4-402.21

QUALITY ASSURANCE PLAN 1808
FOR SILOS 1 AND 2
PROOF OF PRINCIPLE TESTING

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Prepared for:

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Fernald, Ohio

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Record of Issue/Revision

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Date	Rev.	Description of Issue/Revision
3/20/98	A	Initial draft submittal for FDF comment
7/15/98	B	Revision for submittal to FDF
8/26/98	C	Revision for submittal to FDF comments

List of Acronyms/Abbreviations

ACA	Amended Consent Agreement
ALARA	as low as reasonably achievable
ARAR	applicable, relevant, and appropriate requirements
CAR	Corrective Action Request
CAT	construction acceptance testing
CEM	continuous acceptance testing
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFC	certified for construction
CFR	Code of Federal Regulations
CHP	Certified Health Physicist
COC	constituents of concern
CONOPS	Conduct of Operations
CPM	critical path method
CRP	Community Relations Plan
CSXT	CXS Transportation, Inc.
D&D	decontamination and dismantlement
DAC	derived air concentration
DBO	design, build, and operate
DOE	U.S. Department of Energy
DOE-FEMr	U.S. Department of Energy-Fernald Environmental Management Project
DOE-OH U.S.	Department of Energy- Ohio Field Office
DQA/QC	Director Quality Assurance/Quality Control
EPA	U.S. Environmental Protection Agency
ERWM	Environmental Restoration and Waste Management
ETDL	Environmental Technology Development Laboratory
FAR	Federal Acquisition Regulations
FAT&LC	Fernald Atomic Trades & Labor Council
FDF	Fluor Daniel Fernald, Inc.
FEMP	Fernald Environmental Management Project
FERMCO	renamed Fluor Daniel Fernald, Inc.
GC	gas chromatograph
GWTS	groundwater treatment system
H&S	health and safety
HASP	Health and Safety Plan
HAZWOPI	hazardous waste emergency response operations
HTRW	hazardous, toxic, and radiologic waste
HTTS~	Hybrid Thermal Treatment System
IT	IT Corporation
ITEMS~	IT Environmental Database Management System
LEU	low-enriched uranium
LLRW	low-level radioactive waste
mrem/hr	millirem(s) per hour
NCR	Nonconformance Report
NEPA	National Environmental Protection Act.
NRC	U.S. Nuclear Regulatory Commission
NTP	Notice to Proceed
O&M	operation and maintenance
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OSDF	on-site disposal facility
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OUI	Operable Unit No. 1, renamed Waste Pit Remedial Action Project
OU2	Operable Unit 2
OU3	Operable Unit 3
OU5	Operable Unit 5
PCDF	permitted commercial disposal facility
PR	Procurement Requisitions
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician(s)
RD	remedial design
ROD	Record of Decision
RSR	radiological safety requirements
RWP	Radiation Work Permit(s)
SAR	Safety Analysis Report
SARA	Superfund Amendment & Reauthorization Act of 1986
SCC	secondary combustion chamber
SCQ	Sitewide CERCLA Quality Assurance Plan
SDB	small disadvantaged business
SOP	Standard Operating Procedures
SOW	statement of work
SQP	Standard Quality Practices
TCLP	toxicity characteristic leaching procedure
TTF	thermal treatment facility
VOST	volatile organic sampling train
WAC	waste acceptance criteria
WBS	work breakdown structure
WPRAP	Waste Pits Remedial Action Project (aka OU1)
WWTF	wastewater treatment facility

INTRODUCTION

This Quality Assurance Plan (QAP) describes the program through which International Technology Corporation (IT) will comply with the Quality Assurance (QA) requirements set forth for Silos 1 and 2 Proof of Principle Testing. The QA Program documented by this plan defines the development of procedures and practices to achieve the standards of quality prescribed for the project. The QAP will be implemented through the use of existing IT procedures, plans, and practices and documents developed to address specific project activities.

The authority for the implementation and enforcement of this QAP is retained by the Senior Management of IT. The administration and project implementation is delegated to the project management. The authority and responsibilities for the activities are described in further detail in Chapter 1.0 of this QAP. IT Senior Management is responsible for establishing and cultivating principles to integrate quality requirements into the daily work which will provide the associates performing the work with proper information, tools, and support to effectively perform their assigned tasks.

All personnel performing quality related work for this project are expected to be familiar with the QAP through indoctrination and training, and to adhere to these requirements during the performance of their work.

This plan defines the quality management system to be used in performing work under this contract to meet the specified quality requirements. The methods for meeting these requirements and best management practices are provided in this document. Elements responding to source requirements are stipulated by use of "will" or "shall." Those elements are the minimum criteria for complying with source requirements. Practices intended to improve performance are stated as "should" or "may." These are internally determined practices that are not required by outside sources.

IT's Corporate Standard Practices are referenced in the applicable sections throughout this plan. The Table of Contents for this document is provided in Appendix A. A complete set of these procedures will be available at the IT project office on site.

It is the policy of IT to provide construction, remediation, and environmental management services of a quality that meets or exceeds the technical needs of the client and meets applicable regulatory requirements, while maintaining a clear customer focus. IT shall implement the quality management program described in this document for all IT activities so that work is performed in an efficient, controlled manner and is appropriately documented. Requirements of the program shall be applied on a graded approach, based on the potential impact on the safe and reliable operation of the project, risk of failure of the items or processes and the potential harm those risks pose for human health and the environment. Activities shall conform with applicable federal, state, local, and contract requirements.

Quality will be part of the normal course of work and incorporated in planning during the earliest stages. All personnel are responsible for the quality of their work. Quality verification of work is the responsibility of line management. Assessment of work processes and the quality system is the responsibility of IT Management and Quality Assurance (QA) through review, surveillance, inspection, assessment, and audit.

1.1 PURPOSE

This QAP has been prepared to provide the planning and control necessary for effective and efficient work processes. This plan documents the overall QA Program to be implemented and the general quality practices to be followed by IT and IT subcontractors during the performance of the contract. The organization, responsibilities, and authorities of personnel directly responsible for the implementation of this plan shall be described and include the relationships and interfaces of project personnel including subcontractors and suppliers. This plan defines the program elements to determine that the quality of items and processes are commensurate with the importance of the work performed and the achievement of project goals.

1.2 SCOPE

This QAP applies to all activities performed by IT or subcontractors to IT in support of Silos 1 and 2 Proof of Principle Testing which affect the quality of items or operations of the project. The objective of this QAP is to establish a graded system of controls based on the relative importance and complexity of the processes being implemented and which, when implemented, will provide an effective program to achieve the quality levels specified for the project.

1.3 QUALITY MANAGEMENT

This QAP provides procedures, practices, and objectives for meeting the quality goals set forth for the project, and is endorsed and supported by senior management. The Director Quality Assurance/Quality Control (QA/QC) will retain the responsibility for the execution of the QA Program and implementation of this QAP.

The responsibility for enforcing the implementation of this QAP is delegated by senior management to the project QA Manager (QAM) who shall:

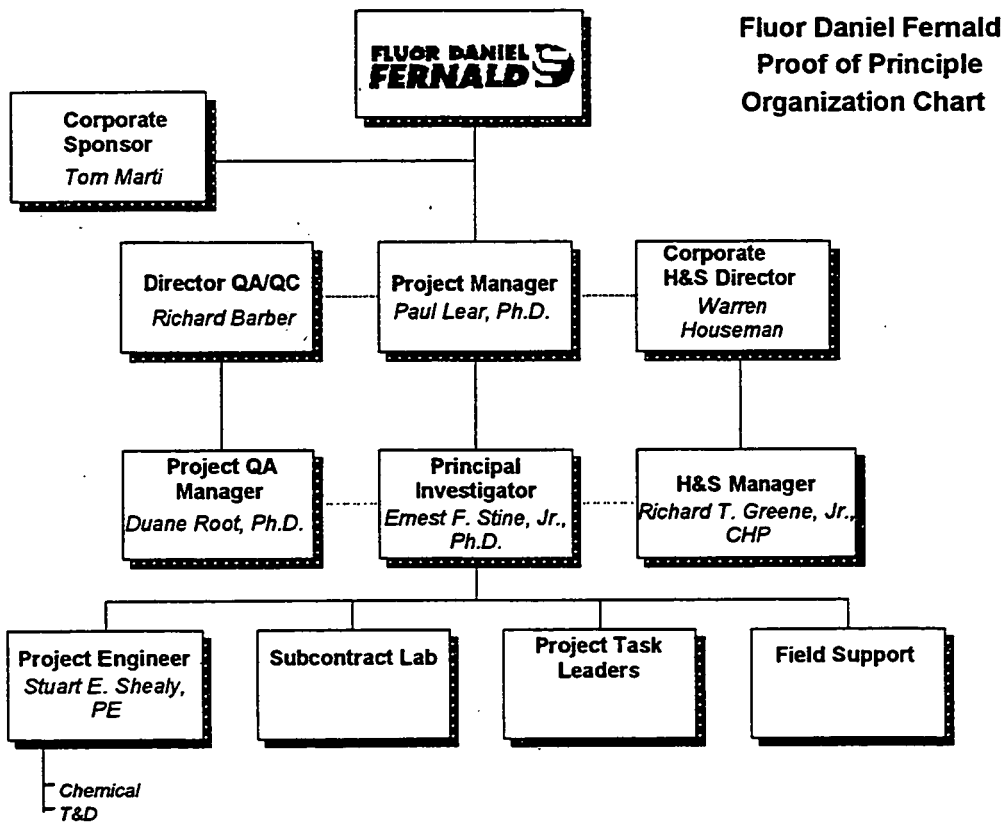
- identify quality problems
- recommend resolutions for problems
- verify resolutions have been correctly implemented
- ensure appropriate corrective actions to preclude recurrence of any problem

This QAP is part of a Quality Program which provides the guidance, practices, and objectives for meeting the goals set forth for the project. This QAP is supplemented using Standard Quality Practices (SQP) and Standard Operating Procedures (SOP) which, together with this QAP, constitute the overall project Quality Management Program. Additional SQPs and SOPs will be developed specifically for this project by the Project Team as required. The project QA Manager and Project Manager will evaluate the work to be performed in order to select the appropriate procedures required to perform and verify the work. When necessary, they will develop additional documents to cover specific work elements.

1.4 ORGANIZATION

The organizational structure and individual position responsibilities are provided in Figure 1.1. It should be noted that where a specific responsibility or duty is designated, that duty is the assigned responsibility for that position. The actual task may be properly delegated to other individuals but the responsibility will remain as shown in this Plan. The organization provides for the independence of the QA organization from those personnel responsible for performing work. The QA staff will maintain a close working relationship with project management, keeping them advised of the quality requirements and situations which, if not corrected or controlled, may adversely affect the project. A brief description of the responsibilities and authority of the key project personnel as related to quality, is provided in the following sections.

Figure 1.1



1.4.1 Project Manager

The Project Manager, Dr. Paul Lear, is responsible and accountable for the overall management and operation and will serve as the focal point and main channel of communication between Fluor Daniel

Fernald (FDF) and IT. Specific responsibilities include development and management of systems to implement project policies, monitor schedule and cost, coordinate reporting, determine availability of resources, identify and resolve potential problems or conflicts, verify safe performance and quality work, and enforcement of compliance to planning documents, which includes the QAP, to achieve the specified quality levels for the project. Responsibilities of the Project Manager include:

- Receive, negotiate, and track project performance.
- Planning and preparation for all project activities.
- Assign supervisory personnel to direct specific tasks and provide the necessary resources to these personnel.
- Enforcement of environmental and health and safety procedures.
- Approve and consistently implement the various program work instructions.
- Assess the program for compliance with regulations, laws, and orders from federal, state, and local authorities in addition to specific facility orders and directives.
- Maintain regular contact with FDF management to provide up-to-date information regarding IT's progress, projected work loads, schedule status, and potential problem areas.
- Disseminate program-related information from FDF and others outside organizations.
- Initiate change control, as appropriate.
- Initiate corrective actions to resolve nonconforming conditions.
- Procure, in conjunction with Contract Administration personnel, and supervise major program subcontractors.
- Report any significant conditions adverse to quality to FDF and obtain a resolution.
- Review QA audit reports and initiate corrected actions for any nonconformance(s) discovered.
- Review, approve, and implement project-specific plans (e.g., Work Plans and QAPs).
- Provide training to allow project personnel to perform assigned tasks.
- Determine the effects of changes and nonconformances on the project.
- Stop work and initiate corrective action whenever continuation of work could result in personnel injury, damage to essential items, or violation of critical work requirements.

1.4.2 Principal Investigator Manager

The Principal Investigator. Dr. Ernest Stine, reports to the IT Project Manager and is responsible for the day-to-day oversight of operations. He will verify that the operation is being conducted in a safe, efficient, and quality manner which is consistent with the approved work plans, procedures, and industry

practices. He will be responsible for ensuring that project resources (field personnel, equipment, and subcontractors) are adequate and correctly deployed to maintain the project schedule. The Principal Investigator will:

- Report to the Project Manager on the status of project task and subtask completion.
- Manage and oversee the day-to-day activities of the subcontracted IT laboratory. Assimilate, review, and submit routine survey results consistent with FDF specifications and reporting requirements.

1.4.3 Director, Quality Assurance/Quality Control

The Director, Quality Assurance/Quality Control (DQA/QC), reports directly to the Vice President, Quality Services and is responsible to provide overall support and direction for the project QA program. He or his designee is responsible for:

- Interface with the project manager, project QA Manager, and other project staff members to resolve quality concerns or problems and recommend quality improvements as appropriate.

