associated SOP and analytical method. Any site-specific laboratory forms shall be included in the Laboratory Documentation Manual

3.7 LABORATORY DOCUMENTATION MANUAL

The Laboratory Documentation Manual includes all site-specific quality control procedures, logbook forms, SOPs, SOP addendums, and associated documentation which are used at the laboratory facility. This QA Manual combined with the Laboratory Documentation Manual serves as the laboratory Quality Assurance/Quality Control (QA/QC) Manual.

Each laboratory facility is required to maintain a Laboratory Documentation Manual. Procedures, policies, and logbook forms which are required in the Laboratory Documentation Manual are specified in the applicable sections of this QA Manual. Any site-specific documentation developed by the laboratory for the following areas shall be included in the Laboratory

Documentation Manual:

- Site-specific organization chart
- Site-specific SOPs and SOP Index
- Addendums to corporate issued SOPs
- Training forms and proficiency certification documentation
- Facility and equipment monitoring logbook forms
- Laboratory analysis logbook forms
- Sample receipt checklists
- Out of Control Event Report forms
- Data review checklists
- Internal audit checklists

3.8 TECHNICAL GUIDANCE DOCUMENTS

Technical guidance documents have been developed by the corporate QA department to assist laboratories and clients in achieving accurate and defensible data. Technical documents that are distributed to each laboratory location include the following:

3.8.1 Data Validation Guidance Training Manual

The Data Validation Guidance Training Manual is used to learn the requirements of analytical tests and to validate environmental analysis data.

3.8.2 Data Validation and Defensibility Guidance Manual

The Data Validation and Defensibility Guidance Manual provides an overview of sample handling, analysis, and data review procedures for

environmental measurements. Also included are guidelines for data validation and defensibility.

3.8.3 Environmental Analysis Survival Guide

The Environmental Analysis Survival Guide summarizes the QC requirements, detection/quantitation limits, and data review procedures for major EPA methods for the analysis of organic and inorganic parameters in ambient air, drinking water, water and wastewater, solid waste, and hazardous waste.

3.8.4 Environmental Sampling, Analysis and Data Review Guidance Manual

The Environmental Sampling, Analysis and Data Review Guidance Manual provides an overview of sampling, analysis, and data review procedures for environmental analyses. Also included are guidelines for defensibility, documentation, and data reporting.

4.0 PERSONNEL QUALIFICATIONS AND TRAINING

Core Laboratories' Training Program is designed to ensure that all laboratory personnel (temporary and permanent) have the necessary education, training, experience, and technical knowledge to perform their assigned job functions. Personnel records are maintained to document that employees have the necessary qualifications for performing their job function. Personnel training entails the following areas: employee orientation, safety training, environmental management training, LIMS training, QA training, analytical method training, proficiency certification and proficiency recertification.

Training for job functions other than the conduction of analytical procedures is normally provided by the appropriate laboratory supervisor. This training may include but not be limited to the following: sample receipt, chain of custody procedures, and LIMS log-in requirements; QA/QC policies and procedures, data review, and data reporting; waste control, treatment, and disposal; and administrative/clerical job functions. In addition, several laboratory areas or specific parameters (i.e., GC/MS, ICP, etc.) may require training on different computer systems.

Training and approval of training records shall be performed by qualified personnel. Training instructors and personnel assigned to approve training records shall meet the minimum requirements defined for QA/QC coordinators, laboratory supervisors and higher level positions. The minimum requirements for these positions are defined in the Job Descriptions available from the Corporate Human Resources Department.

4.1 PERSONNEL RECORDS

Personnel records are maintained for all employees. Qualification records document the qualifications of laboratory personnel to perform their assigned job function. Job descriptions describe the minimum qualifications necessary to perform each job function. Laboratory training records are maintained to document the training the laboratory personnel have received while employed by the laboratory. The following records are included in personnel records:

4.1.1 New Hire Authorization Forms

New Hire Authorization Forms document the minimum requirements

necessary to perform the specific duties of each position.

4.1.2 Job Descriptions

Job descriptions are documented for all staff positions and job functions. Job descriptions are maintained by the laboratory and available from the Human Resources Office at the corporate headquarters. Job descriptions include the following information: essential duties and responsibilities; and the minimum required education and experience.

4.1.3 Qualification Records

Records on the relevant qualifications, skills, experience, and training of the laboratory personnel are maintained by the laboratory. Qualification records include resumes and other associated documentation.

4.1.4 Training Records

Training records are maintained by the laboratory for each employee (temporary and permanent). Training records include documentation on employee orientation, safety training, environmental management training, LIMS training, QA training, analytical method training, and proficiency certifications. Records of any outside training are also maintained.

4.2 EMPLOYEE ORIENTATION

Employee orientation is provided to new employees to familiarize them with the laboratory facility and personnel, safety provisions, QA/QC requirements, and company policies and benefits program. The conduction of new employee orientation is documented on a checklist and the checklist is maintained in the employee personnel file. An example of a New Employee Orientation Checklist is provided in Figure 4.1. New Employee Orientation Checklists used by the laboratory shall be provided in the Laboratory Documentation Manual.

At a minimum, new employee orientation should include the following areas:

- Tour of the facility, introduction to the staff, and familiarization with the

type of services that are provided to clients.

- Familiarization with the location and type of safety equipment available on-site (e.g., eye wash stations, safety showers, fire extinguishers, safety glasses, lab coats, etc.).

- Introduction to Core Laboratories' QA program and issuance of appropriate manuals and documentation. Refer to the Corporate Quality Assurance Program Checklist in Figure 4-2.

- Explanation of company policies and employee benefit program.

4.3 SAFETY TRAINING

Core Laboratories' personnel must complete training in safety, hazards communication, and worker right-to-know. It is the responsibility of the laboratory manager, laboratory supervisor, or the safety officer to provide safety training to new employees. It is the responsibility of each employee to successfully complete all safety training requirements. Safety training program requirements are specified in Core Laboratories' Safety and Environmental Manual.

4.4 ENVIRONMENTAL MANAGEMENT TRAINING

Core Laboratories has committed itself to comply with all applicable local, state and federal regulations and to ensure that its employees are made aware of those regulations. Environmental management policies and procedures have been developed to ensure that the laboratory operations comply with all applicable requirements for the storage, treatment and disposition of hazardous waste. It is the responsibility of the laboratory manager, laboratory supervisor, or the safety officer to provide environmental management training to new employees. Environmental management training program requirements are specified in Core Laboratories' Safety and Environmental Manual.

4.5 LIMS TRAINING

It is essential that all personnel are trained in the proper usage of the Laboratory Information Management System (LIMS) utilized by the

laboratory. The majority of the analytical data generated in the laboratory are entered into LIMS. Daily work assignments, work-type backlog status, holding time reports, job due dates, etc., are all managed using LIMS. LIMS training program requirements are site-specific based upon the system currently used at that laboratory location.

4.6 QUALITY ASSURANCE TRAINING

Quality Assurance (QA) training is provided to ensure that employees are familiar with and are following the requirements of Core Laboratories' QA program. QA training is provided in the following ways:

4.6.1 Quality Assurance Orientation

Quality assurance (QA) orientation is provided to all employees to familiarize them with Core Laboratories' corporate QA program. The conduction of the QA orientation is documented on a checklist and the checklist is maintained in the employee personnel file. The Corporate Quality Assurance Program Checklist is provided in Figure 4-2.

At a minimum, the QA orientation shall include the following:

- Introduction to Core Laboratories' QA program and issuance of appropriate manuals and documentation. Refer to the Corporate QA Program Checklist for the list of documents distributed to new employees.
- Completion of Core Laboratories' Ethics Agreement
- Completion of the laboratory location's Signature List

4.6.2 QA Manual Training Modules

The corporate QA department prepares and provides the laboratories with training modules on sections of the QA Manual. This includes summaries of sections of the QA Manual and tests on the requirements of the QA Manual. A minimum score is required to demonstrate acceptable knowledge of the QA requirements. The QA/QC coordinator provides the training and maintains the training records.

4.6.3 Audiovisual Training Program

The corporate QA department maintains a library of video tapes for check out and use by the laboratories on subjects that include: math for laboratory technicians, sample preparation, basic laboratory operations, and quality control and assurance. In addition to the videotapes, the program includes training booklets and instructors guides. The training booklets include tests on each section covered in the training videos. The QA/QC coordinator coordinates the training and maintains the training records.

4.6.4 Interactive Computer Programs

The corporate QA department provides the laboratories with interactive computer programs on good laboratory practices and quality auditing. The computer program consists of an overview of the subject matter as well as an interactive test. Each program is self paced and takes approximately 45 minutes. The QA/QC coordinator coordinates the training and maintains the training records.

4.7 ANALYTICAL METHOD TRAINING

The analytical method training program is designed to provide analysts with the necessary knowledge and skills required to successfully and safely perform their job. The objectives of the analytical method training program are as follows:

- To demonstrate and document the analyst's knowledge of analytical methods, and
- To demonstrate and document the analyst's competency to perform the analytical methods.

These objectives are accomplished for each method by the following actions: reading the method and associated SOP, supervised method training, practice, successful completion of a questionnaire on the method (optional), and successful analysis of blind samples for which the results are known (i.e., performance evaluation samples, round robin samples, reference standards, or samples of known composition) for proficiency certification.

The conduction of analytical method training shall be documented on training records. The training records shall be maintained for each employee. Training records used by the laboratory shall be included in the Laboratory Documentation Manual. Analytical method training is covered in the following steps:

4.7.1 Method Review

Analysts are required to read and study the analytical method and corresponding SOP, if available, before supervised method training is started. Knowledge of the method requirements is needed prior to performing the method.

Analysts with previous experience in a method are not required to perform the supervised method training and practice steps for that method and may proceed to completion of the proficiency certification.

4.7.2 Supervised Method Training

Supervised method training is provided by a laboratory supervisor, QA/QC coordinator, or senior technical personnel who have demonstrated proficiency in the analytical procedure. The supervised method training should cover the following areas:

4.7.2.1 Safety considerations (i.e., toxic reagents, safety equipment required, unusual method hazards, etc.),

4.7.2.2 Sample preservation and holding time requirements,

4.7.2.3 Specific quality control analyses and their required frequency and acceptance criteria,

4.7.2.4 Known interferences and methods of handling interferences,

4.7.2.5 Reagent preparation and standardization procedures,

4.7.2.6 Sample preparation procedures,

4.7.2.7 Instrument operation, calibration, troubleshooting, and maintenance,

4.7.2.8 Calculations, data review, and LIMS data entry requirements, and

4.7.2.9 Any special considerations of the method.

4.7.3 Practice

After reviewing the method and SOP and receiving supervised method training, analysts are then given the opportunity to independently perform the method. Supervision and guidance is provided, if needed. The analyst will practice by performing the method using both field samples and known reference standards, if they are available. Adequate time for practice is needed.

4.7.4 Method Questionnaire (Optional)

After the initial method training period, the analysts may be required to complete a method questionnaire for use in evaluating their knowledge of the method. The completed method questionnaire is submitted to the laboratory supervisor and QA/QC coordinator for review. The laboratory supervisor and QA/QC coordinator shall review the method questionnaire and approve it if it is acceptable or return it to the analyst for additional training if it is not acceptable. If the questions are answered correctly, the analyst has then completed the first phase of analytical method training. The method questionnaires used by the laboratory are provided in the Laboratory Documentation Manual.

The method questionnaire should include the following information:

4.7.4.1 Parameter, type of analysis, method reference, and SOP reference if available,

4.7.4.2 Brief method summary (Optional),

4.7.4.3 Method detection limits, units, holding times, and preservatives,

4.7.4.4 Quality control types, frequencies, and acceptance criteria, and

4.7.4.5 Calculations.

4.8 PROFICIENCY CERTIFICATION

Proficiency certification is granted to the analysts if they can demonstrate successful analysis of blind samples for which the results are known, (i.e., performance evaluation samples, round robin samples, reference standards, or samples of known composition). After completing the analysis of the blind sample, the laboratory supervisor and QA/QC coordinator review the results and associated raw data to determine if the results are acceptable or if additional training is needed. If the analysis is correctly performed (i.e., results within the acceptance limits), the analyst is considered proficient for that specific method. If the analysis is incorrectly performed (i.e., results are outside the acceptance limits), the analyst will be required to receive additional training and reanalyze blind samples. The analyst must successfully analyze the blind samples and demonstrate proficiency before actual client samples can be analyzed. Proficiency certification documentation used by the laboratory shall be provided in the Laboratory Documentation Manual.

At a minimum, the proficiency certification documentation shall include the following information:

4.8.1 The parameter, type of analysis, and method reference number,

4.8.2 Analyst's name, sample ID and matrix, date of analysis, and results obtained,

4.8.3 The true value or acceptance limits, to be completed by the laboratory supervisor after the analyst has submitted the results obtained, and

4.8.4 Supervisor's name, date of approval, status of approval (either yes or no), and any recommendations for further training if needed.

4.9 PROFICIENCY RECERTIFICATION

Proficiency recertification is completed by each analyst on the parameters they are responsible for performing. Proficiency recertification is conducted at a frequency of every two years or as major changes are made in the method or instrumentation whichever is more frequent. Recertification is performed by successfully completing and documenting the certification

procedure as outlined in the previous section.

5.0 FACILITIES

5.1 PHYSICAL FACILITIES

5.1.1 Laboratory Accommodations

The laboratory accommodations shall be suitable for performing analytical measurements. Each facility shall have suitable provisions for energy sources, lighting, ventilation, and heating and air conditioning. Each facility shall have suitable devices to control temperature, humidity, ventilation, sound and vibration, dust, electromagnetic interferences, and electrical voltage.

5.1.2 Laboratory Environment

The laboratory environment shall be appropriate for the performance of the test procedures. Each laboratory section shall have adequate space and separation from other functions for proper performance of the required test procedures. Good housekeeping measures shall be taken to ensure that the laboratory facility is maintained in a clean and orderly condition.

5.2 FACILITY SECURITY

5.2.1 Restricted Entry

Core Laboratories' locations are all secured facilities with restricted entry. All facility entrances, with the exception of the front reception area entrance, shall be locked during normal business hours. A visitor logbook shall be maintained in the reception area to document entrance by non-employee personnel. Visitors, clients, and maintenance personnel are required to sign-in and sign-out and they may be required to wear a visitor's badge in all areas of the laboratory other than the receiving or reception areas.

5.2.2 After Hour Entry

All doors to the facility shall be locked after normal working hours. Designated employees may be issued keys to the facility in order to

permit after-hour entry.

5.2.3 Key Distribution

Documentation of employee key distribution shall be kept on file by the laboratory manager. Keys must be returned to the laboratory management at termination of employment.