1.4.4 Project Quality Assurance Manager

The project Quality Assurance Manager (QAM), Dr. Duane Root coordinates the QA activities through the Project Manager. The QAM is responsible for implementing the QAP for all project activities. The IT QAM is the lead QA function representative for FDF work and is responsible for the implementation and maintenance of this plan. The QAM will provide the day-to-day supervision and guidance necessary to provide QA functional support. The QAM has the authority to identify quality problems, recommend and/or initiate solutions, provide that nonconformances are controlled and proper disposition is obtained, and verify the implementation of corrective actions. Duties include:

- Evaluate potential subcontractors and review technical procurement documents for project subcontracted items and services.
- Provide guidance on quality issues during project planning.
- Review and approve project-specific QAPs and work instructions.
- Provide QA orientation and training to IT and subcontractor personnel.
- Review project technical changes for quality requirements.
- Identify and document nonconforming items and activities. Recommend solutions and verify implementation of corrective actions.
- Verify that the review of inspection and testing data for compliance with specified requirements is performed.
- Interface with FDF QA personnel.
- Review and monitor project document control and records management systems

- Coordinate and perform assessments such as audits, inspections, and surveillance of project activities for compliance with the approved planning and performance documents.
- Provide indoctrination and training in quality assurance aspects to project personnel.
- Review and concur with dispositions to correct nonconforming items and activities.
- Review of inspection and testing data for compliance with specified requirements.
- Report status and effectiveness of the quality program to project management.
- Stop or control further processing on unsatisfactory work, or use of nonconforming, items until satisfactory resolution is achieved.

1.4.5 Health and Safety Manager

The IT Health and Safety (H&S) Manager, Rick Greene, is responsible for the development and implementation of the program health and safety plan and the control of associated activities during Proof of Principle testing. The responsibilities include organization of project staff, assigning duties and responsibilities, and providing guidance to the project staff so they can safely perform their functions in accordance with the project H&S provisions, federal and state regulations, laws, and orders; and Department of Energy (DOE) requirements. Specific position duties include the following:

- Interface with FDF Health and Safety personnel
- Health and safety training and medical health monitoring
- Oversee development and review and approve any Project-specific H&S provisions
- Perform field and facility safety inspections and audits and verify resolution of any resulting corrective action.

1.5 COMMUNICATIONS

A system for communicating necessary direction and information will be employed for efficient Proof of Principle Testing. This system will cover IT interfaces with the FDF, regulatory agencies, and IT subcontractors. This section discusses the general method for operating this system.

1.5.1 Communication Among IT, FDF, and Subcontractors

Communications may be received from FDF by IT personnel or an IT subcontractor at many levels within the program. While most formal instructions and directives are received by the Project Manager or Contract Administrator, less formal communications received may have impact on other aspects of the program. Communications will be documented and the information shared with those affected by that information.

Interfaces between IT and IT subcontractors will be established prior to the start of subcontractor work. Requirements for subcontractor performance, supplied items, and/or documentation shall be detailed in purchase orders or subcontracts.

1.5.2 Correspondence Control

Incoming program-related correspondence will be routed to the Project Manager after the original is marked with the date received by the recipient or an individual assigned to this duty. The Project Manager should then determine which personnel should review the incoming materials and route a copy of the information accordingly. In a similar fashion, incoming individual project-related correspondence should go to the appropriate Manager for review and routing. Critical project material should also be routed to the Project Manager. The responsible manager will enter the appropriate project identification on the correspondence prior to distribution or filing.

As soon as practical, incoming correspondence originals will be placed in the appropriate filing system (see Chapter 4 of this document). If the correspondence is required by personnel for reference, a copy should be made. Correspondence that is addressed to project personnel, but addresses quality issues will be routed to the QAM.

Project-related correspondence prepared by IT and transmitted outside of IT will be appropriately reviewed and approved prior to transmittal. Outgoing correspondence will be signed by the Project Manager.

1.6 MANAGEMENT SYSTEMS

Work performed through IT is subject to an established management system. This system requires proper planning, scheduling, and cost control for all work to be performed in support of the contract. Control and changes of technical baseline, schedule, and cost control activities shall be performed in a controlled and systematic manner that is compliant with FDF systems.

1. 7 PROJECT PLANNING

Work will be planned for the most effective and efficient achievement of objectives. Client deliverable development efforts will be periodically reviewed to assure that interim milestones have been accomplished.

Project planning meetings will be conducted on a periodic basis. Managers shall provide project status information, determine objectives, discuss project schedules, consider resource needs, and determine personnel responsibilities for the completion of activities.

Planning meeting information shall be disseminated to all project staff. Personnel assigned to a task or activity will be briefed on the purpose of the task, the expected outcome, and scheduling considerations. Resource needs shall be discussed and feedback information shall be encouraged and considered by Managers.

1.8 STOP WORK ORDERS

The QAM is delegated by senior IT management to stop or control further processing of items or activities. A Stop Work Order (SWO) shall be issued to the Project Manager for action when continuing work may result in:

- Failure to adequately control the processing, delivery, installation, modification, or operation of a nonconforming item

- Serious failure or breakdown of the QA Program
- Significant hazard to those items or activities that are important to H&S, the environment, or the mission of the project.
- Repetitive nonconforming conditions.

Resumption of work shall begin only upon completion of the necessary actions specified on the SWO and with approval of the Project Manager, the QAM, and notification to FDF. SWOs initiated for H&S reasons will be processed in accordance with the HASP and shall require the approval and signature of the H&S Manager. Based on the significance of the operation to safety, health, environmental or quality issues associated with the original startup review process, SWOs may also require the initiation and completion of a standard startup review.

2.0 TRAINING AND QUALIFICATION 1808

The appropriate personnel qualifications and training are essential to the achievement of quality. IT Management shall verify that personnel are qualified and knowledgeable in the activities they are assigned to perform. Training will focus on performing the job correctly the first time and explaining potential consequences of improper work. The training program shall be periodically reviewed to determine program and instruction effectiveness and shall be upgraded when deemed necessary.

The Project Manager and Principle Investigator are responsible for the assignment, supervision, and qualifications of the personnel performing the formulation development and demonstration testing procedures and chemical analyses associated with the Proof of Principle testing. Procedural qualification is documented in the individual's training records. All laboratory personnel receive continuous training on laboratory procedures, QA/QC, and laboratory safety. Weekly laboratory safety/staff meetings are held where current project requirements and QA issues are reviewed.

2.1 RESPONSIBILITIES

The responsibilities for personnel training and qualification include the following:

Project Manager: The Project Manager is responsible for the development and implementation of the project training program and for verifying that tasks are performed by personnel that have been qualified through experience, education, and training to perform their assigned tasks. The responsibilities also include evaluation of the training procedures to determine that it is adequate for preparing the individuals to perform the work.

Responsible Supervisory Personnel: It is the responsibility of supervisors to determine that each individual who works in their area is qualified to perform the work assigned. Management is responsible for determining the extent of and need for training based upon the scope, complexity, and nature of the activity to be performed as well as the education, experience, and proficiency of the personnel involved. Personnel will be provided with the fundamentals of their assigned work and an understanding of the associated quality requirements.

Project Personnel: All project personnel will attend the training required for all site personnel and training specific to the work to be performed. Operation of equipment or performance of work will not be permitted until the required training has been completed. All training will be documented, and training records will be maintained.

Quality Assurance Manager: The Project QAM is responsible for reviewing the qualifications of personnel performing quality-related functions to verify that they have the required experience, education, and training to perform their assigned tasks. The QAM is also responsible for verifying that the documented evidence is available to support the education, experience, and training of each individual. In addition, the QAM will perform surveillance and audits of the training activities to verify that training is maintained current and that training records are available.

Training Instructors: Training instructors may be project employees, support personnel, or contracted instructors. The Project Manager and the QAM will review the qualifications of the instructors to verify that they are properly qualified to perform the training, including knowledge of the technical requirements for the work, experience in the activities involved in the training, course development, instructional skills, and (when required) applicable certification.

2.2 PERSONNEL QUALIFICATIONS

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Quality-related activities will be performed by personnel qualified on the basis of education, experience, and training. Personnel qualifications will be documented by resumes, employment applications, academic credentials, employment history, professional registrations/certifications, and training records. General and specific training for the work activities to be performed is required to verify that each employee is qualified and capable to perform their assigned tasks.

2.3 TRAINING PROGRAMS

The goal of training is to provide the knowledge and skills required to perform specific tasks. Training shall be provided to achieve initial proficiency, maintain proficiency, and allow personnel to adapt to changes in technology, methods, or job function. Training identified in the plans shall be designed to prepare the employee to perform assigned work. Personnel performing work that requires special skills or abilities or training that is legally required shall be qualified prior to performing the work. Certification will include demonstrated proficiency. Retraining may be required when it is determined that the personnel performing the activities requiring training are not performing adequately or if discrepancies are identified in the training records.

Training will be developed to cover all phases of the work and will be commensurate with the complexity of the activities being performed. Training methods may include formal classroom, required reading, on-the job training, or any combination of these methods. Training procedures will be reviewed and approved by qualified IT personnel and, when required by the contract, submitted to FDF for review and approval.

The project QAM will perform audits and surveillance of training procedures to verify the continuing effectiveness of the training activities. If it is determined that the training is not meeting the required goals, corrective actions (which may include revision of the training procedures or replacing the instructor) will be initiated.

2.3.1 Indoctrination/Orientation

Employee indoctrination/orientation involves briefings, lectures and/or reading assignments to become familiar with programmatic and work-related documents, policies, and requirements applicable to assigned activities. The indoctrination/orientation program will provide new employees with the necessary information for assimilation into the IT organization. Orientation training shall be performed in accordance with SQP ITEES0003, Quality Assurance Training for Environmental Engineering and Services Associates.

Individual support organizations are responsible for developing indoctrination programs within their areas of responsibility (i.e., QA, H&S). Based upon assigned duties, personnel will be provided with the instructions necessary to perform their assigned activities. Management will determine the appropriate documents for review and study, and issue employees required reading assignments. This indoctrination should include the scope of work, QA/QC compliance requirements, and applicable work instructions.

2.3.2 Formal/Informal Training Programs

Formal training programs will address specific needs and take the form of group classroom instruction, individual instruction, or video presentations. Course development will include selecting the appropriate level of materials to be presented and the most effective instruction methods for the materials. A course

outline describing the objectives and course material will be developed. Training will be conducted by qualified instructors based upon their technical knowledge, experience, and communication ability. Informal training consists of individual instruction or group sessions, organized to instruct or discuss a specific topic. Both types of training will be documented with an attendance sheet providing the names of the attendees, the trainer and the topics covered.

2.3.3 On-the-Job Training

On-the-job training will be conducted and evaluated in the work environment under the direction of experienced personnel who are qualified to perform the task. The subject of the training and expected performance level will be defined. Any work performed by a trainee will be under the supervision of a qualified individual until proficiency has been demonstrated. On-the job training will be documented on a Training Evaluation Standard and placed in the individual's training file.

2.3.4 Project Specific Training

Project-specific training will be conducted and documented on both the Work Plan and the QAP to ensure that all employes working on the project fully under stand their responsibilities.

2.3.4.1 Work Plan Training

Prior to beginning work on the project, IT employees will be given a copy of the Work Plan. After the IT employee has read the Work Plan and has been given a chance to discuss the Work Plan with a member of the Project Team, the IT employee will sign a documentation sheet verifying that he/she has read the Work Plan and understands how it applies to his/her work.

2.3.4.2 QAP Training

Prior to beginning work on the project, IT employees will also be given a copy of the QAP. After the IT employee has read the QAP and has been given a chance to discuss the plan with a member of the Project Team, the IT employee will sign a documentation sheet verifying that he/she has read the QAP and understands how it applies to his/her work.

2.4 TRAINING

Personnel training will be documented and maintained as a project record. The project-specific training matrix is presented in Table 2.1. The project QAM will perform surveillance and audits of the training records to verify that all personnel performing specific tasks requiring training have received the proper training and that the training records are current. If discrepancies are identified within the records, corrective actions will be initiated, including retraining if deemed necessary.

When the tasks being performed require certification, the Project Manager is responsible to provide the individual(s) with training prior to the performance of the work requiring the certification. Certifications will be maintained as a project record, subject to surveillance and audit as described for the training records.

Table 2-1
Project-Specific Training Matrix

Labor Category	Work Plan Training	QA Plan Training	Project-Specific Procedures	
			Formulation Development	Demonstration Testing
Project Team	x	x	x	x
Chemists	x	x	x	
Operators	x	x		x
Office Support	x	x		

2.5 TRAINING RECORDS

Qualification and training records shall be maintained for each employee. The training records will be controlled, stored, and handled in accordance with Chapter 4.0 of this QAP and SQP IT EES0007, Record Control, Status and Retention. Training records shall include all documents that establish the employees capabilities, including outside training and training performed by FDF, or other approved training organizations.

2.6 TRAINING PROGRAM ASSESSMENT

The Training Program will be evaluated periodically to determine the effectiveness of the program and instruction. If it is determined that the program content, instructor capabilities, or other conditions require changes, the program will be updated. At a minimum, the Training Program will be reviewed as part of the Management Assessment.

3.0 QUALITY IMPROVEMENT

IT management will institute a program that focuses on continuous improvement of the products and services provided by the IT office with emphasis on the processes that generate products and deliver services. This program is established to prevent, as well as detect and correct, problems that adversely affect quality during all phases of technical, construction, remediation, and management activities.

3.1 IMPROVEMENT AND PROBLEM IDENTIFICATION

It is the responsibility of all IT personnel to evaluate activities and items used within the program, to verify that each meets specified requirements, and to identify and report nonconforming conditions. It is the responsibility of managers and supervisors at all levels to understand the need for prompt reporting of nonconforming conditions. Nonconforming conditions may be reported in various formats such as nonconformance reports, (Figure 3.1) surveillance reports, and Corrective Action Requests (CAR). Nonconforming conditions will be tracked, trended, and corrected to resolve the nonconforming condition(s) and prevent recurrence. Nonconformance reports, surveillance reports and CAR will be included in the project records. FDF will also be notified as to nonconforming conditions.