6.0 EQUIPMENT, SUPPLIES AND SERVICES

6.1 PROCUREMENT OF EQUIPMENT AND SUPPLIES

The procurement of equipment and supplies shall be controlled to ensure that the equipment and supplies used by the laboratory locations are of known quality and conform to the specified requirements. Control shall include vendor selection, evaluation of the quality records provided by the supplier, and examination of items received upon delivery or completion. Site-specific procedures for procurement shall be utilized at each of the laboratories on the following functions: procurement planning, supplier selection, supplier performance evaluation, verification of procurement requirements, control, and acceptance of the equipment and supplies.

6.2 PROCUREMENT OF SUBCONTRACT LABORATORY SERVICES

The procurement of services from a subcontract laboratory (i.e., a laboratory that is external to Core Laboratories' network) shall be used only in the event that Core Laboratories does not have the capability or capacity to perform the requested analyses or if it is specifically requested by the client. A subcontract laboratory shall be used only after approval is obtained from the client and the quality of the laboratory is determined to be acceptable.

6.3 EQUIPMENT INVENTORY

An inventory record of all major laboratory equipment shall be kept on file at each laboratory. Manufacturer and serial number information (if available) shall be recorded for all major laboratory equipment. The equipment inventory list shall be updated as needed to include any changes in the equipment inventory.

6.4 EQUIPMENT FILES

Equipment files shall be maintained by each laboratory for all major laboratory equipment and instrumentation. The equipment files should include service contracts, maintenance or repair records issued by the service representative, and records on modifications to the instrument. Operation manuals for all major equipment and instrumentation shall be maintained in the laboratory and available to the laboratory staff.

7.0 REAGENTS, STANDARDS AND REFERENCE MATERIALS

Reagents, standards and reference materials shall be prepared and utilized at the proper concentration, composition, and frequency specified in the corresponding technical SOPs and associated method references. Reagents are used according to the method for the preparation and analysis of QC and field samples. Primary and secondary standards are used for the preparation of calibration standards, spiking solutions, and surrogate solutions. Reference materials are used as laboratory control standards for verification of calibration and/or method performance. The procedures in SOP No. AU-SRP-G011 for conducting a program for reagent receipt, and traceability and preparation of standards shall be followed. Specific procedures for each laboratory shall be documented as addendums to SOP No. AU-SRP-G011.

7.1 CHEMICAL RECEIPT AND INVENTORY

All purchased reagents and standards are assigned a laboratory control number upon receipt. A label specifying the laboratory control number, date received, date opened, and initials of analyst opening the container is affixed to the container. The laboratory control number and date received is recorded on the label at the time of receipt. A chemical receipt logbook or computerized reagent software system (i.e., LABNET) is used for documenting the chemicals received, date received, person that received the chemical, and the laboratory control number. A chemical receipt logbook form or example computer generated printout shall be provided in the Laboratory Documentation Manual.

7.2 CHEMICAL STORAGE AND SEGREGATION

As chemicals are received at the laboratory, the assigned person is responsible for documenting the receipt and placing the chemical in the appropriate storage location. All staff members are expected to follow the laboratory's chemical segregation and storage policies and return chemicals to the proper location after use.

Appropriate storage areas shall be available for the segregation and storage of all major types of chemicals. These storage areas shall be properly labeled to assist the laboratory staff in determining the proper chemical storage location. The laboratory staff must be familiar with the storage requirements

and classification of the various chemicals. This information is covered in Core Laboratories' Safety and Environmental Manual.

7.3 PURITY OF REAGENTS AND REAGENT WATER

7.3.1 Reagents

All reagents used in the laboratory shall be "analytical grade" or better. Acids used for metals digestions and analyses shall be "trace metals grade". Ultra-pure acids should be used for metals analyses when needed by the analytical method or to achieve low level detection limits. Solvents used shall be of the purity that is specified by the preparation or analysis method.

7.3.2 Reagent Water

The American Society for Testing and Materials (ASTM) has categorized laboratory-pure water into four classes or types according to the level of purity. The four types of water range from Type I (the purist) to Type IV. Many treatment processes for purifying water are available based on the quality of water required by the laboratory.

Each type of reagent water used in the laboratory shall be monitored to ensure that the water type and parameter specific requirements for water purity are met. A logbook shall be kept for monitoring the analyses performed on each type of reagent water. A water monitoring log shall be provided in the Laboratory Documentation Manual. The requirements for monitoring reagent water for environmental laboratories are as follows:

7.3.2.1 A laboratory staff member is assigned the primary responsibility for monitoring and recording the analyses of the reagent water. A back-up person is designated in the event that the primary person is unavailable.

7.3.2.2 At a minimum, the conductivity of the reagent water shall be monitored daily. A reading of the pH may also be taken. The acceptable control limits for each type of reagent water are provided in ASTM Method D 1193.

7.3.2.3 Reagent water which exceeds the control limits indicates that the water purification system needs maintenance (i.e., need to change the deionization tanks). Any corrective action or maintenance performed needs to be documented in the reagent water monitoring logbook.

7.3.2.4 After performing the maintenance on the water system, another analysis should be taken on the reagent water and documented in the reagent water monitoring logbook.

7.4 TRACEABILITY OF STANDARDS AND REFERENCE MATERIALS

7.4.1 Primary Standards and Reference Materials

Primary standards and reference materials shall be certified and traceable where possible to national standards of measurement or standard reference materials. Certificates of Analysis provided by the manufacturer for primary standards, surrogates and reference materials must be kept on file by the appropriate laboratory section supervisor or QA/QC coordinator. The laboratory control number assigned during chemical receipt is used on all documentation associated with the use of each standard and reference material. The laboratory control number allows traceability to both the manufacturer and the lot number. The date opened and the initials of the analyst opening the container is recorded on the label at the time that the chemical is opened.

7.4.2 Secondary Standards

Secondary standards which are prepared in the laboratory shall be traceable to the primary standard or reference material which they are prepared from. Laboratory control numbers for the individual standard materials used in preparing the secondary standard are either recorded in a standards preparation logbook or entered into the computerized reagent software system of LABNET at the time of standard preparation. Unique IDs or laboratory control numbers are assigned to the secondary standards and either recorded in a standards preparation logbook or entered into the computerized reagent software system of LABNET. This procedure allows traceability for all of the compounds which are in the secondary laboratory standards. The concentration,

date prepared, expiration date, and the initials of the analyst preparing the standard is recorded on the label at the time the standard is prepared. A standard preparation logbook form or example computer generated printout shall be provided in the Laboratory Documentation Manual.

8.0 DOCUMENTATION AND RECORD KEEPING

8.1 DOCUMENT REVIEW AND REVISION

8.1.1 Quality Assurance Manual

The QA Manual shall be reviewed and revised as needed by the corporate QA department every two years to ensure continued suitability and effectiveness. The QA Manual is approved by the corporate QA director and vice-president.

8.1.2 General Laboratory Operation SOPs

The corporate issued general laboratory operation SOPs shall be reviewed and revised as needed by the corporate QA department every two years or when a major change in laboratory operations or procedure occurs. The general laboratory operation SOPs are reviewed to ensure continued suitability and applicability to the laboratory operations. The corporate issued general laboratory operation SOPs are approved by the corporate QA director.

8.1.3 Technical Methods SOPs

The corporate issued technical methods SOPs shall be reviewed and revised as needed by the corporate QA department every two years or when an updated or revised method is promulgated. The technical methods SOPs are reviewed to ensure continued suitability and regulatory compliance. The corporate issued technical methods SOPs are approved by the corporate QA director.

8.1.4 Laboratory Documentation Manual

The Laboratory Documentation Manual shall be updated on a regular basis as new laboratory-specific policies, procedures, documents, and forms are developed and implemented.

8.2 DOCUMENT CONTROL AND DISTRIBUTION

8.2.1 Document Control

Corporate issued general and technical SOPs, SOP Summaries, QA Alerts, Regulatory Alerts, corporate QA audits, and the Corporate QA Manual shall be assigned a control number by the corporate QA department. Laboratory Documentation Manuals, logbooks, SOP addendums, site-specific SOPs, QA Plans, and internal audits shall be assigned a control number by the laboratory QA/QC coordinator.

8.2.2 Document Distribution

Distribution records for corporate issued documents that are controlled shall be kept on file by the corporate QA department. Laboratory logbooks and copies of SOPs that are issued at the laboratory level are to be documented on a distribution log by the laboratory QA/QC coordinator. Laboratory Logbook Control Logs and SOP Distribution Logs shall be provided in the Laboratory Documentation Manual

8.3 DOCUMENT SECURITY

8.3.1 Client Confidentiality Policy

Analytical results and all associated client or project information shall be treated as confidential by all personnel. Requests from other firms or consulting personnel for copies of analytical reports, or sampling, or project information are honored only with the written consent of the specific client. The reporting of results by telephone and telefax is addressed in SOP No. LC-GLO-G010 for telephoning and telefaxing results to clients.

8.3.2 Filing System

Job files shall be organized using a sequential filing system based on the laboratory job number. File cabinets should be used for organizing and storing all job files maintained onsite.

8.3.3 In-progress Job Files

All in-progress job files shall be stored in the secured laboratory facility. The majority of active, in-progress job files are maintained in a designated area of the laboratory.

8.3.4 Completed Job Files

Completed job files shall be archived in a secured facility with restricted access. Access to finalized job files is restricted to the laboratory manager, secretary, QA/QC coordinator, laboratory supervisors, project managers, or other designated personnel. Check-out procedures shall be used for removing completed job files from the storage area.

8.3.5 QA Files

Training records, signature lists, laboratory certifications, performance evaluation results, audit reports and responses, certificates of calibration for balances, ASTM Class weights and NIST traceable thermometers, etc. shall be kept on file by the QA/QC coordinator. Access to these files is restricted to the laboratory manager and QA/QC coordinator.

8.4 RECORDS RETENTION POLICY

All laboratory written records (i.e., hard copy data, logbooks, job files, etc.) must be stored for a minimum of 10 years for environmental testing laboratories and 5 years for petroleum testing laboratories. If a client or regulatory agency requirement exceeds these minimum time requirements, then the longer time requirement will apply.

Magnetic tapes for instrumental analyses (i.e., GC, GC/MS, ICP, ICP/MS, etc.) must be stored for a minimum of 2 years, after which the tape may be reused as long as there is hard copy data of the instrument data stored for the minimum required time period (10 years for environmental testing laboratories and 5 years for petroleum testing laboratories). If a client or regulatory agency requirement exceeds the minimum storage requirement of two years for magnetic tapes, then the magnetic tapes must be stored for the longer time period as specified by the client or regulatory agency.

Records for job files shall be stored by job number in sequential order. Calibration records and raw data shall be stored in chronological order by date. Storage units need to be protected from loss or damage by fire, moisture, insects, etc. Check-out procedures shall be used for the retrieval of records from the storage area. After the minimum storage period has passed, the records may be returned to the client upon request.

9.0 ANALYTICAL LABORATORY RECORDS

9.1 GENERAL DOCUMENTATION PROCEDURES

All information related to environmental sampling and analysis shall be documented in controlled laboratory logbooks, instrument printouts, or other approved forms. The information is to be recorded completely, identifying the who, what, where, when and how of each activity. The following general documentation requirements and staff responsibilities shall be observed for analytical laboratory records:

9.1.1 All entries that are not generated by an automated data system are to be made neatly and legibly in permanent, waterproof black or blue ink. Pencil or non-permanent ink pens are not allowed.

9.1.2 Information shall not be erased or obliterated. The use of correction fluid or correction tape is prohibited in sample handling, data processing, or report preparation.

9.1.3 Correction of errors shall be made by crossing a single line through the error and entering the correct information near the cross-out. All changes shall be initialed and dated and, if appropriate, a brief explanation included as to why the change was made.

9.1.4 Blank pages or substantial portions of pages with no entries are to be crossed out with a "Z" or "X" to prevent additional data being entered in the future.

9.1.5 Analysts shall record all analytical data as it is acquired according to applicable SOPs and method-specified requirements. The transposition of analytical data from an uncontrolled document such as a note pad to a controlled logbook shall be strictly prohibited.

9.1.6 Laboratory supervisors shall review the analytical laboratory records on a regular basis to verify adherence to required analytical and documentation procedures.

9.1.7 The QA/QC coordinator shall review the analytical laboratory records on a quarterly basis at a minimum to verify adherence to required

analytical and documentation procedures.

9.2 SIGNATURE LIST

Signature lists are used to keep a record of the signatures and initials of all personnel (temporary and permanent) that record data. The QA/QC coordinator is responsible for maintaining the signature list for the laboratory location. At a minimum, the following information must be included in a signature list:

9.2.1 Employee's typed or printed name and initials

9.2.2 Employee's handwritten signature and initials

9.2.3 Employment start date

9.2.4 Employment termination date

9.3 LABORATORY LOGBOOKS

All laboratory logbooks shall be issued document control numbers. Laboratory logbooks shall be parameter or instrument specific. Analyst specific logbooks shall not be used for recording laboratory data. Bound standardized format logbooks are recommended for recording laboratory data. Standardized forms developed by the corporate QA department are available for the laboratory's to use in preparing bound logbooks. Bound logbooks prepared from standardized forms must have consecutively numbered pages.

QA/QC coordinators are responsible for checking out logbooks to the laboratory staff, numbering logbooks, keeping a log of logbooks, and storing completed logbooks. The QA/QC coordinator shall review the logbooks on a quarterly basis at a minimum to ensure that the logbooks are being completed according to the required procedure. A log for tracking and documenting logbooks issued by the laboratory shall be provided in the Laboratory Documentation Manual.

Laboratory logbooks are divided into the following categories:

- Sample Receipt

- Sample Preparation
- Standards/Reagent Preparation
- Sample Analysis
- Instrument Run Sequence
- Instrument Maintenance

The specific requirements for each logbook category are provided in the following sections.

9.3.1 Sample Receipt Logbook

Each laboratory is required to maintain a current logbook for recording the receipt of all samples. The logbook should be a permanently bound logbook or ledger. An example of a sample receipt logbook format shall be provided in the Laboratory Documentation Manual. The following minimum information shall be included in the sample receipt logbook:

9.3.1.1 Date of receipt

9.3.1.2 Client sample ID

9.3.1.3 Laboratory sample ID

9.3.1.4 Number of samples received

9.3.1.5 Signature or initials of the sample custodian or designee

9.3.1.6 Sampling kit code (if applicable)

Additional information may also be recorded in the sample receipt logbook, such as, type/matrix of samples, turnaround time, client contact, analyses requested, date of sample disposal, etc.

9.3.2 Sample Preparation Logbook

The sample preparation logbook is used to document the sample preparation activities for specific and related types of parameters (such as metals digestions and organic extractions). The sample preparation logbook should be a bound logbook with consecutively numbered pages. An example of a sample preparation logbook format shall be provided in the Laboratory Documentation Manual. The following minimum information shall be included in the sample preparation logbook:

9.3.2.1 Parameter/analyte

9.3.2.2 Method number

9.3.2.3 Date and time of preparation

9.3.2.4 Analyst's initials or signature

9.3.2.5 Laboratory sample ID

9.3.2.6 Type/matrix of samples

9.3.2.7 Initial sample volume or weight

9.3.2.8 Final sample volume

9.3.2.9 Concentration and amount of spiking solutions used

9.3.2.10 Quality control samples included with the sample batch

9.3.2.11 ID for reagents, standards and spiking solutions used

9.3.2.12 Comments (if applicable)

9.3.3 Standards/Reagent Preparation Logbook

The preparation of all standards, surrogates, spiking solutions, and reference materials is documented in a logbook or computerized

reagent system (i.e., LABNET). The standards/reagent preparation logbook should be a bound logbook for documenting manual entries. If a computerized reagent system such as LABNET is used, a bound logbook is not required since the entries are electronically maintained. Computer printouts from LABNET can be generated upon request. A step-by-step outline for standards preparation is provided in SOP No. AU-SRP-G011. A standards preparation log or example computer printout shall be provided in the Laboratory Documentation Manual. The following minimum information shall be included in the standards preparation logbook or computerized reagent system:

9.3.3.1 Date of preparation

9.3.3.2 Initials of the analyst preparing the standard solution or reagent

9.3.3.3 Concentration and identification of the stock solution or neat materials

9.3.3.4 Volume or weight of the stock solution or neat materials

9.3.3.5 Final volume of the solution being prepared

9.3.3.6 Final concentration of the solution being prepared

9.3.3.7 Laboratory ID/control number assigned to the new standard solution

9.3.3.8 Standardization of reagents, titrants, etc. (if applicable)

9.3.3.9 Expiration date

9.3.4 Sample Analysis Logbook

The sample analysis logbook is used for documenting all information used for performing the analysis and calculating the final analytical result. The logbook can either be a parameter specific logbook or a logbook for several related parameters.

Data should be recorded in the logbook in the same order in which it

was analyzed and if applicable, should correspond with the instrument run log or printout. All information which is used for calculating final analytical results should be clearly identified and accurately documented. Quality control information including the amount and concentration of spiking solutions must be thoroughly documented for each sample batch. All information must be clearly documented to allow reconstruction and verification of the results by another party at a later date. Sample analysis logbook formats shall be provided in the Laboratory Documentation Manual. The following minimum information shall be included in the sample analysis logbook:

9.3.4.1 Parameter/analyte

9.3.4.2 Method number

9.3.4.3 Date of analysis (Some analyses may also require that the time be recorded.)

9.3.4.4 Analyst's initials or signature

9.3.4.5 Laboratory sample ID

9.3.4.6 Sample aliquot

9.3.4.7 Dilution factors and final dilution volumes (if applicable)

9.3.4.8 Absorbance values, peak heights or initial concentration reading

9.3.4.9 Final analyte concentration

9.3.4.10 Calibration data (if applicable)

9.3.4.11 Correlation coefficient (at a minimum if linear regression is used)

9.3.4.12 Calculations

9.3.4.13 Comments on interferences or unusual observations noted during the analysis

9.3.4.14 Quality control information, including percent recovery for laboratory control standards and matrix spikes and RPD for sample duplicates

9.3.4.15 QA number associated with the sample batch (if applicable)

9.3.5 Instrument Run Logbook

The instrument run logbook is used to keep an accurate record of all calibration standards, field samples, and quality control samples processed during an analytical batch. An instrument run logbook shall be used for recording the analyses performed on all major instrumentation. Data must be recorded in chronological order based on the actual analytical run sequence used. Bound instrument run logbooks or instrument generated logs are required for major instrumentation used in the laboratory. An instrument run log shall be provided in the Laboratory Documentation Manual. The following minimum information shall be included in the instrument run logbook:

9.3.5.1 Instrument ID

9.3.5.2 Parameter/analyte

9.3.5.3 Method number

9.3.5.4 Date/time analyzed

9.3.5.5 Analyst's initials or signature

9.3.5.6 Laboratory IDs for standards, field samples, and quality control sample IDs

9.3.5.7 Comments (if applicable)

9.3.6 Instrument Maintenance Logbook

The instrument maintenance logbook is used to document all repair and maintenance performed on major instrumentation. A bound logbook or ledger shall be kept for each major instrument used in the

laboratory. The logbook should be kept near the instrument to facilitate the documentation of all repairs and maintenance. Standardized forms for instrument maintenance logbooks shall be provided in the Laboratory Documentation Manual. The following minimum information shall be included in the instrument maintenance logbook:

9.3.6.1 Name/type of instrument

9.3.6.2 Instrument manufacturer and model number

9.3.6.3 Serial number

9.3.6.4 Date received and date placed in service

9.3.6.5 Instrument ID assigned by the laboratory (if used)

9.3.6.6 Service contract information, including the phone number and name of the service representative

9.3.6.7 Description of each maintenance or repair activity performed

9.3.6.8 Date when each maintenance or repair activity was performed

9.3.6.9 Initials of the person who performed the maintenance or repair activity

9.3.6.10 If an instrument must be removed from service due to a non-routine maintenance procedure or repair, then the date and reason for removing the instrument from service must be recorded. The instrument must be tagged and identified as out of service. A service representative must be contacted and a copy of the repair order kept in the corresponding equipment file. The repair or non-routine maintenance which was performed, including the date, service representative's name and company, and the date the instrument was returned to service shall be recorded in the logbook.

9.4 JOB FILES

All documentation associated with each sample shall be maintained in the job file. Job files shall be labeled with the job number and client name. The following information should be included in each job file:

9.4.1 Chain of Custody Records or other documentation supplied by the client

9.4.2 Interlaboratory Analysis Request Log, if samples were submitted by another Core Laboratories' facility

9.4.3 Sample Receipt Checklist and LIMS log-in report

9.4.4 Copies of all client correspondence, including letters and phone logs

9.4.5 Purchase orders and invoicing information (bids, job quotes, etc.)

9.4.6 Out of Control Event Reports or Nonconformance and Corrective Action Reports if nonconformances or out of control events occur related to the specific samples in the job

9.4.7 Copies of the final analytical and QA reports as submitted to the client and a copy of any case narratives

9.4.8 Copies or originals of raw laboratory data for each parameter, where appropriate. Raw laboratory data may be maintained in logbooks or in laboratory files if it is easily accessible and retrievable. Instrument tuning and calibration data may be maintained in chronological order in the laboratory files if it is easily accessible and retrievable.

10.0 COMPUTER MANAGEMENT

10.1 LABORATORY INFORMATION MANAGEMENT SYSTEM

The laboratory information management system (LIMS) used by Core Laboratories is a software package designed to manage samples and data in each laboratory. The main functions of LIMS are management, data reporting, quality control, and financial accounting.

The primary function of the LIMS is to provide up-to-date information for the management of the laboratory and for the laboratory chemists and technicians to prioritize their analyses to meet client requirements.

The second function of the LIMS is to provide a standard reporting format for the data and associated quality control.

The third function of the LIMS is to provide financial information to laboratory management and to the central accounting office in Houston, Texas. The LIMS enables each laboratory to directly import their financial information into the main accounting computer system.

10.2 COMPUTER SECURITY AND CONTROL

All access to the laboratory information management system shall be approved, limited, and controlled. External parties shall not have access to the computer via modem unless access is approved and limited to specific functions of LIMS. Password access shall be implemented for all users and controlled by the laboratory manager or computer system administrator. Passwords are to be kept confidential and not exchanged between staff members or other parties. The laboratory staff are required to log-off the system when they have completed their use of the system. A procedure for minimizing the infection and spread of computer viruses shall be implemented.

10.3 COMPUTER SYSTEM ADMINISTRATOR

A computer system administrator shall be designated by the laboratory manager. The designee is a staff member who has sufficient knowledge of, and experience with, software and hardware management. The laboratory

manager serves as the computer system administrator if another staff member is not designated. The computer system administrator is responsible for the following functions:

- Ensuring that the routine data backup is performed.
- Ensuring that equipment protection devices are installed and operable.
- Verifying that licensed software is used on-site and that the laboratory is in compliance with all copyright protection regulations.
- Adequately testing and documenting site-generated software.

10.4 EQUIPMENT PROTECTION

The computer system should be protected by the use of an uninterruptable power supply (UPS), anti-static materials, and surge protectors.

10.5 COMPUTER SOFTWARE VALIDATION

All computer software used by a laboratory for automated data handling shall be validated prior to use according to EPA's Good Automated Laboratory Practices. Software validation shall consist of manual verification of automated data capture, processing, manipulation, calculations, recording and reporting procedures. Software validation shall be documented and records maintained on the validation.

10.6 DATA BACKUP

All stored data is backed up on retrievable storage media (floppy disk, magnetic tape, etc.). The back-up schedule is maintained by the computer management coordinator. The back-up should be stored in a manner which protects it from possible destruction.

11.0 SAMPLE MANAGEMENT

11.1 SAMPLE CONTAINERS

Appropriate sample containers shall be used for each parameter. Plastic containers are generally used for metals analysis and the majority of inorganic parameters. Glass containers with teflon-lined lids or septa are used for all organic parameters. The type of container and level of cleanliness must meet the EPA specifications. Certified pre-cleaned sample containers should be used where appropriate such as for volatile samples. Bottle manufacturers should provide information regarding the level of cleanliness for each type of container used by the laboratory. The certificates of cleanliness provided by the bottle manufacturer for each lot of bottles received by the laboratory need to be kept on file.

11.2 SAMPLE KITS

Sample kits are provided to clients upon request. Sample kits should include the appropriate sample containers, preservatives, Material Safety Data Sheets, sample labels, custody seals, chain of custody records, coolers, and packing materials. Requests for sample kits should include the parameters and number of samples to be analyzed, and the date that the kit is needed. The lot number(s) of the containers used in each sample kit needs to be recorded and kept on file.

11.3 CHAIN OF CUSTODY

Chain of custody is the documented evidence of the entire sample transfer from each party to another, from sample collection to final destination for analysis or return to client. Chain of custody procedures shall be followed for all samples received. Refer to SOP No. AN-GLO-G016 for the procedure for completing a Chain of Custody Record and to QA Alert No. QAA-12 for the procedure for maintaining chain of custody for interlaboratory sample transfer. The procedure applies to both the Core Laboratories' Chain of Custody Record or a client form. Laboratory personnel receiving samples shall document and verify the following items on the Chain of Custody Record.

11.3.1 Document the date and time of sample receipt in the next available

section marked "RECEIVED BY:".

11.3.2 The sample custodian or other laboratory personnel receiving samples shall sign (full legal signature), date, and record the time on the Chain of Custody Record.

11.3.3 Verify that the number and type of containers received agrees with the number and type of containers specified on the Chain of Custody Record.

11.3.4 Verify that the sample information recorded on the sample label agrees with the sample information on the Chain of Custody Record.

11.3.5 Any other sections on client provided Chain of Custody Records shall be completed as required.

Discrepancies or unusual sample conditions noted during sample receipt must be documented on the Chain of Custody Record or Sample Receipt Checklist and immediately brought to the attention of the project manager or laboratory supervisor.

If samples are not shipped or delivered directly to the laboratory by the client (sample receipt occurred off-site by a courier, sales representative, supervisor, etc.), both the Core Laboratories' representative who initially received the samples and the laboratory sample custodian must sign and date the Chain of Custody Record.

11.4 SAMPLE RECEIPT

Sample receipt procedures shall be followed according to SOP No. AU-GLO-G018. A sample receipt checklist shall be completed for all environmental samples received, including samples which are received with a Chain of Custody Record. This is in addition to the information recorded in the sample receipt logbook. Sample receipt requirements shall be available (preferably posted) at the sample receipt station. A sample receipt checklist shall be provided in the Laboratory Documentation Manual.

The Sample Receipt Checklist and all associated shipping documents, Chain of Custody Records, Interlaboratory Analysis Request Log, shipping

container custody seals, etc. shall be placed in the job file. If any of the conditions of the sample or sample container upon receipt are not acceptable, then an Out of Control Event Report (OCER) should be completed and the client notified. A copy of the completed OCER should be maintained in the job file, documenting the client authorization to proceed with analyses on samples or sample containers that did not meet the required specifications.

At a minimum, the following information shall be documented on the Sample Receipt Checklist:

11.4.1 Client ID and laboratory job number

11.4.2 Chain of Custody Record provided with samples

11.4.3 Condition of custody seals (if provided)

11.4.4 Sample condition at receipt

11.4.5 Temperature of cooler

11.4.6 Any discrepancies in the type of sample containers used

11.4.7 Any discrepancies in the type or volume of preservatives used

11.4.8 Headspace or presence of air bubbles in volatile sample vials

11.4.9 Agreement between Chain of Custody Record and sample labels

11.5 INTERFACILITY SAMPLE TRANSFER

All of the chain of custody and sample receipt requirements detailed in this manual apply to samples transferred between Core Laboratories' ETS sites. An Interlaboratory Analysis Request Log (LARL) is used for documenting interlaboratory analysis requests. Refer to SOP No. HC-RDC-G006 for completion of the Interlaboratory Analysis Request Log and QA Alert Nos. QAA-12 and QAA-43 for the procedure for interlaboratory sample transfers. Guidelines for interlaboratory sample transfers are as follows:

11.5.1 Shipping laboratories shall contact a laboratory supervisor at the receiving laboratory prior to sample transfer with the details on all analytical, quality control, requested job turnaround and final reportable requirements.

11.5.2 If client requirements cannot be met by the receiving laboratory, the shipping laboratory shall be contacted immediately.

11.5.3 A receiving laboratory supervisor or their designate must approve all sample analysis and client requirements prior to sample shipment. Sample receipt approval shall be documented on the Interlaboratory Analysis Request Log.

11.5.4 An Interlaboratory Analysis Request Log must be completed and sent with each sample shipment. All sections of the Interlaboratory Analysis Request Log must be completed to ensure that client requirements are met.

11.5.5 A Chain of Custody Record shall be provided by the originating laboratory for all samples transferred between Core Laboratories' ETS sites.

11.6 SAMPLE LOG-IN

All samples received by the laboratory shall be logged into LIMS, assigned a unique identification number, and entered into the sample receipt logbook. Samples received after normal working hours shall be placed in the proper storage location and logged into LIMS on the next working day. Sample log-in and sample handling/holding time requirements shall be available (preferably posted) at the sample log-in station. Samples are logged in according to the following procedure.

11.6.1 Samples are logged into LIMS by assigning a job number and sequential laboratory sample identification number to each sample. Sample information (date/time sampled, date/time received, site and project ID information) is entered for each sample site, where available.

11.6.2 Job information is recorded in the sample receipt logbook.

11.6.3 The type and number of containers received for each sample site is entered into LIMS.

11.6.4 Sample containers are labeled with the laboratory sample number using permanent ink or marker or a computer generated tag.