It is equally important to identify and report process improvements and efficiencies. Successful techniques and operations will be evaluated to determine the potential for performance improvements in other areas or projects.

3.1.1 Root Cause

A root cause is the most basic element that, if corrected, will prevent recurrence of the same (or similar) problem. The root cause will be evaluated for its implications to a broader group of possible deficiencies. The root-cause analysis will be used to gain an understanding of the deficiency, its causes, and the necessary corrective actions to prevent recurrence. This analysis will be a sequential and systematic process of investigation that goes beyond identifying the problem to uncovering the ultimate root or generic cause. Corrective actions shall be developed that are aimed at the root cause rather than the symptoms. Root-cause analysis should not be reserved for deficient conditions. Achievements should also be analyzed and communicated throughout the organizations.

Conditions which will receive root-cause analysis will be based on the severity of the problem and trending analysis. Root-cause analysis will be utilized where the understanding of the basic underlying cause is important to the prevention of similar or related problems. The level of effort expended will be based on the possible negative consequences of a repeat occurrence of a problem.

3.1.2 Tracking and Reporting System

A system for tracking deficiencies, findings, and corrective actions will be established by the QAM. Tracking input from various sources will provide objective measures and indicators of performance that may be used as a management tool for decision-making on an ongoing basis. Reports of tracking information will be provided to project management personnel at their request or as deemed necessary by the QAM.

3.1.2.1 Trends

Trend analysis will be performed of nonconforming conditions and deficiencies by the QAM to identify any possible trends. Adverse trends will be reported to the responsible project management personnel immediately, and a request for a corrective action will be issued.

Figure 3.1
Nonconformance/Deficiency Report

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NONCONFORMANCE or DEFICIENCY (circle one)	Project Name/# NCR Number:	Page 1 of ____ Date:
Nonconformance/Deficiency Description (include requirement violated):		
Identified by:		Date:
Root Cause:		
Corrective Action (include expected completion date):		
To be performed by:	Expected Completion Date:	
Action taken to preclude recurrence		[ ] Not applicable
To be performed by:	Expected Completion Date:	
Client notified (include client name, how notified, and response):		
Notified by:		Date:
Corrective action completed by:		Date:
Corrective action approved by:		
Project Manager:		Date:
QA Comments:		
QAO Approval:		Date:

SOP ADM0009, 10/94, Revision 2, Previous version may be used.

3.1.2.2 Lessons Learned

A Lessons Learned system will be established as a focal point for reporting and retrieving important information concerning experiences gained through previous activities. Continuous improvement will be fostered through incorporation of applicable Lessons Learned into project work processes and project

planning activities. The Lessons Learned program will be used interactively with other management tools such as assessments, and the results disseminated to the appropriate associates involved in similar activities identified as lessons learned. The PM and QAM are responsible for identifying, documenting, and distributing Lessons Learned to applicable project and company personnel.

3.2 CORRECTIVE ACTION

IT and subcontractor personnel will identify and report items, activities, and conditions which do not meet specified requirements. Systems will be established so that items and activities that do not meet the established requirements will be identified, controlled, and corrected in accordance with this QAP. Conditions adverse to quality will be identified and controlled through a Nonconformance Reporting System or through CARs.

3.2.1 Responsibilities

It is the responsibility of all project employees to report potential conditions adverse to quality identified during their work activities. Employees will be made aware of this responsibility during project indoctrination. Items and conditions which are potentially adverse to quality will be brought to the attention of project management and QA for a determination of relevancy.

Responsible Supervisory Personnel: Once a condition adverse to quality is identified, it will be reviewed by the supervisor responsible for the work being performed to determine the underlying cause and provide a remedial corrective action. The supervisor will be responsible for reviewing the condition adverse to quality and conducting investigations to determine the root cause, initiating actions to correct the condition and prevent recurrence. The supervisor will implement the disposition of identified corrective actions to be made by qualified personnel who have knowledge of the type of activity being performed.

Project Personnel: All project personnel are responsible for reporting to their supervisor or the QAM condition which, in their opinion, may require corrective actions.

Quality Assurance Manager: The QAM will identify conditions adverse to quality and review reported potential nonconformances to determine if the condition is valid. The QAM is also responsible for reviewing nonconformances and corrective action reports for quality issues, recommended corrective action, and to ensure necessary information is included. The corrective actions recommended in the nonconformance shall be approved by the QAM. Upon completion of the corrective actions, the QAM will verify that the actions have been implemented and determined to be acceptable. The QAM shall log nonconforming items and activities and periodically review these logs for trends adverse to quality.

3.2.2 Nonconformance System

Items and activities which do not conform to the specified requirements will be identified, reported, controlled, and evaluated to prevent their inadvertent installation or use, utilizing a Nonconformance System.

3.2.2.1 Nonconformance Reports

A nonconformance is defined as any departure from a specified requirement, and may be a condition in which a characteristic of an item does not conform to prescribed limits; a required document is not available or is inadequate; a regulatory or contract requirement is violated; or a procedure does not produce the desired results.

Nonconformances will be controlled and documented in accordance with SQP ITC0008, Change/ Nonconformance Control, Requisite Documentation, Review and Approval. Nonconformance Reports (NCR), SQP ITC0008 Figure ITC00084, will be used to identify noncompliances and deficiencies to specifications and requirements discovered during the normal course of project activities such as inspections, tests, and surveillances. The nonconforming activities could be associated with, but not limited to, remediation and construction activities, equipment installation, sample collection, operations, and design. The disposition of nonconformances will include identification of the root cause as required by Section 3.1.1, actions required to correct the nonconforming condition, actions to preclude recurrence, and the proposed date when the corrective actions will be completed.

3.2.2.2 Control of Nonconforming Items and Processes

Items or processes identified as nonconforming will be identified and controlled to prevent inadvertent use, or further processing, until proper corrective actions have been implemented. The controls will include completion of an NCR, marking or tagging to clearly identify an item as nonconforming and, when practical, segregation from conforming items.

Procured items or processes identified as nonconforming will be documented on an NCR and, if applicable, the supplier contracted to provide corrective actions. The disposition of items and processes which do not meet specified requirements shall be reviewed by qualified and knowledgeable personnel, and a justification for the disposition shall be documented. Affected organizations will be notified of decisions reached regarding the disposition and the Responsible Project Manager will verify that the disposition has been implemented. Under no circumstance will nonconforming items be used until corrective actions or determinations to use "as is" are complete and approved by project management.

3.2.3 Corrective Action Requests

The CAR System shall provide a system to identify, report, and obtain resolution to deficiencies identified by IT personnel during the performance of assessments such as audits and surveillances. A CAR will be used to document and provide actions to correct conditions or trends outside of the normal nonconformance process and which are determined to be significantly adverse to quality, such as procedural or programmatic deficiencies.

The CAR system will also provide the methods to identify corrective actions and prevent recurrence. The CAR shall clearly define the deficient condition including the governing requirement. The QAM will evaluate the CAR to verify that conditions considered deficient are adequately described. The QAM or designee shall approve the CAR, including corrective actions to resolve the concerns. CARs shall be transmitted to the Project Manager and other affected personnel. Response requirements and dates shall be included.

The responder shall determine the root cause of the deficiency, remedial corrective action taken, and an action taken or planned to prevent recurrence. Remedial corrective actions may be implemented until actions to prevent recurrence can be implemented. The QAM shall review responses to CARs to determine whether it is acceptable and verify that the approved corrective action has been accomplished as scheduled and is effective.

3.3 DOCUMENTATION

NCRs and CARs will be maintained at the project as quality records. The QAM will be responsible for performing surveillance and audits of the document control system to verify that the NCRs and CARs are being properly maintained and are retrievable for audit or review purposes.

4.0 DOCUMENTS AND RECORDS

This chapter describes the methods and practices for the control of generation, review, issue, distribution, revisions, and superseded documents, as well as for the preparation, collection, and retention of quality records. Quality records are those documents which provide direct documentary and defensible evidence of the quality of items, activities, or compliance to the contract or regulatory requirements and which have been completed and submitted for retention.

Documents and other records furnish evidence of the conduct and quality of work performed by IT. A system shall be established and implemented to ensure sufficient records are prepared, reviewed, approved, and maintained to accurately reflect completed work. Special consideration will be given to the preparation, review, approval, issuance, use, and revision of work instruction documents that establish policy, prescribe work, specify requirements, or establish design.

4.1 DOCUMENT CONTROL

The control of documents will be accomplished in accordance with written procedures and practices (ITEES0007). Documents will include drawings, procedures, plans, and other documents that provide criteria for the construction, operation, maintenance, or other activities that affect the quality or operation of the project. The document control procedures are applicable to documents generated by IT, subcontractors, and suppliers to IT, as well as FDF documents issued to IT. The preparation, review, approval, issue, revision, and control of superseded documents will be controlled to ensure that personnel who perform work are in possession of the most current version of the document applicable to the activity being conducted. All quality related documents will be maintained in the project files.

4.1.1 Document Control Responsibilities

The responsibilities for the control of project documents include the following:

Project Manager: The Project Manager is responsible for establishing an effective document control system to include those documents specifying quality requirements or prescribing work activities affecting quality. The Project Manager is also responsible for designating the groups responsible for the preparation and control of documents. The Project Manager or his designee is responsible for the control of documents assuring that the correct and applicable documents are maintained and available to the responsible individuals performing the work activities or at the location where the activities are performed.

Project Personnel: Project personnel, including supervisory personnel involved in the preparation of project documents, are responsible for ensuring that the documents are complete, legible, and protected from loss or damage until submitted to the Document Controllers for processing.

Quality Assurance Manager: The QAM is responsible for verifying that the methods and practices for document control are available and performing surveillance and audits of the document control system.

4.1.2 Documents

Documents generated by IT may be a contract deliverable or be slated for internal use. Project contract deliverables and internal documents generated to specify how work is to be performed will be prepared and issued in accordance with this plan. The preparation, review, and approval of documents will be performed by experienced personnel knowledgeable in the specific types of activities required by the documents and the technical requirements specified by the contract. The Project Manager or designee will be responsible for identifying the documents needed based upon the activity to be performed, the complexity of the task, and necessary control.

4.1.2.1 Document Preparation, Review and Approval

Documents will be prepared by personnel sufficiently knowledgeable and experienced in the topic or work to be addressed to accomplish the task. Internal reviews will be documented and will be performed by individuals knowledgeable in the requested area of review. Documents will be consistent with IT and FDF format requirements and applicable regulations. Where standard IT format differs from that of FDF, the FDF-requested format will be used. Approvals of internal documents and the submittal of FDF deliverables shall be documented.

The preparation of reports and documents shall be performed in a timely, efficient, and cost-effective manner which shall result in accurate, technically defensible, and properly checked documents that meet the requirements of FDF and IT. Project documents shall be prepared in accordance with SQP ITEES0014, Report Preparation, Review and Disposition. The preparation of documents will be scheduled with the entire process in mind. The document preparation process will include planning, implementation, and production. Each document shall be internally reviewed prior to issuance by people knowledgeable in the subject matter. Reviews by external agencies such as FDF shall be documented with the disposition of the comment recorded.

In addition to the above general requirements, drawings, figures, and tables will be uniquely identified and contain sufficient information to identify the project, report or plan to which the item belongs. Drawings, figures, and tables shall be formally checked using the checkprinting process in accordance with SQP ITC0012, "Figures, Tables, and Logs." Revisions to documents will require the same review and approval cycle as the original document. Design work will be performed in accordance with Chapter 6.0 of this QAP.

4.1.2.2 Document Submittal

The requirements for each document submittal will be determined prior to preparation of the document as part of the planning process. Documents shall be issued with appropriate revision number which shall be included on each page of the document.

Documents submitted to FDF will be accompanied by a transmittal. The document title, number of copies transmitted, document status, and IT contact personnel will be included. The transmittal letter will be signed by the responsible manager, or designee, indicating approval for release.

4.1.3 DOCUMENT DISTRIBUTION

In addition to general requirements for documents, those that establish policies, prescribe work, specify requirements, or establish design have controlled distribution requirements. These documents will be approved, distributed, and revised in accordance with this QAP.

4.1.3.1 Controlled Document Approval and Distribution

Approval of controlled documents will be denoted by an approval page at the front of the document with required signatures and dates. Approval signatures will be obtained prior to the document being used for work.

Controlled documents will be distributed by the Project Manager to the individuals or organizations listed on the document or drawing distribution log. Controlled documents will be distributed to IT, subcontractors, FDF, and regulatory personnel as deemed necessary by IT and FDF project management. A formal system of controlled distribution will be used that includes unique numbers for each document

copy, a distribution list for each document, and acknowledgment of receipt records. Copies of controlled documents made for informational purposes shall be clearly marked "Uncontrolled" and not used for the performance of work.

Changes to controlled documents shall be approved by the PM (or his designee) and FDF prior to their implementation.

4.1.3.2 Revision

Each controlled document shall be periodically reviewed for potential revision. This review will be initiated, coordinated, and documented by the original issuing group. An alternative organization may be designated to perform these activities based upon technical competence and capability. It will be the responsibility of each individual using a controlled document to advise management of any needed changes in a timely manner.

Revision approval will be commensurate with the original document. Controlled document revisions will be issued to all copyholders of the document through the established document control system. The transmittal document for revisions to existing documents will include instructions for the disposal of the superseded document. Superseded documents that are retained for information purposes will be clearly marked as "Superseded" and will not be used for the performance of work.

4.1.3.3 Canceled Documents

Documents that are canceled for any reason will be recalled or removed as controlled documents. Copyholders of the documents will be notified in writing of the cancellation and provided with instructions for the disposal of the documents. Documents that are retained for information purposes will be clearly marked "Canceled" and will not be used for the performance or inspection of work. Superseded and canceled documents will be retained for a maximum of 60 days. The QAM will perform surveillance of the canceled or superseded document control to verify compliance with the QAP.