11.6.5 Parameters are assigned to each sample, utilizing LIMS group data entry where possible. If necessary, group data entry values are modified for individual samples based on sample type. Items which require verification and possible modification include:

- Sample matrix and assigned units
- Dissolved versus total basis parameter requests
- Specific methodology requested
- Detection limits requested

11.6.6 The sample custodian informs the analyst when samples requiring immediate analysis are received. This is done for all parameters which have holding times of 48 hours or less.

11.6.7 Sample containers are placed in the appropriate storage location.

11.6.8 A copy of the LIMS log-in report is placed in the corresponding job file. The job file is given to a laboratory supervisor, project manager or the QA/QC coordinator to verify and document that all log-in procedures have been properly completed.

11.6.9 The client is contacted if conditions which may affect sample integrity or analytical results are noted during sample receipt and log-in. The client's decision on how to proceed with the analyses of the affected samples is documented on a correspondence log or Out of Control Event Report and placed in the corresponding job file.

11.7 SAMPLE STORAGE

Samples shall be stored and segregated according to the requirements for

each parameter. Most environmental samples require storage at 4 °C. In addition, the following sample storage requirements shall be followed for environmental samples:

11.7.1 Non-oily samples (water and soil) submitted for volatile organics analysis shall be segregated from all other sample types in a separate refrigeration unit.

11.7.2 Organic analysis extracts prepared in the laboratory shall be segregated from all other sample types in a separate refrigeration unit.

11.7.3 Samples and sample extracts shall not be stored in the same refrigeration unit with laboratory reagents or standards.

11.7.4 Holding blanks shall be utilized for volatile sample storage units. Refer to Section 12.3.5 of this manual for the requirements for holding blanks.

11.8 SAMPLE HANDLING PROCEDURES

Samples are to be handled according to the requirements for the applicable parameters. Sample handling requirements which include holding times and preservatives for environmental parameters are provided in Core Laboratories' Sample Handling Guide.

All sample analyses must be completed within the EPA recommended holding times. Recommended holding times are based on the date and time sampled, not on the date and time of laboratory receipt. LIMS holding time status reports should be used to monitor all parameters. Samples scheduled for analysis of these parameters must be tracked and analyzed within the recommended holding times.

The analysts are responsible for maintaining the sample segregation and storage requirements for environmental parameters. Samples shall be returned to the appropriate storage location following analysis. All samples requiring refrigeration are to be returned to the appropriate refrigeration unit at the conclusion of each working day.

11.9 PRIORITY SAMPLE ANALYSIS

Clients are responsible for providing the laboratory with samples in a timely manner so that the laboratory can complete the analytical work within the EPA recommended holding times and client specified turnaround. Samples designated for rush turnaround and parameters with short holding times must be given priority for sample analysis. Rush samples should be indicated as such to enable the laboratory to meet the client's turnaround time requirements.

11.10 SAMPLE TRACKING

LIMS is used to monitor sample status from sample receipt to final report preparation. Parameter holding time reports, job due date reports, and associated sample parameter requests are tracked using the laboratory information management system. Based on client or project requirements, additional laboratory sample tracking procedures may be implemented.

11.11 SAMPLE SECURITY

Samples shall be maintained in the secured facility in designated sample storage areas. The sample custodian and management personnel shall limit the access to the sample storage areas. Based on project or client requirements, additional sample security and tracking procedures will be implemented.

11.12 SAMPLE DISPOSAL

Samples shall be retained for a minimum of 30 days from the date of completion of the final report. After this period, samples will either be returned to the client or disposed of in an environmentally approved manner. Core Laboratories reserves the right to charge the client for shipping and/or disposal costs of unused samples.

12.0 CALIBRATION, VERIFICATION AND MAINTENANCE

12.1 EQUIPMENT AND INSTRUMENT CALIBRATION

12.1.1 Calibration Procedures

Equipment and instruments shall be calibrated at the frequency specified in the manufacturer's instructions and the method requirements or applicable SOPs using the designated procedure. The status of equipment and instruments with regard to calibration needs to be readily available and clearly indicated. All applicable acceptance criteria for equipment and instrument set-up and calibration must be met before any sample analyses are performed. All data and documents relevant to equipment and instrument calibration shall be kept up-to-date and readily available to the laboratory staff.

Refer to SOP No. LB-EIM-G073 for the procedures for conducting a program for equipment and instrument calibration. Specific procedures for equipment and instrument calibration shall be documented in the associated SOP.

12.1.2 Calibration Verification

Equipment and instrument calibration shall be verified by the analysis of appropriate reference materials before samples are analyzed and at the required frequency throughout the analytical run. The results must be within the acceptance limits for the method in order to proceed with sample analysis.

12.1.3 Documentation of Calibration

All calibrations shall be documented in the applicable logbook or instrument printout. All records pertaining to calibration shall be safely stored.

12.2 CALIBRATION AND VERIFICATION OF SUPPORT EQUIPMENT

All equipment that is not the actual test instrument, but is necessary to support laboratory operations must be maintained in proper working order

and calibrated and/or verified at the designated frequency. The requirements for the calibration and verification of support equipment are listed below.

12.2.1 Thermometers

All thermometers used in the laboratory for monitoring instruments or procedures shall be calibrated at least once each year against a NIST traceable thermometer. Thermometers that are used in the actual conduction of the test measurement shall be calibrated every 6 months. The temperature correction factor and calibration date will be recorded on indelible tape and attached directly on the thermometer or device which is being monitored.

All thermometers will be labeled with a laboratory control number. The QA/QC coordinator shall keep a record of all thermometers, their laboratory location and control number, and calibration information. A thermometer calibration log shall be provided in the Laboratory Documentation Manual. The certificate for the NIST traceable thermometer shall be maintained in the QA/QC coordinator's files. The NIST traceable thermometer shall be recalibrated as needed according to NIST or at the frequency specified by the governing state or federal regulatory agencies.

12.2.2 Temperature Controlled Devices

Temperature controlled devices, including refrigeration units, incubators, water baths, and ovens, shall be equipped with a thermometer or temperature monitoring device. The temperature of the device shall be monitored to ensure that the applicable temperature requirements are met. The temperature of these devices shall be measured and recorded in a logbook or logsheet. A temperature log shall be provided in the Laboratory Documentation Manual. The requirements for monitoring the temperature of temperature controlled devices in environmental laboratories are as follows:

12.2.2.1 A laboratory staff member is assigned the primary responsibility to perform the daily temperature monitoring. A

back-up person is assigned in the event that the primary person is unavailable.

12.2.2.2 Thermometers which are used for monitoring refrigeration units and incubators should be immersed in deionized water or glycerol using a rubber-stoppered Erlenmeyer flask or other suitable container.

12.2.2.3 Thermometers which are used for monitoring ovens should be immersed in sand using a rubber-stoppered Erlenmeyer flask or other suitable container.

12.2.2.4 The temperature on all refrigeration units shall be monitored on a daily basis at a minimum. Waterbaths, incubators and ovens shall be monitored on the days when they are in use.

12.2.2.5 Temperature logs for recording daily temperature monitoring shall be placed on the device or in the vicinity. The instrument I.D. and temperature requirements shall be clearly marked on the log.

12.2.2.6 The date, corrected temperature reading, adjustments (if needed), and initials of the person who performed the reading shall be recorded in the logbook or on the logsheet. Corrective action must be taken and documented if the temperature is not within the control limits.

12.2.2.7 The laboratory manager shall be notified if the corrective action taken does not correct the problem.

12.2.2.8 The temperature logs shall be removed when complete and kept in the QA/QC coordinator's files. New logs shall be put in place immediately.

12.2.3 Balances

All analytical and top-loading balances shall be serviced and calibrated on an annual basis by a qualified service representative. A tag shall be attached to the balance showing the date of certification. The

annual balance certificates shall be maintained in the QA/QC coordinator's files.

The calibration of all analytical and top-loading balances shall be checked with the appropriate ASTM Class 1 or 2 weights each day of use. A log for recording the balance calibration checks shall be provided in the Laboratory Documentation Manual. The requirements for performing the balance calibration checks for environmental laboratories are as follows:

12.2.3.1 A laboratory staff member is assigned the primary responsibility of checking the laboratory balances daily. A back-up person is assigned in the event that the primary person is unavailable.

12.2.3.2 Analytical and top-loading balances shall be checked daily prior to use with a minimum of two ASTM weights (Class 1 or 2). The weights which are used for checking the balances shall be within the working range which will be used for weight measurement.

12.2.3.3 The daily balance check is to be recorded in a logbook. Corrective action must be taken and documented if the weight measurements are not within the manufacturer's recommended control limits.

12.2.3.4 If any of the control limits are exceeded, notify a laboratory supervisor immediately. Balances which do not weigh within the acceptable control limits are to be serviced and recalibrated prior to usage.

12.2.3.5 The balances are to be cleaned after each use. A soft-bristled brush should be kept near each balance for brushing off any loose material. If a spill occurs, clean the balance thoroughly to prevent corrosion and pitting.

12.2.3.6 Do not leave a tare weight on the balance.

12.2.4 Certified Weights

Certified ASTM Class weights used for performing balance calibration checks shall be recalibrated and recertified annually. The record of certification shall be maintained in the QA/QC coordinator's files.

12.2.5 Volatile Holding Blanks

Holding blanks shall be used in all sample refrigerators where samples for volatile organics analysis are stored. The holding blank shall be prepared by filling a volatile sample storage vial with reagent water used for volatiles analysis. The holding blank shall be stored for the typical period of time that samples are held which is generally no more than two weeks. The holding blank shall be analyzed as a regular sample for volatile analysis. The level of volatile compounds in the holding blank shall not exceed the quantitation limit or 5 times the quantitation limit for acetone, methylene chloride and methyl ethyl ketone. If drinking water is analyzed, then all compounds must be less than the laboratory detection limits for drinking water. If the level of volatile compounds exceeds these specifications, then corrective action must be taken to reduce the contamination to an acceptable level. Holding blanks must be analyzed on a monthly basis, at a minimum, and documentation maintained by the QA/QC coordinator to demonstrate the analyses of holding blanks.

12.2.6 Spectrophotometer Check

All UV spectrophotometers shall be monitored for linearity, wavelength calibration, and stray light detection using standardized commercial solutions. IR spectrophotometers shall be checked according to the procedure recommended by the manufacturer. Spectrophotometer checks shall be performed at a frequency which corresponds to usage or annually at a minimum. A log for documenting spectrophotometric checks shall be provided in the Laboratory Documentation Manual.

12.2.7 Radioactivity Check

All devices that potentially release radioactivity shall be checked as prescribed by the applicable manufacturer. A wipe test for radioactivity leaks shall be performed every 6 months at a minimum on all GC electron capture detectors. Wipe test results shall be

documented and kept on file.

12.2.8 Measuring Devices

Adjustable volumetric dispensers (i.e. Eppendorf pipets, Oxfords, etc.) used to prepare standards and spikes or to aliquot or dilute samples shall be checked for accuracy on a weekly basis, at a minimum. Dispensing deionized water and verifying the volume (weight) dispensed using a top-loading or analytical balance is required. The checking of adjustable volumetric dispensers shall be documented in the analysis logbook or in a separate logbook reserved for this use. A log for checking adjustable volumetric dispensers shall be provided in the Laboratory Documentation Manual.

12.2.9 Autoclaves

The sterilization temperature and pressure of each autoclave run must be documented by the use of appropriate chemical or biological sterilization indicators. Autoclave tape may be used to document that a load has been processed. The sterilization time, temperature, and pressure of each run shall be documented to demonstrate completion of an acceptable sterilization cycle. A log for recording the autoclave information shall be provided in the Laboratory Documentation Manual.

12.3 EQUIPMENT AND INSTRUMENT CERTIFICATION

Equipment and instruments which require certification shall be certified at the required frequency by a qualified technician or agency. Calibration certificates shall indicate the traceability to national standards of measurement. Calibration certificates shall be maintained by in the QA/QC coordinator's files.

12.4 EQUIPMENT AND INSTRUMENT MAINTENANCE AND REPAIR

12.4.1 Maintenance and Repair Procedures

Routine maintenance shall be performed according to the manufacturer's recommended procedure and at the frequency in the manufacturer's specifications. Equipment and instrument maintenance

and repair shall be performed only by qualified personnel or a manufacturer representative. When required, maintenance and repair contracts shall be used for specific instrumentation.

Refer to SOP No. LB-EIM-G036 for the procedures for conducting a program for equipment and instrument maintenance and repair. Specific procedures for equipment and instrument maintenance and repair shall be documented as addendums to SOP No. LB-EIM-G036.

12.4.2 Status of Equipment and Instrument Condition

Equipment and instruments that are taken out of service shall be clearly identified as "out of service" and, if possible stored in a designated location until the repair work has been completed and the equipment or instrument is operating satisfactorily. Equipment and instruments that are not marked shall be considered in proper working order.

12.4.3 Documentation of Maintenance

All maintenance and repair events shall be documented in a maintenance logbook or file for each instrument. Service reports completed by the manufacturer representative should be filed in the appropriate equipment or instrument file.

13.0 ANALYTICAL TEST METHODS AND PROCEDURES

13.1 ANALYTICAL TEST METHODS

EPA and ASTM approved methods are used for the majority of analytical parameters. Standard Methods, USGS methods, and documented Core Laboratories' methods are also used. Deviations from approved methods or the use of non-standardized methods may be allowed if the deviation provides equivalent results and is documented and if client approval is granted and fully documented. The analytical methods utilized for environmental and petroleum analyses are provided in the Environmental Testing Services Division Description and Fee Schedule.

13.2 ANALYTICAL METHOD REQUIREMENTS

All requirements shall be followed by the analyst as stated in the applicable method, technical SOP, and client project plan. Any deviation from any method or SOP requirement must be documented on the SOP Addendum form and approved by the laboratory manager and corporate QA director. Copies of SOP addendums shall be included in the Laboratory Documentation Manual.

Summaries of the QC requirements, detection/quantitation limits, and data review procedures for the major EPA environmental analytical methods are provided in Core Laboratories' Environmental Analysis Survival Guide.

13.3 DETECTION LIMIT STUDIES

Method detection limits shall be established for all analytes on each instrument for each trace level analytical procedure. If required, the detection limit should also be determined for each sample matrix analyzed. Method detection limit studies shall be performed annually and results shall be kept on file with the QA/QC coordinator. The reporting limits cited in analytical reports cannot be less than the laboratory determined method detection limits.

The recommended procedure for determining method detection limits is to analyze a minimum of seven replicates of a standard prepared at a concentration of 2-5 times the estimated detection limit. The method

14.0 QUALITY CONTROL

14.1 TYPES OF QUALITY CONTROL

The types of quality control samples and their definitions, purposes, and general acceptance criteria are provided in Figure 14.1.