4.2 RECORDS MANAGEMENT

The IT records system will provide adequate control and retention of project information by the use of a records filing system. Records management will include the identification of records, transfer to storage, indexing and filing, retrieval, and storage and maintenance. Records will be defined as completed documents submitted for acceptance and retention. Working documents will not be considered as records or subject to the requirements of this section until the documents have been completed and submitted for retention as project records. Retention will include records inventory, disposition, and archival. The management of records shall be in accordance with SQP ITEES0007, Record Control, Status, and Retention.

4.2.1 Records Management Responsibilities

The responsibilities for control, retention, and maintenance of project records include the following:

Project Manager: The Project Manager is responsible for establishing an effective records management system which provides for indexing, filing, and storage of records in a manner that will preclude loss, damage, or other detrimental conditions of the records. The responsibilities also include preparation, review, and approval of the records to verify that they are legible, complete, and accurately reflect the work documented by the records, as well as the identification of records to be turned over to FDF and the scheduled turnover periods.

The Project Manager will designate an individual to be responsible for the collection, handling, storage, retrieval, and control of project records. Responsibilities include indexing and filing of the records, maintaining a central filing storage area, providing for the security of records, and record retrieval as required for audit or review purposes in accordance with this QAP.

Quality Assurance Manager: The QAM is responsible for the performance of surveillance and audits of the record management system to verify the effectiveness of the program for compliance, to the QAP, SQPs, and contract requirements.

4.2.2 Records Identification and Generation

Sufficient records shall be prepared during the performance of activities to furnish documentary evidence of the conduct and quality of the work. Records may be originated by FDF, subcontractors, and IT personnel. A working document will not be considered as a record or subject to the requirements of this section until the document has been completed and submitted for retention as a project record.

IT project records will include all applicable documentary materials generated or received by project participants in connection with business transactions under the contract. Individual records should contain sufficient information to document IT activities as well as provide traceability to associated activities or items. Records required by federal regulations shall also be considered project records.

4.2.3 Record Filing Systems

Records generated during the performance of IT activities shall be managed in accordance with developed procedures, and shall be controlled and retained in a central filing system. The system shall provide an organized method for the secure storage and retrieval of records. Records will be submitted for filing by personnel who manage, generate, or receive records. This may be done periodically or at the completion of a phase or task. Records shall be readily retrievable for audit or review purposes. Guidance for the filing system and system categories may be found in SQP ITEES0006, Record Types and File Categories.

Controlled access facilities that provide a suitable environment to minimize deterioration, tampering, damage, and loss will be used for storage of records. The filing system will provide a sufficient level of control and meet regulatory requirements for records retention. Only authorized personnel will be permitted to remove records from the central filing system.

4.2.4 Central Filing System

Project records will ultimately be managed in a central filing system unless a separate filing system is established. Records will be identified according to fixed filing categories based upon content and use as defined in SQP ITEES0006, Record Types and File Categories. Categories, which are not applicable to the project may be deleted or modified to fit the needs of the project, with the approval of the QAM. Records received and removed from the central files will be controlled. The records management system will include the ability to trace records removed from the central storage location on a temporary basis. The central files will be maintained by designated support personnel.

4.2.5 Separate Filing Systems

Files separate from the central filing system may be established for project support of a unique nature or when unique retrieval and use requirements exist. Project records handled in this manner shall be approved by the QAM and the Responsible Manager.

4.3 RECORDS RETENTION AND DISPOSITION

The inventory, retention, and disposition of records shall be performed in a manner consistent with the contract requirements.

4.4 GENERAL REQUIREMENTS

Records will be maintained as required by the contract. Documents specified as project records will be legible, accurate, and complete. When required, records will be signed and dated or otherwise validated as a quality record.

Records will be completed using permanent ink or word processing media. Records may be completed and stored on electronic media, however a signed hard copy should be maintained in the central filing system. Corrections or changes to record documents will be made by marking a single line through the change, entering any additional information, and initialing and dating the change

Project records will be available for FDF review at the project central filing area. Records identified as deliverables during the project will be forwarded to FDF on a scheduled basis. At the conclusion of the project, the records will be forwarded to FDF or maintained in accordance with the contract requirements.

Proof of Principal Testing activities will be performed by technically competent personnel, using qualified and (as required) approved procedures, instructions, or guidelines to perform quality-related functions.

Work processes shall be controlled, reviewed, and evaluated to determine the quality of work and to identify areas where improvement is needed. Design, operation, and analytical activities shall be performed by technically competent personnel, using qualified and approved procedures, instructions, and technical standards to perform work. Responsible Managers will define the scope of work and the criteria for acceptable work performance for personnel under their direction and will provide the necessary plans, resources, and administrative controls for the efficient accomplishment of the assigned work. All personnel will be responsible for the quality of their work.

5.1 RESPONSIBILITIES

Responsibilities for the control of work processes include the following:

Project Manager: The Project Manager is responsible for planning the work processes and for the development of plans, procedures, and other documents to provide sufficient detail for performance of the processes. Responsibilities include providing trained and qualified personnel to perform the activities specified by the appropriate plans and procedures.

Responsible Management: The responsible manager or supervisor of the work process being performed is responsible for providing the plans and procedures for performing the work in their functional area. Responsibilities also include verifying that the personnel performing the work are trained and technically competent to perform the activities assigned to them.

Project Personnel: Project personnel, including supervisory personnel, will receive training in the work processes to be performed. They will not be permitted to perform any work process until the required training for that process is completed. The responsibilities include implementing the work in accordance with the approved plans and procedures.

Quality Assurance Manager: The QAM is responsible for the review of quality-related plans and procedures for quality requirements and for monitoring work processes to verify that the appropriate procedures to perform the work are in place and are being implemented by trained and qualified personnel. The QAM will perform surveillance and audits of the work process activities as required to verify continuing effectiveness of the system.

5.2 WORK PROCESS PLANNING

Planning for the work processes involves project management, engineering, quality assurance, and supervisory personnel for the work activity to be performed. The planning process is designed to establish effective methods for performing and verifying acceptance of the work. The planning process will be used to obtain objectives and provide for the efficient use of resources. Procedures applicable to the scheduled activities will be commensurate with the complexity and importance of the work and used to establish the methods for implementation. The planning process will include the following:

- Definition of the scope of work and objectives to be achieved
- Primary requirements listing activities involved with the work

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- Identification of data to be collected and analyzed
- Identification of applicable requirements, standards, and acceptance criteria
- Identification of personnel, equipment (including monitoring and data collection), and other resources required
- Coordination between involved parties
- Required record documentation.

5.3 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

Written instructions, procedures, plans, and drawings will be prepared to define the work activities and to provide direction to the personnel performing the work. The documents will provide sufficient detail so that the work can be performed in the proper sequence and in accordance with specified requirements. The instructions, procedures, plans, and drawings will be prepared by qualified personnel and reviewed/approved by personnel technically competent in the type of work activities being performed. The approved documents will be readily available to the personnel performing the work.

5.3.1 Design Documents

Site-specific environmental technology design documents will be prepared, reviewed, approved, and implemented. The preparation, review, and approval of the design documents will be performed by experienced personnel knowledgeable in the types of activities required by the documents and the technical requirements of the contract. Appropriate technical methods or a scientific rationale for making design decisions will be employed and documented. Design documents such as work or performance plans will include, but not be limited to, defining the responsibilities, personnel qualifications, documentation requirements, and a detailed description of any sampling and inspection to be performed. Documents will include the identification of specific environmental technology components to be designed, fabricated, used, and operated.

Design documents will be prepared and controlled in accordance with Chapter 6.0 of this QAP.

5.3.2 Standard Quality Practices and Standard Operating Procedures

SQPs are IT corporate-level documents which are used to define procedures and practices applicable to quality functions. SQPs provide the controls for quality elements such as audits, document control/record management, quality assurance training, and other functions related primarily to the performance of quality assurance activities. IT SQPs are standard IT corporate-level documents which provide the elements frequently performed on this type of project and which can be easily modified, or a new document developed, to include activities unique to the project. SOPs provide the elements to control quality for routine work, inspection, and tests as well as other applications related to the activities being performed.

5.4 WORK PLANS

Work Plans will be developed based on the work process planning for nonroutine activities specified for the project. The plan will provide detailed work instructions to perform specific activities required to complete the project. Work plans will be prepared and reviewed/approved by qualified personnel knowledgeable in the types of activities being performed and the applicable technical requirements

specified by the contract. Revisions to the work plans will require the same level of IT and FDF review/approval as the original plans. The work plans will include controls for handling, storage, shipping, cleaning, and preservation when applicable to the work being performed under the plan. When the activities covered by the work plan include data monitoring or collection, the types of equipment will be specified in the work plan or separate procedures for the performance of these activities.

5.5 IDENTIFICATION AND CONTROL OF ITEMS

Sufficient controls shall be established to control the handling, storage, shipping, cleaning, and preservation of items to prevent damage, loss, or deterioration. Labeling will be performed to ensure that quality-affecting items can be readily identified to prevent incorrect use, that materials will retain their intended quality, and that equipment will retain its desired operating characteristics. Environmental samples shall be identified and controlled to provide custody, traceability, and appropriate analysis. The application of controls shall be based on the risk to the project should control of the item be lost.

5.5.1 Equipment and Materials

Equipment shall be uniquely identified and controlled. Materials shall be adequately marked for identification from the time of receiving through storage and use. Project personnel are responsible for ensuring that incoming equipment and materials are identified upon receipt from suppliers. If, for any reason, item labeling is not adequate, personnel shall obtain the correct identification and mark the item, item container, or records prior to use.

Materials and equipment, stored prior and/or subsequent to use, will be handled, stored, shipped, cleaned, and preserved to prevent damage, loss, or deterioration. If an item is stored in a different container from that in which it was received, any original identification shall be transferred to, or transcribed on, the new container. Prior to use, all IT personnel are responsible for identifying and verifying that materials have not sustained damage or deterioration. Items and materials that have sustained damage, loss, or deterioration, will be documented as a nonconformance in accordance with Chapter 3.0 of this QAP.

5.5.2 Inspection and Testing

Inspection and testing of items and activities covered by the work plans and processes is included as Chapter 8.0 of this QAP.

5.5.3 Samples

Samples shall be collected and controlled, using strict chain-of-custody, in accordance with SQP ITEES0008, Documentation of Field Activities. Custody shall be initiated by sampling personnel prior to relinquishing control and completed by the organization performing final disposition of the sample. Documentation shall be accomplished through a chain-of-custody record that lists each sample and the individuals performing the sample collection, shipment, and receipt. The Project Chemist shall monitor the sampling event(s) to verify that custody procedures and records are being properly implemented.

Samples will be adequately marked for identification from the time of collection and packaging, through shipping and storage. Marking will generally be on a label attached to the sample container (e.g., canister, bottle, jar, core box, and bag), but may be applied directly to the sample, depending on the type of sample and its intended use.

Packaging of samples shall be based on the protection a sample will require during handling, shipping, and storage. Protection will vary according to sample type, sample media, the amount of hazardous

substances present, required testing, handling methods, and storage conditions and duration. To the extent possible, the desired in situ characteristics should be maintained. Packaging of hazardous samples for off-site shipment is controlled by the Department of Transportation (DOT) requirements in 49 CFR Parts 170-179.

5.6 CHANGE CONTROL

Variances (changes or modifications) to approved procedures or plans may be necessary in order to adjust an activity to actual conditions or to revise programmatic methods of implementing project requirements. FDF will be notified of the variances and proposed resolution. Project participants will provide variances that are properly identified, documented, approved, and controlled. Variances shall be approved commensurate with the original document prior to implementation.

5.7 LABORATORIES, ANALYSIS, AND DATA HANDLING

The use of on-site and off-site laboratories will be controlled to ensure that sample analysis is performed to established standards and meets the intended use of the data. Generated data will be verified to provide quality data used in decision processes.

5.7.1 Laboratories

Analytical laboratories will be responsible for ensuring that samples are received, handled, stored, and analyzed according to the laboratory QA and this QAP. This program will ensure that all environmental, process, and closure samples will fulfill the waste acceptance criteria of the subcontract.

Laboratories performing analysis will be verified on a regular basis through the use of audits, surveillances, and inspections. Laboratory performance will be verified for evidence that they are capable of providing acceptable data.

The Task Leader will be involved in the planning stages of the project to establish communication between the project and the laboratory to provide project strategy information that may be, useful for predicting potential impacts to analytical operations and sample loading.

5.7.2 Analysis

For this project, laboratory analysis will be performed to determine physical, chemical, and radiological parameters. The level of quality control applied to laboratory analysis will be determined by the desired data quality level, the type of testing performed, and the intended use of the final data. This will be determined by Project Management, the Task Leader, and the QAM in conjunction with FDF and regulatory agencies.

Analysis will be performed in accordance with approval methods. The Task Leader will provide the laboratory personnel with the information necessary to perform the desired testing program and will confirm that the required analysis can be accomplished. The IT Technology Development Laboratory (TDL) QA Manual, plans, procedures, and documentation will be available for audit and review.

5.7.3 Data Handling

Uniform methods for reviewing data will be established so that quality requirements are met, consistently reviewed, and management of analytical data is achieved. The objective of this activity is to establish a

method for performing data handling operations intended to identify technical problems associated with a set of data that will affect its usability and to communicate those problems to the user as data qualifiers.

Analytical data shall be checked and verified so that data are complete, correct, consistent, and compliant with standards. Analytical data will be checked for completeness with respect to analyses requested on the Chain-of-Custody/Request-for-Analysis (COC/RFA) form. Quality control analyses will be checked to verify that results are within method specifications or, in the absence of method specifications, laboratory specifications. All data qualifiers will be reviewed with respect to analytical methodology and customary convention for acceptance. Analytical results will be examined for consistency with results from analyses of samples with similar makeup or origin, or for consistency with trends displayed by analysis of samples that are similar but very in extent of one or more properties.

Verification will be documented by the examiners' initials and date on the top page of the analytical data package. Any resolution to missing, non-compliant or inconsistent data will be documented by written communication with the laboratory, and copies of this communication will become part of the analytical data package.

The process of data verification will occur at various levels both internal and external to the laboratory or data generator. The output of the verification process will be a complete and accurate data package. A data package will consist of analytical results, along with all supporting data and documentation. Verification will be performed by qualified individuals.

6.0 DESIGN CONTROL

A formal design process shall be established and implemented to ensure that the project is designed using sound engineering/scientific principles and appropriate standards and regulatory requirements. Implementation of this process shall ensure control of design inputs, processes, outputs, configuration and design changes, interfaces, documentation, and records.

6.1 RESPONSIBILITIES

Project Manager. The Project Manager will be responsible for the overall design effort. He will be supported by the QAM in the performance of this function. The Project Manager, with guidance from the Principal Investigator and Project Task Leaders will assign deliverable/submittal responsibilities to the project engineers and the design execution group personnel.

Principal Investigator. The Principal Investigator will be responsible for the management of the design tasks. Specific responsibilities include:

- Meet quality performance objectives
- Approve deliverables prior to submittal to FDF and incorporate review comments by FDF
- Coordinate design activities regarding quality and performance among involved parties.
- Assign appropriate technical resources for individual tasks
- Meet quality review requirements
- Chair the Design Review Panel.

Quality Assurance Manager. The QAM will monitor design activities in accordance with quality requirements. Specific responsibilities include:

- Review all documents for conformance to QA procedures
- Perform schedule QA audits and surveillances.

Health and Safety Manager. The H&S Manager will review each document, as required. Specific responsibilities include:

- Review documents for conformance to safety requirements.

6.2 DESIGN PROCESS

6.2.1 Design Inputs

Three levels of design inputs are recognized:

- **Activity Specific Criteria** - which include the IT and selected subcontractors SQPs applicable to engineering design

- **Project Specific Criteria** - which include the design standards, procedures, and practices identified within the proof of principal testing work plan.

- **Design Package Criteria** - which are determined by IT prior to executing the design tasks included in the design package. The design package criteria will include quality levels and review requirements consistent with the type and complexity of the deliverable.

6.2.2 Data Collection Process

Data will be collected in accordance with the proof of principal testing work plan. In the event that an existing plan does not include procedures covering the necessary data collection activity, a new plan (or section for an existing plan) will be prepared in accordance with the applicable IT or selected subcontractor's SQP.

6.2.3 Design Records

6.2.3.1 Design Information

Design information will be recorded in a timely fashion and maintained during the execution of the work in accordance with applicable IT or selected subcontractor's SQPs. Design information will document decisions made that affect the work and designs prepared by others. Design information includes, but is not limited to:

- Agendas and minutes for meetings to document decisions
- Records of telephone calls
- Copies of letters and FAX communications
- Copies of vendor quotes and correspondence
- Copies of procurement documentation
- Copies of vendor approval drawings and certified drawings
- Copies of test reports, laboratory analysis.

6.2.3.2 Design Documentation

Design documentation includes all calculations, drawings, and designs prepared by the IT design team. Design documents will be prepared in a timely fashion and maintained during the execution of the work in accordance with applicable IT or selected subcontractor's SQPs. Design documents include, but are not limited to:

- Manually performed design calculations
- Outputs from computer performed designs
- Copies of drawing and calculation check prints
- Copies of draft and final specifications including review comments.

6.2.4 DESIGN VERIFICATION AND REVIEW

6.2.4.1 Design Verification

Design verification will include review of design calculations, drawings, and specifications to verify that the work has been performed correctly and that they satisfy the input requirements with regard to technical performance, safety, and quality. Manual calculations and drawings will be checked in accordance with the applicable IT or selected subcontractor's SQPs. Design verifications are to be conducted by qualified personnel who are knowledgeable in the design and its input. These personnel, assigned by the PM, may be from the same organization, but must not be those who performed the original design. Computer software will be verified and validated prior to use in accordance with applicable IT or selected subcontractor's SQPs.

Test programs involving field or laboratory trials to verify the acceptability of the design will be performed in accordance with specifications covering the activity. To the extent possible, these specifications will incorporate the requirements of existing site-specific Field Sampling and Analysis Plans, H&S Plans, and the QAP. In the event that an existing plan does not include procedures covering the testing activity, a new plan (or section for an existing plan) will be prepared in accordance with the applicable IT or selected subcontractor's SQP. These test programs will demonstrate acceptable performance under conditions that simulate the most adverse design conditions that are expected to be encountered.

6.2.4.2 Design Review

The Project Manager will be responsible for determining the review requirements and for coordinating these reviews with appropriate personnel. The personnel will be experienced and have knowledge of the types of activities reviewed and the technical requirements of the contract applicable to their review. The complexity of these reviews should be commensurate with the design package. Records of each review will be prepared and maintained. After each document review is complete, it will be reviewed by personnel from QA, H&S, and Radiological Controls, as necessary, for conformance to quality requirements and to verify that the documents meet safety standards before being included as part of a design package.

At the conclusion of the design phase for each design package, the Design Review Panel, assembled by the PM, will conduct a formal documented review of the design results. The members of the Design Review Panel will be experts in their respective areas of technical expertise and will be selected based on their qualifications and not their affiliations. This review should ensure that all necessary design documents, drawings, guidance, instructions, specifications, and data sheets have been verified, reviewed and approved by authorized personnel, and are distributed in accordance with the document control procedures included in Chapter 4.0 of this QAP.

6.2.4.3 Audits

System and performance audits will be conducted to verify that the design efforts are being performed in accordance with the quality program and specific design instructions. Audits will be performed in accordance with IT or selected subcontractor's SQPs. System audits will verify that quality practices are being consistently and correctly implemented in the preparation of all deliverables. Performance audits will verify that quality practices are being correctly implemented in the execution of a specific design task. The Project Manager will respond to findings resulting from system and performance audits.

6.3 DESIGN RECORDS CONTROL AND MANAGEMENT

Project records will be controlled and managed in accordance with the applicable IT or selected subcontractor's SQPs. Design records are to include not only the final design output and revisions to the final output, but also the important design step (calculations, analyses, and computer programs, for example) and the sources of the input that support the final output. Procedures for records control and management are discussed in more detail in Chapter 4.0 of this QAP.

6.4 DESIGN CHANGES

All design changes and modifications (including temporary modifications) shall be identified, documented, reviewed, and approved before their implementation. Design control measures associated with changes shall be commensurate with those applied to the original designs and approved by the organization that approved the original design, or a qualified designee.

6.5 COMPUTER PROGRAMS

Software and computer programs used in the design and data collection process are to be proven through previous use or verified in accordance with SQP ITC0010, Computer Software Development and Usage, prior to use. These decisions are to be document and retained in accordance with Chapter 4.0 of this QAP.

7.0 PROCUREMENT

A program shall be established and implemented to verify that purchased items and services meet IT, FDF, and regulatory requirements and perform as expected. The control of procurement documents and the resulting quality-related items and/or services furnished will be based on the effect an item or service will have on project results. It is the policy of this program to develop good working relationships with suppliers and subcontractors by opening clear lines of communications, which will provide a more consistent level of quality.

Controls will be provided to include preparation of purchase and subcontract documents, supplier prequalification, supplier monitoring, inspection of received items, and inclusion of all required inspections, tests and quality requirements. This section is not applicable to the procurement of non-quality related, off-the-shelf, or temporary items which will not affect the operation or safety of the project.

7.1 RESPONSIBILITIES

The responsibilities for the procurement of quality-related items and services include:

Responsible Project Manager: The Project Manager will have overall responsibility for the procurement of quality related items, equipment and services for the project in accordance with the IT procurement policies and procedures. The responsibilities include review and approval of purchase requisitions and subcontract documents. Responsibilities will include verifying that suppliers or subcontractors are approved and prequalified to provide the items or services, and the procurement activities are in accordance with the specified requirements and schedule constraints, including safety requirements and required documentation (i.e., Material Safety Data Sheets (MSDSs).) The Project Manager will be responsible to assign qualified personnel to perform and document inspections of procured items or services.

Procurement Manager: The IT Procurement Manager is responsible for all IT procurement activities in IT offices and at the projects. Responsibilities include reviewing procurement documentation to verify that all items and services procured by IT are in compliance with the IT procurement policies and procedures.

Project Personnel: Project personnel, including supervisory personnel, will be responsible (as applicable to their work) to provide the Project Manager or Principal Investigator with accurate information pertaining to the procurement of items or materials, recommended suppliers, and other pertinent information related to procurement activities.

Quality Assurance Manager: The QAM is responsible to review procurement documentation of a technical nature to verify all quality, inspection and test requirements required by the contract have been included. The QAM will also monitor the procurement activities through the performance of surveillance and audits. Responsibilities also include making sure verification of acceptance through receipt inspections, source inspections, and when required, performance testing is performed.

7.2 PROCUREMENT DOCUMENT CONTROL

Procurement documents issued by IT for quality-affecting items and services include bid requests, purchase orders, and contracts. Modifications to a procurement document will be subject to the same degree of control as the original document.

Procurement processes will be implemented on the project in accordance with project procurement procedures. In addition, SQP ITC0004, Procurement Document Content, Control, and Review provides the quality assurance requirements for procurement activities.

7.2.1 Procurement Document Preparation and Content

The requesting department will initiate procurement documentation and provide the requirements for items or services needed. Procurement Requisitions (PR) will be completed for all quality related procurement. Procurement documents will include all applicable specifications, provisions, requirements, and cite appropriate standard references. The documentation required for procurement will, as applicable, include the PR, inspection and testing requirements, technical specifications, and other referenced information.

Where applicable, procurement documents will stipulate support documentation required from the vendor. Support documentation may include required acceptance inspections, specific drawings, specifications, statements of work, procedures, regulations, or codes that describe the item or service to be procured. Acceptance criteria should be based upon specified contract requirements.

It is the responsibility of the procurement department to locate sources, negotiate, and execute the necessary contractual or purchasing agreements. Suppliers may be suggested, but use of a single supplier can not be required without adequate sole-source justification. Competition will not be restricted. Adequate lead time for executing these activities should be planned.

7.2.2 Procurement Document Review and Approval

Procurement documents will be reviewed prior to their distribution or contract award to verify that all applicable requirements have been incorporated.

PRs will be reviewed and accepted by the Project Manager prior to initiating the purchase order or subcontract. Procurement document review will be performed by Purchasing and Project personnel. Documentation of review will be indicated by signature and date on a document copy or routing sheet. The QAM will review quality related PRs to verify it contains necessary technical, quality, inspection and testing requirements, referenced codes and standards, and acceptance criteria. The PR will list specific elements such as required submittal, specific tests, documentation, and other information critical to the procurement as line items.

Contract approval will be performed as required by IT corporate purchasing policies. Copies of all contracts, bid requests, and purchase orders and their review copies will be maintained by the procurement department.

IT will obtain the approval of the FDF Subcontractor Administrator prior to subcontracting any on-site training and work under this subcontract. As applicable, procurement documents will include the contract requirements for Suspect and Counterfeit Parts Quality Act of 1990. Utilization of small business (SB) and small disadvantaged business (SDB) concerns in accordance with Federal Acquisition Regulations (FAR) 52.219-8 will be evaluated during procurement activities.

7.3 CONTROL OF PROCURED ITEMS AND SERVICES

Items and services procured by IT will be controlled to preclude the installation or use of items which do not conform to the specified requirements or have not been properly inspected or tested. This will be accomplished through performance of the following activities, as appropriate to the procurement:

- Prequalification of subcontractors
- Bid evaluation
- Procurement source evaluation and selection
- Subcontractor performance verification.

Control will be applied to procured items and services on a graded approach based upon the effect an item or service will have on project results. Deficiencies identified during procurement control activities will be reported to the Responsible Project Manager and if required documented on a Non-conformance Report and processed in accordance with Chapter 3.0 of this QAP.

7.3.1 Subcontractor Prequalification

Subcontractors performing services for IT will be prequalified in accordance with IT procurement procedure SQP ITC0005, Subcontractor Prequalification prior to performing work on the project. The Prequalification process will act as an aid to eliminate potential subcontractors that do not meet basic requirements.

Subcontracted analytical laboratories will be prequalified in accordance with IT procurement procedure PR013, or will be designated by FDF as an "FDF approved laboratory," prior to performing any analytical testing for the project. Only laboratories that have a demonstrated capability to provide the level of analytical and data handling quality required for this project will be contracted.

Prequalification information includes, but is not limited to, company background, H&S practices, medical practices for employees, accident report results, accident reporting mechanisms, insurance information, Experience Modification Rate for the past 5 years, and QA practices. Information completed in the subcontractor prequalification process will be reviewed by H&S, QA, and Purchasing personnel to determine if the subcontractor meets basic requirements. Prequalification status will be reviewed and updated periodically, as long as services or items are being provided.

7.3.2 Bid Evaluation

Bids may be required from suppliers interested in providing a particular item or service. Bids will be reviewed for cost and conformance to applicable requirements. As appropriate, individuals qualified to evaluate technical considerations, quality and documentation requirements, and subcontractor personnel qualifications will be used to perform the reviews. This activity will be documented.