14.2 GENERAL QUALITY CONTROL GUIDELINES

14.2.1 Quality control samples must be analyzed with each batch of samples, where applicable and available.

14.2.2 Quality control data which is associated with a sample batch must be entered into LIMS along with field sample analytical results and reported with the sample results.

14.2.3 Quality control data which does not meet the method-specified acceptance criteria must be documented on the Out of Control Event Report and brought to the attention of a laboratory supervisor or the QA/QC coordinator.

14.2.4 If quality control data does not meet the method-specified acceptance criteria, analytical results for that batch of samples may also be questionable. Analytical results should not be reported to the client until this data has been reviewed and approved by the laboratory supervisor or the QA/QC coordinator.

14.3 QUALITY CONTROL REQUIREMENTS

All analyses performed at Core Laboratories include the quality control measures specified by the applicable method, technical SOP, and client project plan. Certain methods have method-specified quality control samples and acceptance criteria which the analysts are required to follow. Specific types, frequencies, and acceptance criteria of QC samples for select organic, inorganic, and radiochemistry methods are provided in Core Laboratories' Environmental Analysis Survival Guide. If the quality control requirements are not specified in the method then the NELAP quality control standards shall be used.

detection limit is calculated by multiplying the standard deviation of the analytical results by the students' t-value for the number of replicates analyzed (3.14 for 7 replicates).

13.4 METHOD COMPETENCY

Prior to performing analyses, the laboratory shall demonstrate competency to perform the method. This shall be accomplished according to guidelines set forth in the applicable method and SOP. If no guidelines are stated, the laboratory shall analyze multiple control samples to demonstrate adequate precision and accuracy. Demonstration of method proficiency shall be documented and kept on file by the QA/QC coordinator.

13.5 METHOD VALIDATION

Method validation shall be performed for new methods prior to implementation in the laboratory. Method validation includes detection limit studies, method competency, analysis of blind samples, and analyst proficiency.

14.4 CALCULATIONS

14.4.1 Percent Recovery for Standards or Surrogates

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

14.4.2 Percent Recovery for Matrix Spikes

$$\frac{\text{Spiked Sample Result} - \text{Sample Result}}{\text{Spike Value}} \times 100 = \%\ \text{Recovery}$$

14.4.3 Relative Percent Difference

$$\frac{|A - B|}{A + B} \times 200 = \text{Relative Percent Difference}$$

14.5 CONTROL CHARTS

Laboratory control limits shall be established for surrogates, laboratory control samples, and duplicate samples when method control limits are not available or if an analytical method, client, or certification/accreditation agency specifically requires that laboratory control limits be determined. These limits, which measure laboratory performance, shall be based on historical data which has been produced in the laboratory. Laboratory established control limits may be used in place of control charts unless control charts are specifically requested by a client or certification/accreditation agency.

Laboratory established control limits should only be used for the acceptance or rejection of data if they are within the limits prescribed in the applicable method. LIMS provides for the entry of parameter-specific control limits which can be used for flagging out of control QC data. Laboratory established control limits should be re-established at the minimum frequency of once a year or as specified by the analytical method, client, or certification/accreditation agency.

15.0 DATA REVIEW AND REPORTING

15.1 DATA REVIEW AND APPROVAL

The following section specifies the data review and approval responsibilities for laboratory staff members. Specific job titles referenced in the following sections (which may vary at some laboratories) refer to functional responsibilities.

15.1.1 Analyst Level Data Review

All analysts are responsible for reviewing the analytical and quality control data that they have generated. The following conditions must be verified prior to entering data into LIMS.

15.1.1.1 Appropriate analytical methodology was used, based on the sample matrix, analyte concentration, and project specifications.

15.1.1.2 Instrumentation was functioning properly during sample analysis.

15.1.1.3 Quality control analyses were analyzed at the proper frequency and the analyses met the QC acceptance criteria.

15.1.1.4 Sample analysis was completed within the method-specified holding time. If holding times were exceeded, immediately inform the appropriate laboratory supervisor.

15.1.1.5 All analytes were quantitated within the calibration range and, if necessary, samples were diluted to bring results into calibration range.

15.1.1.6 Matrix interference problems were verified. Corrective action, including reanalysis, dilution, matrix modifiers, etc. was taken to minimize or eliminate the interference, where possible.

15.1.1.7 Method-specific analytical requirements were met, including correlation coefficient values, surrogate recoveries, etc.

15.1.1.8 Calculations, dilution factors, and detection limits have been verified.

If any of the method-specific requirements or the requirements listed above were not met, do not enter this data into LIMS. Instead, immediately inform the appropriate laboratory supervisor and complete an Out of Control Event Report form. The laboratory supervisor will determine the corrective action that is required.

All data calculations, dilution factors, etc. must be verified prior to LIMS data entry. If data is acceptable, then the data should be entered in LIMS. Refer to Section 15.2 of this QA manual for LIMS data entry requirements.

15.1.2 Supervisory Level Data Review and Approval

Laboratory supervisors are responsible for verifying the analytical and quality control data generated in their laboratory section. The following items must be reviewed and approved before releasing the data for final reporting.

15.1.2.1 Verify that the analytical methodology which was used met the client and regulatory requirements.

15.1.2.2 Verify that the samples were analyzed within the method-specified holding time. If holding times were not met, this must be documented on an Out of Control Event Report and included in the job file.

15.1.2.3 Verify that quality control analyses were analyzed at the proper frequency and that the acceptance criteria were met.

15.1.2.4 Verify that the data in the logbooks or instrument printouts was correctly entered into LIMS.

15.1.2.5 Review and document problems encountered during analysis. Determine whether corrective action is required and, if action is required, inform the appropriate personnel.

15.1.2.6 Prepare case narratives which will be included in the final analytical report when out of control events or non-conformances occur, such as QC acceptance limits not met for QC analyses, matrix interference problems resulting in high detection limits, missed hold times, quality control problems, etc.

If the method-specific requirements or the requirements listed above were not met, corrective action may be necessary.

15.1.3 Final Data Review and Approval

Laboratory supervisors, project managers, the QA/QC coordinator, or the laboratory manager are responsible for approving the final data report which is submitted to the client. The following items must be verified before releasing the final analytical and QA reports.

15.1.3.1 Verify that the final analytical report format and content is appropriate and meets client and regulatory requirements.

15.1.3.2 Review the final analytical and QA reports to assure that the data was reported correctly (i.e., significant figures, method references, detection limits, units, date analyzed ,etc).

15.1.3.3 Verify that any additional QA reportables requested by the client are provided (i.e., matrix spike duplicates, copies of raw lab data, surrogate recoveries, etc.).

15.1.3.4 Verify that an Out of Control Event Report or Nonconformance and Corrective Action Report is present in the job file for any analytical and QA problems associated with that job.

15.1.3.5 Verify that documentation is present in the job file for any decisions made to report data which deviates from method-specified requirements.

15.1.3.6 Verify that analytical and QA problems were addressed and appropriate corrective action was taken to minimize or

eliminate the problem.

15.1.3.7 Prepare case narratives to include with the final data report when problems, nonconformances or out of control events have occurred.

If the requirements listed above were not met, document the out of control event and all corrective actions taken on an Out of Control Event Report and contact the client, if necessary.

15.2 DATA ENTRY

LIMS data entry requirements are provided in the technical methods SOPs. If LIMS data entry requirements are unclear, contact a laboratory supervisor or the QA/QC coordinator before entering the data. The following procedures shall be used for LIMS data entry.

15.2.1 Significant Figures

Report analytical or QA data to the number of significant figures specified by the method and technical SOP. Statistical rounding should be employed when reporting the data to the correct number of significant figures.

15.2.2 Method Detection Limits

Verify the LIMS default detection limit when entering data. If the detection limit is incorrect, contact the laboratory supervisor. Samples which have been diluted due to matrix interference, analyte concentration, or lack of sample must have their detection limit increased.

15.2.3 Method References

Verify the method reference when entering data. If the method reference is incorrect contact a laboratory supervisor or the QA/QC coordinator.

15.2.4 Units

The concentration units must be entered according to the sample matrix (mg/L, mg/kg, etc.). Verify the units in LIMS, and change them if necessary, if the default units are incorrect.

15.2.5 Date/Time Analyzed

The date analyzed values which are entered in LIMS must accurately reflect the actual date of sample analysis. Enter the date and time when the analysis began, not the ending date and time.

15.2.6 Quality Control Data

Quality control data which is associated with an analytical batch must be entered into LIMS along with analytical results. If the quality control analyses are out of control and cannot be entered in LIMS (password override is required), the analyst must immediately contact the appropriate laboratory supervisor or the QA/QC coordinator.

15.3 DATA REPORT FORMAT

15.3.1 Cover Sheet

The report cover sheet shall include the job number, the client name and address and an approval section for the laboratory manager or their designee. The laboratory manager or their designee shall sign and date the cover sheet.

15.3.2 Disclaimer Statement

Each page of the data report shall include the following standard disclaimer:

"The analytical results, opinions or interpretations contained in this report are based upon information and material supplied by the client for whose exclusive and confidential use this report has been made. The analytical results, opinions or interpretations expressed represent the best judgment of Core Laboratories. Core Laboratories, however, makes no warranty or representation, express or implied, of any type, and expressly disclaims same as to the productivity, proper operations

or profitableness of any oil, gas, coal or other mineral, property, well or sand in connection with which such report is used or relied upon for any reason whatsoever. This report shall not be reproduced, in whole or in part, without the written approval of Core Laboratories."

15.3.3 Case Narrative

A case narrative should be prepared and included in the final report documenting any problems encountered with the samples or analyses and any data which does not meet the quality control acceptance criteria.

15.3.4 Analytical Test Results

Sample results are provided in the report section titled "Analytical Report". Analytical test results shall include the parameter, analytical results, units, detection limit, method number, date of analysis, initials of analysts, and reference to subcontractors, if applicable.

15.3.5 Quality Control Report

All quality control sample data which is associated with an analytical batch shall be reported in the report titled "Quality Control Report". The quality control report shall include the analyzed values and true values for any QC samples associated with the sample data. Relative percent difference and percent recovery are reported for duplicates, reference standards, and matrix spikes.

15.3.6 Quality Control Footer

Standard QC footers referencing the methods used in performing the sample analyses should be included on a quality control footer page. Footers may be added as needed for information relevant to the sample results or associated quality control.

15.3.7 Chain of Custody Record

The original Chain of Custody Record or a copy thereof shall be included with the data report.

15.4 ELECTRONIC DATA DELIVERABLES

Core Laboratories' LIMS has the capability of providing clients with electronic data deliverables. Client requests for electronic deliverables must be reviewed by the laboratory prior to the project to ensure that the data can be delivered in the requested format and in accordance with any project specifications. Electronic data can be delivered on diskette or transmitted directly by modem.

15.5 DATA MODIFICATION, UPDATES, AND TRACEABILITY

All data modifications and updates must be documented and traceable. All raw data must be documented or recorded in a laboratory logbook or instrument printout. Any changes to data must be initialled and dated. Any changes to reported results must be based on a legitimate reason and corrected results must be traceable to the raw data. The following procedure is used to document data modifications and updates.

15.5.1 A review of the raw laboratory data is required prior to any data modifications.

15.5.2 Verify all questionable data with the analyst or supervisor before changing any data in LIMS.

15.5.3 Reports that are revised and reissued to a client for any reason must be clearly identified as a revised report. A case narrative explaining the reason for the report revision must be provided to the client with the revised report. A copy of the original report, revised report, and case narrative that was provided to the client must be kept in the job file.

16.0 QUALITY ASSESSMENT PROGRAMS

Core Laboratories' Quality Assessment Programs are designed to measure laboratory performance and monitor laboratory adherence to corporate QA policies, method-specified requirements, and regulatory requirements. Quality Assessment Programs help to identify and eliminate nonconformances and ensure that client and regulatory requirements are met. Programs used by Core Laboratories to accomplish this goal include the following:

- Audit Programs
- Performance Evaluation Studies
- Round Robin and Exchange Group Programs
- Internal Blind Duplicate and QC Sample Studies
- Laboratory Certification and Accreditation Programs
- Reports to Management

16.1 QUALITY ASSURANCE AUDIT PROGRAMS

16.1.1 Corporate Quality Assurance Audits

Corporate Quality Assurance (QA) audits are conducted on an annual basis at each laboratory location by the corporate QA department. QA audit checklists are routinely used for performing and documenting the corporate QA audits. Refer to SOP No. HC-QAC-G013 for the procedures for Core Laboratories' internal audit program.

Corporate QA audits assess compliance with the requirements in the QA Manual. The following items and functions are included in the corporate QA audit:

- QA roles and responsibilities
- QA and analytical method training

- Laboratory security
- General facilities requirements
- Laboratory documentation
- Sample custody
- Instrumentation procedures
- Analytical procedures
- Quality control procedures
- Data entry, review and approval procedures
- Data reporting
- Quality assessments

Each laboratory facility is audited a minimum of once each year by the corporate QA department. Deficiencies which are identified in the corporate QA audits shall be documented in a laboratory audit report with findings and recommendations for corrective action.

Reports for corporate QA audits shall be numbered as follows: XX for the laboratory 2 letter code designation (such as AU for Aurora) - ## for the last two digits of the year (such as 97 for 1997) - ## for the sequential number of the audit for that year (such as 01 for the first audit of the year). The audit report is directed to the laboratory manager and QA/QC coordinator and a copy of the audit report is provided to the division vice president and regional manager.

The laboratory is required to review the audit report and respond within four weeks after receipt of the audit report, unless approval for additional time is granted by the corporate QA department. Corrective action and a written corrective action response which includes documentation to support the implementation of the corrective action is required for each finding. The audit response

shall be directed to the corporate QA director with copies to the division vice-president and regional managers. The laboratory manager, QA/QC coordinator, laboratory supervisors, and key personnel shall be informed of each deficiency and required corrective action. All affected staff must implement the required corrective action within the designated time period.

The corporate QA department reviews the laboratory's response and prepares a reply to the laboratory on the acceptability or lack of acceptability of the laboratory's corrective action. The laboratory may be required to prepare and submit an additional corrective action response to the corporate QA department for review and approval if the initial response is incomplete or unacceptable. The implementation of corrective action on the deficiencies and nonconformances which are identified in the audit report is reviewed in subsequent annual corporate QA audits.

16.1.2 Internal Laboratory Audits

Internal laboratory audits are conducted on a quarterly basis by the QA/QC coordinator. Internal audits help the laboratories prepare for external audits. Audit checklists may be used to conduct and document internal laboratory audits. Audit checklists used by the laboratory shall be provided in the Laboratory Documentation Manual.

Internal laboratory audits are performed to review the laboratory's compliance with the QA Manual, the Laboratory Documentation Manual, and any project or laboratory specific QA Plans. The QA/QC coordinator is responsible for implementing an identification and document control system for internal laboratory audits.

Any findings that are identified in internal laboratory audits are reported to management using an audit report or a Nonconformance and Corrective Action Report. The laboratory manager, supervisors, and key personnel are informed of the findings and involved in the corrective action process. Corrective action and a written corrective action response or completed NCR is required for each finding. The audit report and corrective action response are submitted to the

corporate QA director in the monthly QA reports. Subsequent internal laboratory audits include a review of the implementation of required corrective action.

16.1.3 Data Audits

Data audits are performed on a monthly basis by the QA/QC coordinator to ensure the accuracy and defensibility of the data generated by the laboratories. The corporate QA department conducts data audits on performance evaluation samples and randomly selected client samples to ensure compliance with client requirements and internal QA/QC policies and procedures. Checklists may be used to document data audits and to provide consistency. Examples of data audit checklists are provided in Core Laboratories' Environmental Analysis Survival Guide. Other data audit checklists used by the laboratory shall be provided in the Laboratory Documentation Manual.

Data audits typically include a review of the following items:

- Final analytical and QA reports
- Sample receipt documentation and chain of custody procedures
- LIMS log-in information
- Job file contents, including client contact documentation
- Raw laboratory data
- All associated logbooks
- Analytical procedures
- Adherence to method specifications

Any findings identified in data audits are documented in an audit report or Nonconformance and Corrective Action Report. The laboratory manager, QA/QC coordinator, supervisors, and key

personnel are informed of the findings and involved in the corrective action process. Corrective action and a written response on the corrective action implementation are required on each finding. For data audits performed by the QA/QC coordinator, copies of the data audit report and corrective action response are submitted to the corporate QA director in the monthly QA report. Subsequent data audits include a review of the implementation of required corrective action.

16.1.4 External Audits

External audits are audits which are performed by clients, accrediting agencies, or regulatory agencies. The frequency at which external audits will occur is not generally known. Laboratories should be prepared at all times for the possibility of an external audit. Refer to SOP No. HC-QAC-G012 for the procedure for preparing for, participating in, and following up on external audits. A training program on preparing for audits is also available from the corporate QA department. The responsibilities of the QA/QC coordinator concerning external audits are as follows:

16.1.4.1 Notify the corporate QA department of the audit schedule and areas to be audited.

16.1.4.2 Assist the laboratory manager in the preparation for the audit.

16.1.4.3 Accompany the primary auditor throughout the audit and take notes on the auditor's findings.

16.1.4.4 Attend the introduction and debriefing sessions.

16.1.4.5 Immediately notify the laboratory manager and corporate QA director on major deficiencies and items of concern identified by the auditor(s).

16.1.4.6 Submit the report prepared by the auditor's to the laboratory manager, corporate QA director, and regional manager.

16.1.4.7 Prepare the draft audit response for approval by the laboratory

manager and corporate QA department.

16.1.4.8 Prepare the final audit response for submission to the auditor(s) with copies to the laboratory manager, corporate QA director, and regional manager.

16.1.4.9 Monitor, document, and aid in the implementation of the necessary corrective actions on all audit findings.

16.2 PERFORMANCE EVALUATION STUDIES

Performance evaluation studies are conducted at a frequency specified by the client, government agency, or corporate QA department. Participation in performance evaluation studies is required for the parameters analyzed by the laboratory. Nonconformance and Corrective Action Reports must be issued for any not acceptable results to document the corrective action taken.

16.2.1 External Performance Evaluation Studies

External performance evaluation studies are conducted at a frequency specified by the client or government agency. The performance evaluation studies in which the environmental testing laboratories participate in include the following:

- EPA semi-annual Water Pollution (WP) Studies for laboratories which perform wastewater analyses
- EPA semi-annual Water Supply (WS) Studies for laboratories which perform drinking water analyses
- EPA EMSL radiochemistry performance evaluation studies for laboratories which perform radiochemistry analyses
- State and Federal performance evaluation studies
- Client-sponsored performance evaluation studies

The results of performance evaluation analyses are provided to the

corporate QA director in the next monthly QA report.

16.2.2 Internal Performance Evaluation Studies

The corporate QA department conducts semiannual blind performance evaluation programs on the EPA water pollution parameters utilizing commercial suppliers to assess laboratory performance on unknowns. The vendors APG, ASI, or ERA are used to conduct blind and double blind performance evaluation studies. The results of the corporate-issued internal PE studies are provided directly to the corporate QA department by the commercial vendor.

16.3 ROUND ROBIN AND EXCHANGE GROUP PROGRAMS

Participation in round robin and exchange group programs is determined by the management of the laboratory. The samples are processed using the same QC and sample handling procedures as regular client-submitted samples. Performance results for the samples are recorded on control charts, showing the mean and standard deviation from the mean. Nonconformance and Corrective Action Reports are issued for any not acceptable results. The results of the round robin and exchange group programs and any NCRs issued are included in the monthly QA report to the corporate QA director. Round robin and exchange group programs that the petroleum testing laboratories participate in include the following:

- ASTM Interlaboratory Cross Check Program
- Great Lakes Regional Exchange Group
- Gulf Coast Regional Exchange Group
- National Exchange Group
- Northwest Exchange Group
- Pacific Coast Regional Exchange Group
- Refinery Systems Exchange Group

- Texas Regional Exchange Group
- Client-sponsored round robin programs

16.4 INTERNAL BLIND DUPLICATE AND QC SAMPLE STUDIES (OPTIONAL)

Internal blind duplicate and QC sample studies are initiated by the QA/QC coordinator for the purpose of evaluating the laboratory's precision and accuracy. Blind QC samples are samples containing analytes of known concentration introduced in the laboratories to test laboratory accuracy. Blind duplicates are duplicates of actual samples introduced at the time of sample receipt in order to measure repeatability within the laboratory. Nonconformance and Corrective Action Reports are issued on any not acceptable results. The results of the blind duplicate and blind QC sample studies and any NCRs issued are included in the monthly QA report to the corporate QA director. Guidelines for conducting blind duplicate sample studies are as follows.

16.4.1 Identify samples that are homogeneous and of sufficient volume to allow sample splitting.

16.4.2 Log-in the original sample as normal.

16.4.3 Remove half the sample and place into a clean container appropriate to the sample matrix and parameter types.

16.4.4 Log-in the duplicate at least one day after the original sample under a separate job number. Ensure that any holding time requirements can still be met.

16.4.5 Modify the duplicate sample ID slightly to include a code which indicates to the laboratory manager that this data is for internal use.

16.4.6 Erase the account receivable code and replace with "Do Not Invoice" at the time of log-in.

16.4.7 Send copies of the log-in documentation for the duplicate and original sample to the QA/QC coordinator.

16.4.8 When analysis is complete, remove the duplicate file from the system and forward to the QA/QC coordinator.

16.4.9 The QA/QC coordinator reviews the data to determine whether the precision is acceptable (RPD $\leq$ 20%).

16.4.10 The laboratory staff and management is informed of the results and a copy of the results (including control charts, if generated) is provided to the corporate QA department in the following monthly QA report.

16.5 LABORATORY ACCREDITATION AND CERTIFICATION PROGRAMS

Core Laboratories' environmental and petroleum testing laboratories participate in state, federal and international certification and accreditation programs. Each laboratory location is approved or certified by select accreditation and certification agencies. To gain certification, the laboratory must meet the prerequisites specified by the agency and provide detailed information about the laboratory's qualifications, capabilities, and quality control program. The certification or accreditation program may also require the acceptable analysis of performance evaluation samples and a comprehensive inspection or audit before certification or approval may be granted. A Certification Log listing any changes in the certifications, accreditations, and approvals that the laboratory has received or is pursuing is included in the monthly QA report and submitted to the corporate QA director.

16.6 REPORTS TO MANAGEMENT

16.6.1 Audit and Performance Evaluation Reports

Reports on laboratory performance, as identified by internal and external laboratory audits, performance evaluation studies, round robin and exchange group programs, and blind duplicate and QC sample studies are provided to the laboratory manager, QA/QC coordinator, regional manager, division vice-president, and corporate QA director. Nonconformance and Corrective Action Reports (or similar documentation) required in response to deficiencies noted are also provided to the appropriate on-site management personnel.

16.6.2 Monthly Quality Assurance Reports

Monthly quality assurance (QA) reports on the QA activities at each laboratory are prepared by laboratory QA/QC coordinators and provided to the corporate QA director with copies to the laboratory manager and regional manager. The procedure for preparing monthly QA reports is found in SOP No. HC-QAC-G005. The monthly QA reports include the following items:

16.6.2.1 Monthly QA Report Cover Sheet listing the location, report period, date submitted, name and signature of the person that prepared the report, and distribution list.

16.6.2.2 Monthly QA Report Narrative listing any comments associated with the report and indicating QA activities that are planned for the next period(s).

16.6.2.3 Monthly QA Report List of Contents which provides a checklist for preparing the report and serves as a list of the contents and order for the report.

16.6.2.4 Audit Log listing the external audits performed by clients, regulatory agencies, or accreditation agencies. Copies of the audit report(s) and audit response(s) should be attached.

16.6.2.5 Audit Log listing the internal audits performed by the laboratory QA/QC coordinator or corporate QA department. Copies of audit report(s) and audit responses(s) should be attached.

16.6.2.6 Data Review Log listing the data audits performed by the laboratory.

16.6.2.7 Performance Evaluation/ Round Robin Sample Log listing the performance evaluation, round robin, and proficiency studies that the laboratory participated in. Copies of any results received during the reporting period should be attached.

16.6.2.8 Certification Log listing any changes in the certifications, accreditations, and approvals that the laboratory has received

or is pursuing. Copies of new certificates or approval notifications should be attached.

16.6.2.9 Blind Duplicate Study Log listing the results of any blind duplicate studies performed by the laboratory during the month. Copies of the associated data reports should be attached. (OPTIONAL)

16.6.2.10 Blind QC Sample Study Log listing the results of any monthly blind QC sample studies performed by the laboratory. Copies of the associated data reports should be attached. (OPTIONAL)

16.6.2.11 Client Survey Log listing the number of client surveys conducted during the month and any corrective action that was required. Copies of the Client Survey Reports for the surveys conducted during the month should be attached.

16.6.2.12 Facility Monitoring Status Log listing the status of each item that is monitored on a routine basis and any corrective action that was required.

16.6.2.13 QA Correspondence Log listing all memos related to QA/QC matters that were provided to the laboratory staff or clients by the QA/QC coordinator or laboratory manager. Copies of the memos should be attached.

16.6.2.14 QA Meeting and Training Log listing the QA meetings and training sessions held by the laboratory. A copy of the meeting agenda and distributed materials should be attached.

16.6.2.15 QA Meeting/Training Session Attendance List for each QA meeting or training session conducted during the month.

16.6.2.16 Master Laboratory Training Records listing the parameters that each analyst has been trained on and received proficiency certification.

16.6.2.17 Method Detection Limit Study Log listing the method detection

limit studies performed by the laboratory. Copies of the associated data should be attached.

16.6.2.18 SOP and SOP Addendum Preparation Log listing any new site-specific SOPs or SOP Addendums that are being prepared or are completed. Copies of the completed site-specific SOPs and SOP Addendums should be attached.

16.6.2.19 Monthly Reporting and Turnaround Status Report listing the number of jobs completed, average turnaround time, % of jobs on time, and % of jobs past due for jobs released during the month.

16.6.2.20 Nonconformance and Corrective Action Reports issued for any nonconformances that required corrective action.

The monthly QA reports are reviewed by the corporate QA department. A standard Monthly QA Report Review form is used to document the review and identify any areas that need further action. An updated QA Assignment Status Log listing the status on all past due and pending QA assignments is prepared by the corporate QA department and submitted to the laboratory after the 15th of each month. The information provided in the monthly QA reports are assessed on a regular basis by the corporate QA department and reviewed during corporate QA audits.

17.0 CORRECTIVE ACTION

17.1 CORRECTIVE ACTION DOCUMENTATION

Deficiencies or other nonconformances which affect laboratory operations, QA procedures, or analytical and quality control results are to be documented using an Out of Control Event Report or Nonconformance and Corrective Action Report. The procedure for issuing and using a Nonconformance and Corrective Action Report is found in SOP No. HC-RDC-G002.

17.1.1 Out of Control Event Report

Out of Control Event Report (OCER) forms are used to document nonconformances and corrective actions which are taken to resolve problems related to sample receipt, calibration, sample analysis, quality control, and data reporting. The Out of Control Event Report form shall be utilized by analysts, sample receipt personnel, supervisors, and quality control personnel for documenting analytical problems and in preparing case narratives explaining any problems and corrective actions that were taken. A copy of the corporate issued Out of Control Event form is provided in Figure 17-1. Additional Out of Control Event documentation records used by the laboratory shall be provided in the Laboratory Documentation Manual.

17.1.2 Nonconformance and Corrective Action Report

Nonconformance and Corrective Action Reports are used to effectively document nonconformances and corrective actions which are taken to eliminate or minimize analytical problems. Analysts, supervisors, and quality control personnel are encouraged to use this system to document problems encountered during analysis and data reporting. A copy of the corporate-issued Nonconformance and Corrective Action Report is provided in Figure 17-2. Additional nonconformance documentation records shall be provided in the Laboratory Documentation Manual.

17.2 CORRECTIVE ACTION PROCEDURES

17.2.1 Analytical Data

When out of control events or nonconformances occur during sample analysis, analysts must document the incident on an Out of Control Event Report or Nonconformance and Corrective Action Report and inform the appropriate laboratory supervisor. The laboratory supervisor will then determine what corrective action is required. The following guidelines are used to validate data and determine what corrective action may be required.

17.2.1.1 Verify all calculations from the raw analytical data, including sample aliquots, dilution factors, linear regression calculations, etc.

17.2.1.2 Verify that method-specific matrix interference procedures were followed. Check the raw data for other field samples in the same analytical batch in order to determine whether the problem is unique to a single sample (a possible matrix problem).

17.2.1.3 Review the analytical procedure with the analyst to make certain that the required procedures and sample preparation techniques were performed correctly.

17.2.1.4 Check the initial calibration data to verify that instrumental operating requirements were met prior to starting sample analysis.

17.2.1.5 Verify that all necessary instrumental quality control checks met specifications during sample analysis; these specifications include the manufacturer's operating guidelines.

17.2.1.6 Verify that quality control analyses were performed at the required frequency and that QC acceptance criteria were met.

17.2.1.7 Determine whether an alternate method would be more appropriate and accurate for sample analysis.

17.2.1.8 Review log-in and chain of custody information to determine whether sample conditions may have affected analysis. Specific items to verify include sample condition on receipt, sample volume provided, bottle type, preservative used, and unusual field conditions which are noted on the Chain of Custody Record.

When a definitive explanation for the problem cannot be determined, sample reanalysis is required (sample volume permitting). Nonconformances, out of control events, and all corrective actions taken to eliminate the problem must be documented on an Out of Control Event Report or Nonconformance and Corrective Action Report and included in the job file. If necessary, a case narrative will be included with the final report.