7.3.3 Source Evaluation and Selection

Procurement source evaluation is performed, as necessary, to provide more detailed information of subcontractor capabilities than can be obtained through the prequalification process. Suppliers of procured items and services will be evaluated to determine qualifications, capabilities, and performance and schedule requirements. Suppliers who provide items or services will have a current and acceptable qualification status and be capable of performing work within the requirements of the procurement documents. Procurement source evaluation will be performed to determine the qualifications and capabilities of suppliers of items and services. The evaluation may include any or all of the following:

- Historical quality performance data - The previous ability of a potential supplier to provide an item or service in a satisfactory manner should be evaluated. The experience of other purchasers of similar items or services provided by the prospective supplier and any IT records of previous procurement can form the basis for the evaluation.

8.0 INSPECTION AND TESTING

This chapter describes the system and provides the criteria for verifying compliance with the specified requirements through the performance of inspections and tests. Inspections and tests will be performed as required based upon contract or regulatory requirements or the complexity and intended use of the items.

8.1 RESPONSIBILITIES

The responsibilities for the inspection and testing of quality-related items include:

Project Manager: The Project Manager will have overall responsibility for the performance of inspections and tests to verify that equipment and systems for the project will perform as intended. The Project Manager or designee will be responsible for assigning technically qualified and if required certified personnel to perform or witness the inspection and testing activities. The Project Manager will also verify that sufficient inspections and tests are specified and performed to determine acceptability, that they are performed by personnel independent of those responsible for the work, the results are documented, and any identified deficiencies are documented and resolved.

Project Personnel: Project personnel, including supervisory personnel performing or responsible for the performance of inspections and tests will attend the applicable training as scheduled. They will not be permitted to perform or witness inspections and tests prior to completing the training. Personnel performing acceptance tests will have documented evidence of current training status including required certifications.

Quality Assurance Manager: The QAM will be responsible for monitoring the inspection and testing activities to determine that the activities are effective and in compliance with the specified criteria. In addition the QAM is responsible for documenting nonconformances identified during inspection and testing activities and processing them in accordance with Chapter 3.0 of this QAP.

8.2 INSPECTION AND TEST PROCEDURE

Unless otherwise specified in the contract documents or required by specific codes or standards, inspections and tests will be performed as consistent with the complexity or intended use of the item. Inspection may include in-process, source, completion, receipt, maintenance and in-service activities. The required inspections will be in accordance with the activities and frequencies shown in the Schedule of Inspections as approved by FDF. Source inspections for specific equipment will be identified in the Schedule of Inspections. The schedule of inspections will be updated as required, but at a minimum annually. Testing may include bench, pre-operational, post-maintenance, or operational. The responsible project management or engineer and the QAM will identify the types of inspections and tests and the appropriate criteria to determine acceptability for the intended use.

Inspections and tests for acceptance will be performed by individuals or organization independent of those responsible for performing the work. Hold points may be assigned by the QAM, FDF, or the design organization to prevent inadvertent operation of the item or system which could affect the quality or operational integrity of the item and to preclude bypassing required inspections or tests. In-process inspections and tests may be performed at the discretion of the Project Manager and QAM during the normal work activities unless they are to satisfy a hold point. A QA assessment/inspection/surveillance matrix is given in Table 8-1.

Deficiencies and nonconforming conditions identified during the inspection and testing activities will be documented. Conditions which can be corrected at the time and which may be corrected using normal construction or installation processes may be corrected and the item reinspected or tested for acceptance.

Conditions which require additional evaluation or changes for resolution will be documented on a Nonconformance Report and processed in accordance with section 3.0 of this QAP.

The disposition will include reinspection or retesting as required to determine acceptability.

Table 8-1.
QA Assessment/Inspection/Surveillance Matrix

Project Phase	Task	Assessment	Inspection/ Surveillance
Formulation Development	Receipt of reagents	Yes	Yes
	Preparation of 70 wt % solids slurries	Yes	
	Formulation development	Yes	Yes
	Review of laboratory data	Yes	
Demonstration Testing	Pilot Scale Review	Yes	
	Receipt of Reagents	Yes	
	Preparation of 30 wt% solids demonstration surrogate slurry	Yes	
	Demonstration testing	Yes	Yes
	Review of laboratory data	Yes	
Final Report	Report preparation	Yes	

8.3 EQUIPMENT CALIBRATION

In order to obtain data of known quality, equipment must be properly calibrated and maintained. Periodic equipment calibration records are maintained in the Laboratory Quality and Operations files by the QAM or designee. Equipment maintenance is normally recorded in a laboratory notebook assigned to the equipment item. The calibration status of all equipment with periodic calibration requirements will be identified on the item where possible.

A summary of laboratory equipment calibration requirements and acceptance criteria is presented in Table 8-2.

Table 8-2
Schedule of Equipment Inspections

Equipment	Calibration Frequency	Acceptance Criteria
ICP	Prior to use, 2 points	±10%
pH Meter	Prior to use and verified every 2 hours, 2 points	±0.05 pH units
UCS Load Measurement Device	Annually	±1% of full scale
Thermocouples	Annually	±3% of full scale, dependent on type
Thermometers, general purpose, readable to 0.5°C	Annually	±1°C
Balances	Quarterly and verified daily when in use, 1 point	Greater of ±2 least significant digits or ±0.1% of scale

8.3.1 LABORATORY BALANCES

Laboratory balance calibration is checked quarterly against American Society for Testing and Materials (ASTM) Class 1 weights, and calibration is verified daily when the balance is used, with Class M2 (or better) weights. Laboratory balance calibration procedures are described in SOP PDGADM0002. Daily verification is recorded in a logbook assigned to the balance. Acceptance criteria is ±0.1 percent of the scale or ±2 significant digits, whichever is greater.

8.3.2 PIPETTORS

Air displacement pipettors are calibrated gravimetrically on a quarterly basis (SOP PDGADM0014). Positive displacement pipettors are calibrated quarterly using a manufacturer's gauge, and annually by gravimetric measurements. Accuracy and precision requirements are specific to a pipettor range.

8.3.3 pH METERS

Calbiration of pH meters is to be performed prior to used, and calibration is verified every two hours when in use. Unstable or erratic pH reading may indicate fouling of the pH probe which may or may not be avoidable, but should be corrected when noticed. This calibration and verification, including time performed, will be recorded in a laboratory notebook assigned to the project. Acceptance criteria is ±0.05 pH units. With combination electrodes, temperature correction for pH measurements is automatic.

8.3.4 GRADUATED CYLINDERS FOR MODIFIED ANS 55.1 TEST

Graduated cylinders used for the modified American Nuclear Society (ANS) 55.1 test (free-standing liquid) will not be calibrated. Graduated cylinders which meet the specifications for ASTM Class B graduated cylinders found in ASTM E 1272, *Specifications for Graduated Cylinders*, or better, will be used.

8.3.5 TEMPERATURE MEASUREMENT

Temperature measurement device (thermocouples or thermometers) calibration will be verified annually (SOP PDGADM0008). Thermometers will be accurate to ±1°C. Thermocouples will be checked with an Altek Model 22 thermocouple source, or equivalent, and be accurate to ±3 percent of full scale.

8.3.6 UCS LOAD MEASUREMENT

The load measurement devices (typically a load cell) used during Unconfined Compressive Strength (UCS) testing will be calibrated annually. Accuracy will be within ±1 percent of full scale.

8.3.7 CHEMICAL ANALYSIS EQUIPMENT

Calibration of analytical instruments (e.g., inductively coupled plasma spectrometer [ICP]) will be as specified in the analysis procedure.

8.4 EQUIPMENT MAINTENANCE

Equipment maintenance requirements will be those specified by the manufacturer. Equipment cleanliness is not only a maintenance issue, it affects hygiene and sample integrity. Equipment will be cleaned after use, and will be maintained as clean as practical.

8.5 DOCUMENTATION

Inspections and tests will be documented. Checklists or other documentation developed for the specific item may be used to document in-process inspections, manufacturer's source inspections, completion inspections, and acceptance tests. At a minimum the documentation will include the following elements, as applicable, to the items being inspected:

- Identification of item
- Identification of applicable inspection/test characteristics
- Description of inspection/test methods
- Inspection/test equipment and calibration requirements, as applicable
- Suitable environmental conditions
- Acceptance and rejection criteria
- Inspection/test conditions
- Hold points, if required
- Safety measures
- Required qualifications of individuals performing examinations
- Date of inspection/test
- Signature and qualifications of responsible inspection/test personnel.

Equipment source inspections will include, but not be limited to:

- Water treatment equipment
- Laboratory equipment
- Dryers and associated equipment.

Acceptance test records will include as a minimum:

- Item tested
- Date of test
- Tester or data tester
- Observations
- Test Results and Status
- Deviations and actions taken.

Inspection and test results shall be evaluated and verified by qualified personnel authorized to document that all requirements have been satisfied.

Inspection and Test documentation will be maintained as project quality records and will be available for surveillance or audit purposes. The QAM will perform periodic surveillance or audits of the inspection and test records to determine that all required inspections and tests are performed and properly documented.

Measuring and test equipment will be controlled in accordance with SQP IT EES0009, Field Equipment Calibration and Control. This SQP establishes a system to control the calibration, maintenance, and use of measuring and test equipment used for monitoring and data collection. Monitoring and data collection equipment shall be of the accuracy and type suitable for the intended use. The types of equipment shall

be specified in the work documents. Equipment shall have calibration certificates traceable to national standards, where possible. Equipment on which calibration is overdue shall be tagged and segregated to the extent practical to prevent use until calibrated.

9.0 CONTROL OF MEASURING AND TESTING EQUIPMENT

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The control, calibration, and preventative maintenance of Measurement and Test Equipment (M&TE) that may affect the quality of results will be controlled and calibrated in accordance with the requirements of this section and SQP IT EES0009, M&TE Calibration and Control.

9.1 RESPONSIBILITIES

The responsibilities for the control and calibration of measuring and testing equipment includes:

Project Manager: The Project Manager is responsible for the development and implementation of the M&TE system. The responsibilities include the delegation of authority to the supervisory personnel responsible for the activities requiring the use of M&TE to verify that the proper equipment is used and the required calibrations have been performed and are current at the time of equipment usage.

Responsible Supervisory Personnel: Supervisors responsible for activities involving the use of M&TE will verify that the equipment used on their activities has been calibrated to the required ,standards, the calibrations are current, the equipment is properly marked or tagged with the calibration status, and calibration records are available. Responsibilities also include verification that personnel using the equipment are qualified.

Project Personnel: Project personnel using M&TE equipment, including supervisory personnel, will be properly trained in the use of the equipment as scheduled. They will not be permitted to perform tests and measurements prior to completing the appropriate training. Training will include the proper use of M&TE, calibration requirements, and handling of out of calibration or damaged equipment.

Quality Assurance Manager: The QAM will monitor the M&TE activities to verify that calibration of the required equipment is being maintained and that calibration records and schedules are available and current for the equipment being used.

9.2 CALIBRATION PROCEDURES

The calibration of M&TE will be in accordance with SQP ITEES0009, M&TE Calibration and Control, known national or industry standards, and manufacturers recommendations. All instruments that measure a quantity, are expected to perform at a stated level, or used for acceptance of items during inspection and testing will be subject to periodic calibration prior to use and at prescribed intervals thereafter. When required by the type of equipment and governing standards, M&TE will be calibrated before and immediately after use.

Factory or external calibrations will be traceable to the National Institute of Standards and Technology (NIST) where such standards exist. Operational or internal calibration checks of equipment should be performed using certified reference equipment and standards. It is the responsibility of all personnel to verify calibration status prior to using the equipment.

A unique number will be assigned to each M&TE to identify that piece of equipment to the calibration records. This number will be permanently marked on the equipment. The manufactures serial number may be used as this number if available. A Calibration Log will be maintained which includes the M&TE identification number, calibration standard, date last calibrated and date calibration is due. A label or tag will also be attached to the equipment indicating calibration status.

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9.2.1 Out of Calibration M&TE

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In the event M&TE has expired calibration, is damaged, or if found out of tolerance, the affected equipment will be removed from service and tagged as "out-of-service" to prevent inadvertent use. Out-of-service equipment will be physically separated from operational equipment, if practical. Prior to further use on the project, M&TE will be repaired and recalibrated by an approved source. M&TE which cannot be repaired will be removed from the project and as necessary, replaced. The items measured, inspected, or tested with the out of calibration M&TE will be evaluated to determine acceptability.

9.2.2 Frequency of Calibration Controls

The frequency of calibration of M&TE Will be based on governing national standards, manufacturers recommendations, type of equipment, stability characteristic, required accuracy, past experience, and other conditions affecting measurement control.

Calibrations will, as much as practical, be performed at the work site and will be performed so that environmental conditions that could affect the accuracy of the M&TE are sufficiently controlled. When it is not practical to perform the calibrations on-site, the M&TE will be sent to an approved source for calibration. The approved suppler will provide documented evidence that the calibration standards used meet the requirements of this QAP.

9.2.3 Calibration Documentation

Specific calibration records will be prepared and maintained for each item of M&TE used at the project. The calibration records will be available for audit or review purposes.

9.3 PREVENTIVE MAINTENANCE

A preventive maintenance program will be implemented for M&TE and will include routine maintenance actions (e.g., equipment cleaning, lubricating, reconditioning, adjustment, and/or testing) needed to maintain proper performance, prevent equipment from failing during use, and provide measurement reliability.

Information pertaining to histories of equipment maintenance will be kept in individual logs or files for each instrument. Instrument manuals, if available, will be kept on file as references for equipment needs and repair. The frequency of preventive maintenance will be based on the manufacturers' recommendations and the users' professional knowledge and experience.

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10.0 MANAGEMENT ASSESSMENT 1808

Planned and periodic assessment of project activities will be conducted and will involve management at all levels. The primary emphasis of management assessments will be to identify problems or barriers that could affect achievement of goals and to assess the effectiveness of system controls to establish and achieve quality.

10.1 RESPONSIBILITIES

IT Management: It is the responsibility of IT senior management to assess the integrated quality management systems performance and effectiveness on a periodic basis.

Project Manager: The Project Manager is responsible for participating in and providing input to management assessments.