When corrective actions have not eliminated the nonconformance or out of control event, and the validity of the reported data is in question, a laboratory supervisor, laboratory manager or the QA/QC coordinator shall contact the client. All client contact should be recorded in a phone log. Copies of the phone log and all other associated documentation should be included in the job file.

17.2.2 Performance Evaluation Studies

When a not acceptable result is reported for a performance evaluation study, a Nonconformance and Corrective Action Report must be issued by the QA/QC Coordinator to the appropriate laboratory supervisor. The laboratory supervisor and QA/QC coordinator must review all not acceptable results and determine the corrective action that is required. The following guidelines are used for evaluating not acceptable performance evaluation results and determining the corrective action that is required.

17.2.2.1 Verify all calculations from the raw analytical data, including sample aliquots, dilution factors, linear regression calculations, etc.

17.2.2.2 Review the data for any transposition errors that may have occurred.

17.2.2.3 Review the analytical procedure with the analyst to make certain that the required procedures and sample preparation techniques were performed correctly.

17.2.2.4 Check the initial calibration data to verify that instrumental operating requirements were met prior to starting sample analysis.

17.2.2.5 Verify that all necessary instrumental quality control checks met specifications during sample analysis; these specifications include the manufacturer's operating guidelines.

17.2.2.6 Verify that quality control analyses were performed at the required frequency and that QC acceptance criteria were met.

17.2.2.7 Determine whether an alternate method would be more appropriate and accurate for sample analysis.

The reason for the failure and the corrective action taken must be documented on the NCR and the NCR submitted to the corporate QA department for review and approval. Any additional comments or recommendations from the corporate QA department are recorded on the NCR in the reply section.

17.2.3 Audits

Any deficiencies identified during an audit must be documented in an audit report or Nonconformance and Corrective Action Report and submitted to the corporate QA department. The laboratory manager, QA/QC coordinator, supervisors, and key personnel are informed of the findings and involved in the corrective action process. Corrective action and a written corrective action response which includes documentation to support the implementation of the corrective action is required for each finding. Refer to SOP Nos. HC-QAC-G013 and HC-QAC-G012, respectively, for the reporting and corrective action procedures required for internal and external audits.

17.3 RESOLUTION OF COMPLAINTS

Any complaint received by Core Laboratories from a client or other party regarding a laboratories' activities shall be documented and a copy of the document distributed to the corporate QA director, laboratory manager, QA/QC coordinator and any other appropriate laboratory personnel. All complaints will be investigated and resolved in a timely manner to ensure that client requirements are met. Refer to SOP No. LB-GLO-G008 for Core Laboratories' policy and procedure for the resolution of complaints.

17.4 CLIENT SURVEYS

Monthly client surveys are conducted by each laboratory to evaluate their performance in meeting client requirements. Annual surveys are conducted by the corporate QA department to further evaluate client satisfaction. Clients are randomly surveyed to determine how well their requirements were met. Action is taken if any area is found to require improvement.

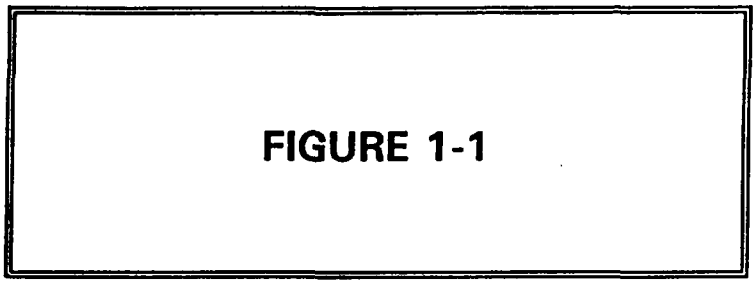


FIGURE 1-1

CORE LAB

CORE LABORATORIES
ETHICS AGREEMENT

I, _____, (print name), understand that high standards of integrity are required of me with regard to the duties I perform and the data I report in connection with my employment at Core Laboratories.

I agree that in the performance of my duties at Core Laboratories:

- I will not intentionally report data values that are not the actual values obtained;
- 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; and
- I will not intentionally report data values that do not meet established quality control criteria as set forth in the Method and/or Standard Operating Procedures, or as defined by Company Policy.

I agree to inform my Supervisor of any accidental reporting of non-authentic data by me in a timely manner.

I agree to inform my Supervisor of any accidental or intentional reporting of non-authentic data by other employees.

I have read this Ethics Agreement and understand that failure to comply with the conditions stated above will result in disciplinary action up to and including termination from the Company.

_____ (Signature)

_____ (Location)

_____ (Witness)

_____ (Date)

Received by Corporate QA on:

_____

FIGURE 2-1

CORELAB

ENVIRONMENTAL & PETROLEUM TESTING SERVICES

ORGANIZATIONAL CHART

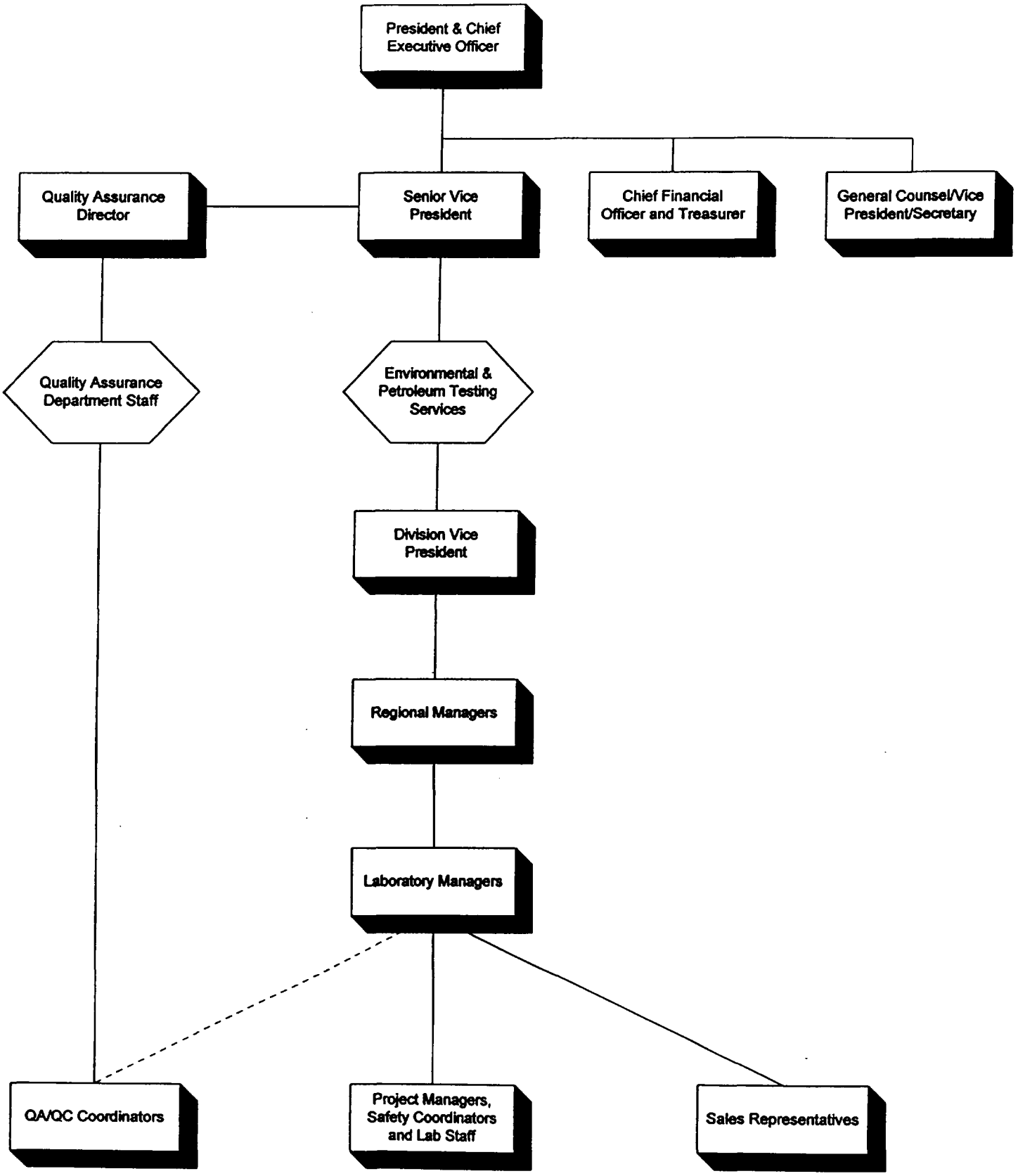
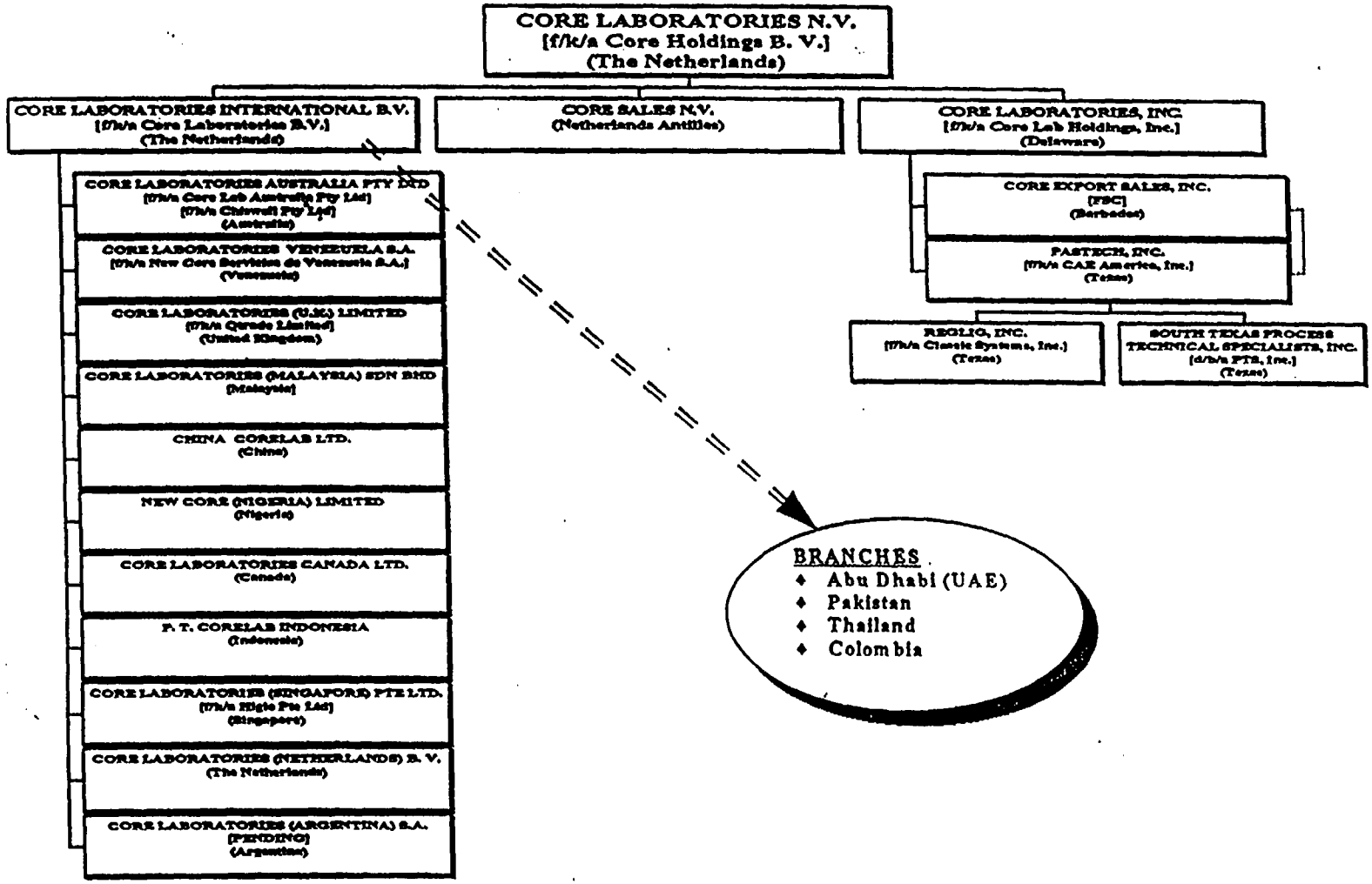


FIGURE 2-2

CORELAB

CORE LABORATORIES

WORLDWIDE ORGANIZATION CHART



10/4/95

FIGURE 2-3

CORELAB

ENVIRONMENTAL & PETROLEUM TESTING SERVICES

LABORATORY LOCATIONS DIRECTORY

UNITED STATES

LOCATION	ADDRESS	TELEPHONE NO.	FAX NO.
Anaheim, CA	1250 E. Gene Autry Way Anaheim, CA 92805	(714) 937-1094 800-404-2673	(714) 937-1170
Aurora, CO	10703 E. Bethany Drive Aurora, CO 80014	(303) 751-1780 800-972-2673	(303) 751-1784
Casper, WY	420 West 1st Street Casper, WY 82601	(307) 235-5741 800-666-0306	(307) 266-1676
Corpus Christi, TX	1733 North Padre Island Drive Corpus Christi, TX 78408	(512) 289-2673 800-548-8228	(512) 289-2471
Edison, NJ	284 Raritan Center Parkway Edison, NJ 08837	(908) 225-6700 800-924-2673	(908) 225-6777
Houston, TX (Corporate)	5295 Hollister Road Houston, TX 77040	(713) 460-9600	(713) 895-8982
Houston, TX (Environmental)	6310 Rothway Drive Houston, TX 77040	(713) 690-4444 800-946-4727	(713) 690-5646
Houston, TX (Petroleum)	8210 Mosley Road Houston, TX 77075	(713) 943-9776 800-734-2673	(713) 943-3846
Indianapolis, IN	7726 Moller Road Indianapolis, IN 46268	(317) 875-5894 800-641-2673	(317) 872-6189
Lake Charles, LA	3645 Beglis Parkway Sulphur, LA 70663	(318) 583-4926 800-259-4926	(318) 583-4929
Long Beach, CA	3700 Cherry Avenue Long Beach, CA 90807	(310) 595-8401 800-814-3433	(310) 427-5174
Valparaiso, IN	2400 Cumberland Drive Valparaiso, IN 46383	(219) 464-2389 800-688-6522	(219) 462-2953