10.2 PROCEDURES

Management assessments of the project will be conducted by IT management personnel through a review of project related activities and project control activities. The assessments will focus on elements that affect work processes and the achievement of project goals to include quality, health and safety, strategic planning, organizational interfaces, cost control, use of performance indicators, training and qualifications, and supervisory oversight and support. A Management Assessment Plan and checklist will be developed for the project.

10.2.1 Project Review

An assessment of each IT project will be made by IT management on a monthly basis at a project review meeting conducted at the site. The meeting will be attended by the Project Manager, QAM, H&S Manager, Cost & Schedule and other appropriate management personnel. Management assessments will include direct participation of IT senior management. Monthly assessments will be documented in the Project Manager's Project Status Report. The Status Report is available for review and appropriate results of the assessments will be disseminated to the affected personnel.

Programmatic elements to be considered during management assessments will include strategic planning, organizational interfaces, use of performance indicators, and oversight effectiveness. Discussions at the project level will include the following elements:

- Overall Project Status
- H&S Issues
- Engineering Activities
- Procurement
- Construction/ Site Activities
- Cost and Schedule Status
- SB, SDB and Women Owned Business (WOB) Business Goals
- Personnel and Policies (staffing, problems, concerns)
- Opportunities, Problems and Concerns
- Existence of effective training program.

10.2.2 Management Assessment

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In addition to monthly project review meetings, annual assessments will be performed by IT management and will be conducted to evaluate the effectiveness of management system controls and the adequacy of personnel and resources to achieve the specified quality levels. Annual assessments will be performed through a review of project quality related activities and control mechanisms. The results of the management assessments will be documented and reported to the Project Manager for dissemination to the appropriate staff.

10.2.3 Corrective Actions

Activities addressed during the Project Review meetings that require actions by IT senior management and project management to correct or resolve deficiencies or concerns will be assigned as action items during the meeting and noted in the report. Status of the action items will be reviewed at subsequent meetings. Corrective actions or areas for improvement identified during the annual management assessment will be documented, implemented on a timely basis, and monitored for effectiveness. Where necessary, interim corrective actions will be initiated while final corrective actions are being developed.

11.0 INDEPENDENT ASSESSMENTS AND QA AUDITS

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A system of planned and documented independent assessments shall be implemented to promote improvement and verify that the performance of work activities are in accordance with approved work instructions and project requirements. Independent assessment will be used as a tool to evaluate the implementation of an integrated quality program, promote continuous improvement initiatives, and will focus on improving processes and ensuring technical requirements. The independent assessments will be applicable to all project activities including design, construction, operations, decontamination and dismantlement (D&D), and all other activities that affect project quality.

Assessments will generally take the form of audits or surveillances; however, other methods may be employed. Audits are more comprehensive in scope and will evaluate a single system or integrated systems. Surveillances will be oriented to processes, activities, and technical requirements.

11.1 RESPONSIBILITIES

The responsibilities for independent assessments of the project include:

Project Manager: The Project Manager is responsible for providing access and cooperation with the personnel performing independent assessments of the project activities. Responsibilities also include providing the disposition and implementation of corrective actions and quality improvement actions for items or activities that can be improved or are determined to be out of compliance.

Project Quality Assurance Manager: The project QAM is responsible for planning, scheduling and performing audits, surveillance and inspections of quality related activities including those of subcontractors and suppliers to verify compliance with the contract requirements and determine the effectiveness of the quality assurance program. The project QAM is generally responsible for the performance of audits and surveillances. Other personnel knowledgeable in specific areas or activities may assist or perform surveillance or inspection activities.

11.2 ASSESSMENT SCHEDULE

Audits and surveillances will be scheduled at a frequency commensurate with the complexity and extent of the activity, previously identified deficiencies, and the importance of the activity. Critical assessments shall be performed prior to work moving forward.

The project QAM is responsible for scheduling audits and surveillances at the site to include subcontractor activities. Surveillance activities may be scheduled or unscheduled monitoring activities. Additional audits or surveillances may be scheduled based upon audit result, repetitive nonconformances, and other conditions that could affect the quality of the project.

11.3 QUALIFICATIONS OF ASSESSORS

Surveillances may be performed by the QAM and QA Staff. Other project personnel with technical training, education, or experience commensurate with nature of a specific areas or activities may assist or perform surveillance activities in that area as long as they do not have direct responsibilities in the area to be assessed. All surveillances will be performed under the guidance of the QAM.

APPENDIX A

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IT Corporate Standard
Quality Practices

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APPENDIX B

Referenced IT Corporate Standard Quality Practices and Operating Procedures

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'ed by:

STANDARD QUALITY PRACTICE

PROCUREMENT DOCUMENT CONTENT, CONTROL, AND REVIEW

1.0 Scope and Objectives

Items or services provided to IT by suppliers or subcontractors must be of a quality commensurate with the quality-related requirements of the project. The requirement for the provision of a specified quality for an item or service is provided to suppliers and subcontractors through procurement documents. This SQP applies to purchasing of a technical nature. It is applicable to technical equipment rental which is to have the same level of procurement specification and review as technical equipment purchased by the Corporation. The procurement requirements listed herein do not apply to nonproject-specific items such as office supplies, furniture and computing equipment, for example.

2.0 Definitions

Procurement Documents. Procurement documents include: Purchase Requisitions (for the purpose of internal review), Purchase Orders, Telephone Purchase Orders, Contracts, Contract Change Orders, Work Agreements, and Task Orders.

3.0 Methodology

3.1 Document Content

Procurement documents must describe or reference applicable requirements for personnel qualification (e.g., requisite Certifications, Registrations, and Licenses), technical performance standards (e.g., specifications, codes, standards, regulations, procedures, instructions, and test methods), quality requirements, requirements for acceptable performance (e.g., inspection, audits, documentation), permits, and equipment and facilities. Documents must specify the scope of work in sufficient detail so that confusion and misunderstandings are eliminated. As appropriate, the documentation must include a schedule for the completion of work performed.

To the extent necessary, procurement documents must require suppliers and subcontractors to have a documented quality assurance (QA) program commensurate with the complexity, cost, and performance characteristics of the item or service being procured. For work or items

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similar to work or items typically performed or manufactured by IT, and where a item or service cannot be provided internally, the supplier's/subcontractor's QA program should at a minimum meet IT standards as delineated in division QA Manuals. Alternatively, IT QA requirements may be "passed down" by specifying QA requirements in the procurement documents. The degree of independence of the subcontractor's service, for example, must be considered in determining the procurement controls needed. As a general comment, the more independent a subcontractor/supplier is of IT supervision, the more stringent should be the QA requirements placed upon the subcontractor/supplier.

3.1.1 Relationship of Procurement Document Information to the IT Corporation Work Agreement

Subcontractors providing service to IT are required to execute a IT Corporation Work Agreement. Several sections of the Work Agreement reference or rely on information provided in the procurement documentation. Line items as numbered in the Work Agreement and corresponding procurement document content (as specified in 3.1 above) follow.

1. **ITEMS SUPPLIED.** Except for items and facilities furnished by Company as set forth on the Purchase Order, Contractor shall furnish at its expense all labor, services, equipment, appliances, tools, facilities, and materials necessary to commence and complete said work, in good, expeditious, and workmanlike manner.

   The QA Program requires that procurement documentation include or reference a scope of work including information concerning appropriate equipment and facilities as well as technical specifications (e.g., materials and constructions).

2. **DELAY.** Contractor shall commence and complete the work in accordance with the schedule set forth in the Purchase Order and shall defend, indemnify and hold the Company harmless for any additional expenses or damages arising out of any delay or Contractor's inability to proceed with the work.

   The QA Program requires that, as necessary, a schedule for the completion of work performed be included in the procurement documentation.

3. **CONTRACT PRICE; BILLING.** Unless otherwise agreed upon in writing, Company shall pay Contractor for said work upon Company's acceptance of the work...

   The QA Program requires that, as necessary, the procurement documentation specify requirements for acceptable performance.

5. **COMPLIANCE WITH LAWS AND EQUAL OPPORTUNITY.** Contractor agrees to obtain and maintain all permits and licenses required for Contractor's performance of said work...

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The QA Program requires that requisite personnel qualifications and permits be specified in the procurement documentation.

21. **DELIVERY.** Time is of the essence to Company. Tender of goods or services shall be made in the manner and on the date specified on the Purchase Order.

    As with Line Item 2, the QA Program requires that, as necessary, the procurement documentation specify any required schedule.

3.2 Procurement Document Control and Review

Procurement document control and review is a joint responsibility of Purchasing, Project, and QA personnel. Procurement documentation can include, as appropriate:

- Request for proposal
- Specifications and scopes of work
- Quotes (proposals) submitted by subcontractors
- Telephone conversation documentation
- Meeting notes
- Purchase Requisitions
- Purchase Orders
- Prequalification Forms
- Bid reviews
- Bid comparisons
- Change order documentation.
- Subcontractor performance verification.

A checklist of items to be considered in reviewing technical purchase requisitions is presented in Table ITC0004-1.

3.2.1 Responsibilities of Project Personnel

Project personnel are responsible for the following:

- Requesting, through the appropriate purchasing office, the prequalification of suppliers and subcontractors. Subcontractor prequalification is described in SQP ITC0005.

- Soliciting quotations from prequalified subcontractors. Potential subcontractors should be supplied, as necessary, with information concerning the scope of work. This information can be provided in a written request for proposal, documented in a Record of Telephone Call, or provided in a copy of the specifications or pertinent sections of the Request for Proposal (the latter should be accompanied by a letter of transmittal).

- Maintaining records of telephone conversations and meeting notes.

- Evaluating and comparing quotations for economic and technical appropriateness.

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- Submitting Purchase Requisition to the appropriate QA personnel for review. The Purchase Requisition should contain all the requisite items identified in Section 3.1 of this SQP. After QA approval the Requisition is submitted to the appropriate purchasing office

- Initiation of change order documentation for work performed by subcontractors. Change Orders should be as complete in scope as the original procurement documentation. Change control is described in ITC0008

- Documenting the review of subcontractor performance as required (described in ITC0006).

3.2.2 Responsibilities of QA Personnel

The QAO, or a reviewer assigned by the QAO, is required to review and approve all Purchase Requisitions of a technical nature. The QAO, or designee, is to review technical Purchase Requisitions for completeness of the appropriate requirements listed in Section 3.1 of this SQP. Documentation of the review shall be by signing the Purchase Requisition "QA Review and Approval by:". Items and/or services that do not meet QA requirements shall not be accepted.

3.2.3 Responsibilities of Purchasing Personnel

Supplier and Subcontractor procurement documentation approval shall be indicated as required by IT purchasing policies.

3.3 Procurement Document Availability

Copies of all contracts, contract change orders, bid request, bid evaluations, purchase requisitions, correspondences, and subcontractor performance verification shall be maintained as records in the project file. Copies of Purchase Orders, Subcontractor Prequalification Forms, subcontractor performance verification, and other documents required by IT purchasing policies will be maintained by purchasing personnel as required.

4.0 Format/Forms

A standard IT Purchase Requisition is presented in Figure ITC0004-1. An example of a completed Purchase Requisition is presented in Figure ITC0004-2.

5.0 References

None.

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TABLE ITC004-1

TECHNICAL REQUISITION REVIEW CHECKLIST FOR THE QUALITY ASSURANCE OFFICER OR DESIGNEE

1. Is the proper IT Purchase Request (PR) form being used (i.e., Telephone Purchase Order, PR, Intercompany PR or AFE)?

2. Is the Vendor completely identified and the mandatory vendor number included?

3. Is Merchandise/Equipment completely described with respect to the following as applicable?

   - material specification/coatings
   - units/unit rates
   - special or safety features
   - color
   - size
   - model, ID No., or specific years
   - capabilities
   - quantity
   - special time frame
   - any certifications

4. Are Services completely detailed with respect to the following, as applicable?

   - specific functions to be performed (SCOPE)
   - time frame needed, reporting times, dates (SCHEDULE)
   - manhours required or estimated?
   - labor rates/ (BUDGET)
   - site/locations
   - qualifications of workers
   - methods to be employed
   - safety or quality requirements
   - other special requirements
   - reports/documentation desire

5. In general, does this PR contain enough information to act as a contract between IT and the vendor for merchandise or services to be obtained?