INTERNATIONAL

Aberdeen	Kirkhill Industrial Estate Howe Moss Drive, Dyce Aberdeen, Scotland AB2 0ES	(44-1224) 723303	(44-1224) 770168
Calgary	1540 25th Avenue, N.E. Calgary T2E 7R2	(403) 250-4000	(403) 250 5120
Jakarta	Bldg. 303 Cilandak Commercial Estate Jalan Cilandak K.K.O. Jakarta, Selatan, Indonesia 12560	(62-21) 780-1533	(62-21) 780-2042
Kuala Lumpur	No. 17, Jalan U1/23, Section U1 HICOM, Glanmarie Industrial Park Shah Alam, Selangor Darul Ehsan Malaysia 4000	(60-3) 705-1188	(60-3) 705-2288
Maracaibo	Calle 25, Carretera Via el Mojan Parcelamiento Buena Vista Apartado 116, Maracaibo Estado Zulia, Venezuela	(58-61) 575484	(58-61) 910987

March 1997

"Providing Solutions for the Future"

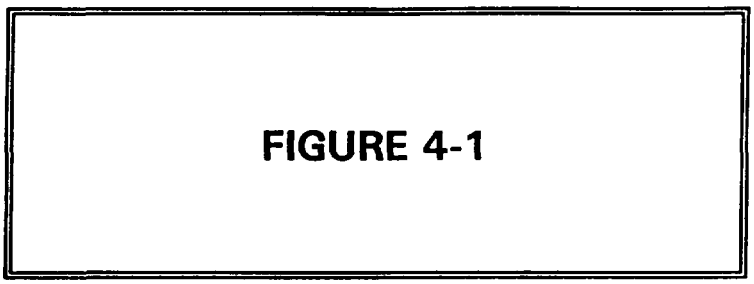


FIGURE 4-1

CORELAB

NEW EMPLOYEE ORIENTATION CHECKLIST

Location:_____ Employee:_____

ITEM	DATE ISSUED/COMPLETED
Introduction to Core Laboratories	
Laboratory Location and Contact Directories	
Employee Benefits and Pay Schedule	
Job Responsibilities	
Quality Assurance Orientation (See Corporate QA Checklist)	
Safety Training (See Safety Checklist)	
LIMS Training	
Sample Management Training	
Waste Management Training	
Analytical Method Training	
Proficiency Certification	
Client Confidentiality Requirements	
Other:	

Approved By:_____ Date Approved:_____

FIGURE 4-2

CORELAB

CORPORATE QA PROGRAM CHECKLIST
Employee Orientation

Location:_____ Employee:_____

DOCUMENT	DATE ISSUED/COMPLETED
Quality Policy and Analyst's Commitment to Quality	
Quality Goals for 1997	
Quality Assurance Program Description	
Quality Assurance Manual Summary	
Ethics Agreement (signed)	
Signature List (signed)	
Documentation and Record Keeping Requirements	
Environmental Analysis Survival Guide	
Environmental Analysis Method Summary	
Data Validation and Defensibility Guidance Manual	
Audit Guidelines	
Out of Control Event Report and Nonconformance and Corrective Action Report	

Approved By:_____ Date Approved:_____

FIGURE 14-1

QUALITY CONTROL SAMPLES

General Definitions, Purposes and Frequencies

The following document provides general definitions, purposes and frequencies for field blanks, laboratory blanks, standards, spikes and duplicates. Specific frequencies and acceptance criteria for Quality Control samples in the organic and inorganic analysis methods are provided in the Comparisons of QC Requirement Charts at the end of this section.

FIELD BLANKS

Field blanks are analyzed to measure and monitor contamination which might have been introduced during bottle preparation, bottle or sample shipment, and field activites. The contamination levels in field blanks should be less than the reporting limit for all analytes.

TRIP BLANKS

Definition: Trip blanks are sealed bottles or vials that contain laboratory reagent water and accompany samples during transit, collection, and storage.

Purpose: Trip blanks measure cumulative contamination derived from laboratory water, sample containers, sample site, and sample transit and storage.

Frequency: Trip blanks are normally provided for all volatile organics analyses at a frequency of one per shipment batch.

SITE BLANKS

Definition: Site blanks are the same as trip blanks except that the container is opened at the site where the samples are collected.

Purpose: Site blanks measure the same cumulative contamination which a trip blank measures but also include airborne background site contaminants.

Frequency: Project specific.

RINSATE BLANKS

Definition: Rinsate blanks are samples of laboratory reagent water or clean water which were used to rinse field equipment prior to sample collection.

Purpose: Rinsate blanks measure the cumulative contamination from the sample container rinse water, field sampling equipment, sample site, and sample transit and storage.

Frequency: Project specific.

DECONTAMINATION BLANKS

Definition: Decontamination blanks are samples of laboratory reagent water or clean water which were used to rinse field equipment after or between field sample collection sites.

Purpose: Decontamination blanks measure the cumulative contamination from the sample container rinse water, field sampling equipment, equipment contamination, sample site, and sample transit and storage.

Frequency: Project specific.

LABORATORY BLANKS

Laboratory blanks are analyzed to measure and monitor contamination introduced during laboratory storage, sample preparation, and analysis. The contamination levels in laboratory blanks should be less than the reporting limit for all analytes.

STORAGE BLANKS

Definition: Storage blanks are laboratory reagent water samples which are stored in the same type of sample containers and in the same storage units as field samples.

Purpose: Storage blanks are prepared, stored for a defined period of time, and then analyzed to monitor volatile organics contamination derived from sample storage units.

Frequency: One per sample batch or as per method specifications.

INSTRUMENT BLANKS

Definition: Instrument blanks are laboratory reagent water samples which are analyzed at the beginning, during and end of an analytical run.

Purpose: Instrument blanks measure instrument contamination and indicate if corrective action is needed prior to proceeding with sample analysis.

Frequency: Instrument blanks are normally analyzed once per analytical batch of samples or as needed.

CALIBRATION BLANKS

Definition: Calibration blanks are laboratory reagent water samples which are analyzed at the beginning of the analytical run (initial calibration blank), and during and at the end of the analytical run (continuing calibration blank).

Purpose: Calibration blanks verify the calibration of the analytical system and measure instrument contamination or carryover.

Frequency: As per method specifications.

METHOD BLANKS

Definition: Method blanks (also referred to as preparation blanks) are laboratory reagent water samples or solid material which contain all of the method reagents which have been introduced into the field samples and are processed through the same sample preparation and analysis procedures.

METHOD BLANKS (cont.)

Purpose: Method blanks measure the combined contamination from laboratory reagent water or solid material, method reagents, and the sample preparation and analysis procedures. The measured analyte concentrations in method blanks should be less than the reporting limit for each analyte.

Frequency: Method blanks are typically analyzed once per batch of samples or at a rate of 5-10% of the sample population, depending on the method specifications.

REAGENT BLANKS

Definition: Reagent blanks are laboratory reagent water samples containing all of the method reagents except the color forming reagent.

Purpose: Reagent blanks are used in certain spectrophotometric/colorimetrictric analyses to zero instruments or blank correct.

Frequency: One per batch or as per method specifications.

INSTRUMENT CARRYOVER BLANK

Definition: Instrument carryover blanks are laboratory reagent water samples which are analyzed after a high-level sample.

Purpose: Carryover blanks measure instrument contamination which may occur after analyzing highly concentrated samples. This type of blank is often used to decontaminate the instrument prior to continuing with sample analysis.

Frequency: As needed, when high level samples are analyzed.

NOTE: Refer to the Comparison of QC Requirements charts for method specific frequency and acceptance criteria for laboratory blank analyses.

STANDARDS

Standards are analyzed to measure the accuracy of laboratory analyses. Performance criteria for specific standard types are provided in the applicable analytical method.

CALIBRATION STANDARDS

Definition: Calibration standards are a series of standards that contain known concentrations of the target analytes.

Purpose: Calibration standards define the working range and linearity of the analytical method and establish the relationship of the instrument response to the target analyte concentration used to quantify field samples.

Frequency: As per method specifications.

REFERENCE STANDARDS

Definition: Reference standards are standards of known analyte(s) and concentration obtained from an independent source (EPA, NIST, etc.) than the standards which are used for instrument calibration.

Purpose: Reference standards are used to verify the accuracy of the calibration standards.

Frequency: At a minimum, reference standards should be analyzed after each initial calibration or as per method specifications.

QC CHECK SAMPLES/LABORATORY CONTROL STANDARDS (LCS)

Definition: QC check samples/LCSs are standards of known analyte(s) and concentration which are added to an interference-free matrix, such as laboratory reagent water or solid material, and carried through the same preparation and analysis procedures as the field samples.

Purpose: This technique isolates laboratory performance from field sample matrix related effects and measures the accuracy of the analysis in a blank sample matrix.

Frequency: QC check samples/LCSs are typically analyzed once per analytical batch of samples or as per method specifications.

NOTE: Refer to the Comparison of QC Requirements charts for method specific frequency and acceptance criteria for standard analyses.

SPIKES

Spikes are analyzed in order to measure the recovery of known analytes in a sample or blank matrix. Performance criteria for spike recovery are provided in the applicable analytical method.

MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Definition: Matrix spikes and matrix spike duplicates are two separate field sample aliquots which are spiked with target analytes at known concentrations prior to sample preparation and analysis.

Purpose: Matrix spikes and matrix spike duplicates measure the recovery of analytes in a specific sample matrix and are used to indicate matrix interference problems. Matrix spike duplicate analyses measure the laboratory precision achieved between two separate analyses.

Frequency: Where applicable, matrix spikes should be analyzed once per sample batch or as per method specifications.

BLANK SPIKES

Definition: Blank spikes are prepared from laboratory reagent water or solid material which is spiked with target analytes at known concentrations prior to sample preparation and analysis.

Purpose: Blank spikes are used to determine the percent recovery of target analytes in an interference-free matrix and to measure the efficiency of all steps of the sample preparation and analysis procedures.

Frequency: Blank spikes are primarily analyzed when sufficient field sample volumes are not provided for matrix spiking or as per method specifications.

INTERNAL STANDARDS - ORGANICS ANALYSIS

Definition: Internal standards are non-target analytes of known concentration which are added to organic samples following sample preparation but prior to instrument analysis.

Purpose: Internal standards are used to measure the efficiency of the instrumentation in quantifying target analytes and for performing calculations by relative response factors.

Frequency: All samples, standards and associated quality control.

SURROGATE SPIKES - ORGANICS ANALYSIS

Definition: Surrogate spikes are non-target analytes of known concentration which are added to organic samples prior to sample preparation and instrument analysis.

SURROGATE SPIKES - ORGANICS ANALYSIS (cont.)

Purpose: Surrogate spikes are used to measure the efficiency of all steps of the sample preparation and analytical method in recovering target analytes from the sample matrix. It is assumed that the non-target surrogate compounds behave identically to the target analytes in the method.

Frequency: All samples, standards and associated quality control.

METHOD OF STANDARD ADDITION (MSA)

Definition: The method of standards addition involves the analysis of a series of field samples which are spiked at increasing concentrations of the target analytes.

Purpose: This method of standard addition provides a mathematical approach for quantifying analyte concentrations when martix interferences are present.

Frequency: Perform the method of standard additions for all EP Toxicity samples and as needed for FLAA, GFAA, and ICP analyses when spike recoveries are outside the method specified QC acceptance limits or as specified by the analytical method.

FIELD SAMPLE SPIKES

Definition: Field sample spikes are samples which have been spiked with known amounts of target analytes in the field prior to shipment to the laboratory.

Purpose: Field sample spikes are submitted as "double-blind" quality control samples to measure the recovery of the target analytes for both field and laboratory procedures.

Frequency: Project specific.

NOTE: Refer to the Comparison of QC Requirements charts for method specific frequency and acceptance criteria for spike analyses.

DUPLICATES

Duplicates are analyzed in order to measure the precision of the analyses. Duplicate analyses for homogenous samples should be within the method specified QC limits.

FIELD DUPLICATES

Definition: Field duplicates are duplicate field samples which are collected in separate containers under similar field sampling conditions.

Purpose: Field duplicates are performed to measure the precision of both field and laboratory procedures.

Frequency: Project specific.

LABORATORY DUPLICATES

Definition: Laboratory duplicates are two separate sample aliquots taken from the same field sample that are processed separately through the sample preparation and analysis procedures.

Purpose: Laboratory duplicates are used as a cumulative measure of laboratory analytical precision and non-homogenous sample matrix effects.

Frequency: Laboratory duplicates should be analyzed once per batch of samples or at a rate of 5-10% of the sample population, or as per method specifications.

LABORATORY REPLICATES

Definition: Laboratory replicates are repeated analyses of a single field sample aliquot that has been prepared by the same sample preparation procedure.

Purpose: Laboratory replicates measure the repeatability of the sample analysis.

Frequency: As needed.

SPLIT SAMPLES

Definition: Split samples are separate aliquots of a sample taken from the same field site and submitted to two or more independent laboratories for analysis.

Purpose: Split samples measure the reproducibility of the analysis.

Frequency: Project specific.

NOTE: Refer to the Comparison of QC Requirements charts for method specific frequency and acceptance criteria for duplicate analyses

FIGURE 17-1

CORELAB

OUT-OF-CONTROL EVENT REPORT

Location _____ Job No./Samples _____

Parameter _____ Method _____

Date Occurred _____ Completed by _____ Date _____

OUT-OF-CONTROL EVENT

SAMPLE ANALYSIS

____ Holding time missed
____ Surrogate % recovery not within QC limits
____ Calculation error
____ Reporting error

CALIBRATION

____ Initial calibration not within QC limits
____ Calibration verification not within QC limits

QUALITY CONTROL ANALYSES

____ Blank value not within QC Limits
____ LCS % recovery not within QC limits
____ Spike % recovery not within QC limits
____ Duplicate RPD not within QC limits
____ Reference standard not within QC limits

OTHER (Explain)

_____

_____

_____

CORRECTIVE ACTION

____ Recalculate/report sample results
____ Reanalyze sample(s)
____ Redigest/reextract and reanalyze sample(s)
____ Perform method of standard additions
____ Repeat QC analysis
____ Repeat calibration
____ Prepare new standards
____ Perform instrument service

OTHER (Explain)

_____

_____

_____

RESOLUTION

_____

_____

_____

_____

APPROVED BY: Case Narrative Required: ____ Yes ____ No

Laboratory Supervisor/Manager _____ Date _____

QA/QC Coordinator _____ Date _____

FIGURE 17-2

CORELAB

NCR No. _____ Page _____ of _____

NONCONFORMANCE AND CORRECTIVE ACTION REPORT

PRIORITY	1	2	3	4

Reference No.	*Finding No.*	*Subject*

1. FINDING

2. REQUIREMENT/RECOMMENDED ACTION

Completed by	*Date*

3. CORRECTIVE ACTION RESPONSE

Completed by	*Date*	*Approved by*	*Date*	*Implementation Date*

4. REPLY *Corrective Action:* ☐ *Acceptable* ☐ *Not Acceptable* ☐ *Further Action Needed*

Approved by	*Date*

1. Serious Deficiency - Immediate Action Required
2. Major Deficiency - Action Required
3. Minor Deficiency - Action Required
4. Recommendation for Improvement