6. Has the proper management authorization signature been obtained?

7. Have you, as the designated reviewer, initialed the PR?

8. Is the PR entered in the office log?

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INTERNATIONAL TECHNOLOGY CORPORATION

PURCHASE REQUISITION

045163

VENDOR NAME		REQUISITION DATE	ORIGINAL PO ☐ CHANGE ORDER ☐ No.
VENDOR ADDRESS		VENDOR NUMBER	NEW ☐ NAME CHANGE ☐ ADDRESS CHANGE ☐
CITY & STATE	ZIP CODE	VENDOR PHONE NO./CONTACT	
SUGGESTED SUPPLIER (IF SINGLE SOURCE ATTACH JUSTIFICATION) 1	PHONE NO	CONFIRMATION ☐ NO ☐ YES-NAME OR QUOTE NO.	
ADDRESS CITY & STATE	ZIP CODE	SHIP TO	
SUGGESTED SUPPLIER 2.	PHONE NO.	ADDRESS	
ADDRESS CITY & STATE	ZIP CODE	CITY & STATE	ZIP CODE
BILL TO (IF DIFFERENT FROM SHIP TO)		ATTENTION	
ADDRESS CITY & STATE	ZIP CODE	BILLABLE ITEM ☐ YES ☐ NO	NEED DATE / DATE ORDERED / SHIP DATE
REQUESTED BY	PHONE NO.	F.O.B./SHIPPING TERMS	
ORIG. SAT./REGION / PROFIT CENTER	JOB/PRJ/AFE NO.	CREDIT TERMS	
CLIENT CONTRACT NO./PROJECT TITLE	☐ GOVT. ☐ COMM.	PREMIUM FREIGHT AUTHORIZED ☐ NO ☐ YES MODE	SHIP VIA

LINE ITEM	QUANTITY	U/M	PART NO. AND DESCRIPTION	PHASE	TASK	SUB TASK	PRODUCT CTL NO	UNIT PRICE	EXTENDED PRICE

SOURCE SELECTION CODES A B C D E F G H I J	QA. INT	MIN. BUY ☐	EST'D TOTAL COST	AUTHORIZED SIGNATURE / DATE APPROVED	SUBTOTAL
BUYER/S NAME	PHONE NO.	BUYER'S SIGNATURE		I.D. NO	TAX(____%)
REMARKS/P.O. NOTES					FREIGHT
					TOTAL

PURCHASING

801-9-90

Figure ITC0004-1
Standard IT Purchase Requisition
(Reduced)

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INTERNATIONAL TECHNOLOGY CORPORATION

PURCHASE REQUISITION

045163

VENDOR NAME		REQUISITION DATE	ORIGINAL P.O. ☐ CHANGE ORDER ☐ No.
VENDOR ADDRESS		VENDOR NUMBER	NEW ☐ NAME CHANGE ☐ ADDRESS CHANGE ☐
CITY & STATE	ZIP CODE	VENDOR PHONE NO./CONTACT	
SUGGESTED SUPPLIER (IF SINGLE SOURCE ATTACH JUSTIFICATION) 1.	PHONE NO	CONFIRMATION ☐ NO ☐ YES–NAME OR QUOTE NO.	
ADDRESS CITY & STATE	ZIP CODE	SHIP TO	
SUGGESTED SUPPLIER 2.	PHONE NO	ADDRESS	
ADDRESS CITY & STATE	ZIP CODE	CITY & STATE	ZIP CODE
BILL TO (IF DIFFERENT FROM SHIP TO)		ATTENTION	
ADDRESS CITY & STATE	ZIP CODE	BILLABLE ITEM ☐ YES ☐ NO / NEED DATE	DATE ORDERED / SHIP DATE
REQUESTED BY	PHONE NO.	F.O.B./SHIPPING TERMS	
ORIG. SAT./REGION / PROFIT CENTER / JOB/PRJ/AFE NO.		CREDIT TERMS	
CLIENT CONTRACT NO./PROJECT TITLE	☐ GOV'T. ☐ COMM.	PREMIUM FREIGHT AUTHORIZED ☐ NO ☐ YES MODE	SHIP VIA

LINE ITEM	QUANTITY	U/M	PART NO. AND DESCRIPTION	PHASE	TASK	SUB TASK	PRODUCT/ C/L NO	UNIT PRICE	EXTENDED PRICE

SOURCE SELECTION CODES A B C D E F G H I J	QA INT	MIN. BUY ☐	EST'D TOTAL COST	AUTHORIZED SIGNATURE / DATE APPROVED	SUBTOTAL
BUYER'S NAME	PHONE NO.	BUYER'S SIGNATURE	I.D. NO.		TAX(____%)
REMARKS/P.O. NOTES					FREIGHT
					TOTAL

PURCHASING

801-0-90

Figure ITC0004-2
Example; Completed Purchase Requisition
(Reduced)

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ved by:

STANDARD QUALITY PRACTICE

CHANGE/NONCONFORMANCE CONTROL, REQUISITE DOCUMENTATION, REVIEW, AND APPROVAL

1.0 Scope and Objectives

This Standard Quality Practice (SQP) delineates the system used by the Corporation in the control and documentation of changes and nonconformances during the fulfillment of contract obligations. Documentation of change control is appropriate to all divisions and includes changes/nonconformances involving services (e.g., field activities, engineering/scientific design and evaluation, laboratory activities), and manufacturing (e.g., engineering/scientific design and evaluation, construction/manufacturing activities, field installation.

Change must be documented, evaluated, and, if necessary, reported. Changes/nonconformances can represent the severest test for maintaining control and continuity of a project. It is necessary to manage change and nonconformance so that the actual course of the project work or product development, instead of the original planned work activities/product, can be demonstrated and justified.

During evaluation, the cognizant manager shall consider whether the change/nonconformance affects the scope of work, project plans, design requirements or product development. If so, the change/nonconformance shall be reported as soon as possible to the client and/or regulatory agency. Reporting shall include, as appropriate, the effect of the change upon schedule, cost, the course of work, the quality of work, and the final result. For projects that have a scope of work defined by an IT proposal or client contract, it is imperative that the scope of work and product requirements be revised to reflect the work as actually performed.

2.0 Definitions

2.1 Record of Technical Change

Controlled variances from the original scope of work or work instructions. These changes can result from modifications required to complete the project or product and meet the original project, regulatory, product or design requirements. They may also result from modifications

to the original project scope of work, or original regulatory product or design requirements.

2.2 Contract Change Order

Contract Change Orders result from modifications to the original contract or work agreement. Modifications can include changes in costs, scope, or design requirements. Many technical changes will result in the issuance of a Contract Change Order.

2.3 Nonconformance

An uncontrolled and unapproved change or deviation which does not meet project/product requirements, procurement document criteria, contractual scope of work, approved work procedures, or acceptable IT practice (e.g., malfunctions, failures, and unapproved technical changes).

3.0 Methodology

3.1 Change Control, Technical Changes

Technical changes can be initiated by IT or the client in response to a contractual change, or a modification to the scope of work or design requirements. Technical changes are controlled changes to a project plan or procedure, or to construction and design instructions. Technical changes are approved by the IT Associate(s) whose responsibility and authority include project or product managerial oversight (e.g., Project Manager, Product Manager, Site Manager, Facility Manager). Additionally, technical changes are reviewed and approved by the appropriate Quality Assurance/Quality Control personnel (e.g., Quality Assurance Officer, Quality Control Manager, Quality Control Coordinator), and the client as appropriate or required. Technical changes are documented with a Record of Technical Change (Figure ITC0008-1) and in the project chronological Change Log (Figure ITC0008-2). The Change Log should follow immediately after the Project File Index in the project file.

3.2 Change Control, Contractual Change

Contract Change Orders (Figure ITC0008-3) require client execution and both IT and client approval. Changes in work scope and design requirements, as described in the Record of Technical Change, must be included on the Contract Change Order. As an alternative, a copy of the Record of Technical Change may be transmitted to the client with the Contract Change Order. As with Records of Technical Change, Contract Change Orders are documented in the Change Log.

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3.3 Nonconformance Control

Each nonconformance is documented by the Associate, Associates, or subcontractor originating it. Deviations are documented on a Nonconformance Report form (Figure ITC0008-4). Nonconformance disposition must be approved by the Associate(s) whose responsibility and authority include project or product managerial oversight (e.g., Project Manager, Product Manager, Site Manager, Facility Manager). Additionally, nonconformances are reviewed and approved by the appropriate Quality Assurance/Quality Control personnel (e.g., Quality Assurance Officer, Quality Control Manager, Quality Control Coordinator).

Documentation is made available to IT project management, laboratory management, QA personnel, site personnel, and subcontractor management, as appropriate. Management, and/or Quality Assurance personnel are required to notify the appropriate Associates (those impacted by the nonconformance) of the disposition of the nonconformance. For example, most specifications for construction activities require that all nonconformances be resolved to the satisfaction of the oversight contractor prior to construction on top of the nonconforming work. In this case, work activities could not continue until site personnel were notified of the disposition by management. Nonconformances are additionally used to identify chronic problems. Quality Assurance personnel review nonconformances to identify recurring problems, discuss potential solutions with management, and track corrective action(s).

Nonconformances can include, for example, specification or delivery of items or services that do not meet the contractual requirements; errors made in following work instructions, or improper work instructions; unforeseeable or unplanned circumstances that result in items or services that do not meet quality, contractual or technical requirements; technical modifications to the project or product by Associates without the responsibility and authority; and errors in craftsmanship and trade skills.

4.0 Format/Forms

- Record of Technical Change; Figure ITC0008-1
- Change Log; Figure ITC0008-2
- Contact Change Order; Figure ITC0008-3
- Nonconformance Report; Figure ITC0008-4

5.0 References

None.

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RECORD OF TECHNICAL CHANGE

Technical Change No. _____ Page_____ of_____

Project/Job No. _____ Date _____

Project/Job Name _____

Phase/Task _____

The following technical changes (including justification) are requested by:

_____ _____

(Name) (Title)

The project time will be (Increased)(Decreased)(Unchanged) by approximately _____ days

Applicable Project-Specific Document(s):

CC:

Approved By: _____ Date _____
(Project Manager)

_____ Date _____
(Quality Assurance Officer)

Client Notified Yes____ No____ Date _____

Contract Change Order Required Yes_____ No _____

Contract Change Order No. _____

Figure ITC0008-1

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CHANGE LOG

Project/Job No. _____ Page____ of_____

Project/Job Name _____

Phase/Task _____

DATE	CONTRACT OR TECHNICAL	NO.	SCOPE OF CHANGE

Figure ITC0008-2

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INTERNATIONAL TECHNOLOGY CORPORATION

CONTRACT CHANGE ORDER

CHANGE ORDER NO.

DATE

JOB NO.

CUSTOMER CONTRACT/P.O. NO.

JOB NAME

TO:

REVISED CONTRACT AMOUNT

Original Contract Amount		$ .....
Amount of Previous Change Orders		
	ADD	$ .....
	DEDUCT	$ .....
Amount of this Change Order		
	ADD	$ .....
	DEDUCT	$ .....
Revised Contract Total		$ .....

We are making the following changes in this contract in accordance with (Written) (Oral) instructions received from:

_____ (Name) _____ (Title) _____ (Date)

The project time will be (Increased) (Decreased) (Unchanged) by _____ days, thus revising the date of substantial completion as a result of this change to _____ (Date).

The work covered by this change order shall be performed in accordance with the same terms and conditions as included in the original contract, except as noted above.

CHANGES APPROVED BY:

_____

BY _____

TITLE _____

DATE _____

INTERNATIONAL TECHNOLOGY CORPORATION

BY _____

TITLE _____

DATE _____

WHITE - CLIENT YELLOW - FIELD PINK - OFFICE GOLD - ACCOUNTING 304A-9-86

Figure ITC0008-3

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NONCONFORMANCE REPORT

Project/Job No. _____ Page____ of____

Project/Job Name _____ Date _____

Phase/Task _____

Nonconformance:

Identified By: _____ Date:_____

Corrective Action Required:

To Be Performed By: _____ Date:_____
Must Correction Be Verified? Yes____ No_____
To Be Verified By: _____
Prepared By: _____ Date:_____

Corrective Action Taken:

Performed By: _____ Date:_____
Verified By: _____ Date:_____

CC:

Approved By: _____ Date: _____
_____ Date: _____

Figure ITC0008-4

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ved by:

STANDARD QUALITY PRACTICE

COMPUTER SOFTWARE DEVELOPMENT AND USAGE

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1.0 Scope and Objectives

This Standard Quality Practice (SQP) outlines the procedure which provides quality assurance controls for the development, documentation, verification, application, revision, and protection of software. The SQP is intended for general application to engineering, scientific, and business software used throughout IT.

The primary objective of this procedure is to establish requirements for controlling the development and use of computer software so that confidence can be placed in the results of computer analyses.

This procedure applies to the quality-related activities performed by IT and its consultants during software development, application, and maintenance. It is intended for application to all software ranging from complex codes to simple spreadsheets. The procedure provides requirements and controls that are commensurate with the complexities and intended use of the software.

2.0 Definitions

See Table ITC0010-2.

3.0 Methodology

3.1 Software Development

Developed or acquired software can be organized into two categories, namely:

- Major Computer Codes
- Peripheral Computer Codes

Major computer codes are codes that meet either of the following criteria: (1) a code that translates mathematical models describing natural or engineered systems into computer language, and/or (2) a code intended for repeat usage over an extended period of time. For the purposes of this procedure, major computer codes can include spreadsheets that meet either of the above criteria. Major codes can represent problem solutions using either analytical or numerical methods.

Peripheral codes are computer routines used for the manipulation or reduction of data such as changing data formats, data unit conversions, or generating special files. Often, peripheral

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codes are special purpose and used only once. **Most spreadsheet applications will be considered peripheral codes.**

It is the responsibility of the code developer/user to determine whether the code is a major or peripheral code. This determination must be approved by the Project Manager and the Quality Assurance Officer.

3.1.1 Major Computer Codes

Prior to the development of a major computer code or the modification of an existing code (to the extent that its numerical capabilities or intended use is to be changed), the responsible Project Manager will formally identify a Technical Leader. The responsible Technical Leader will assemble a Technical Review Group of at least three persons including himself/herself and, at a minimum, the Quality Assurance Officer and one additional technical staff member. The Technical Review Group will determine the necessary elements for development and documentation of the code on a case-by-case basis. Elements to be considered are included in Section 3.2, Table ITC0010-1, and Table ITC0010-2. The review will consider whether the mathematical model is adequate for translation into computer language or whether additional work must be performed prior to code generation. The written recommendations of the Technical Review Group will be communicated to the Project Manager for approval prior to implementation. Documentation of Technical Review Group recommendations will be maintained in the project files.

While the code is being generated, the Technical Leader, or designee, will maintain documentation of code development activities and progress by using a standard log (e.g., Figure ITC0010-1), progress reports, or other means consistent with code complexity. A code listing and computer backup to document major steps in the code development process will also be maintained.

After the code has been developed and verified (Section 3.3), the Technical Leader will reassemble the Technical Review Group to evaluate the existing documentation (Section 3.2) and make recommendations for finalizing the code. Group findings will be documented in a report and submitted to the Project Manager for review. Technical Review Group reports should include the following:

- Date(s) of review
- Participants

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- Items reviewed
- Statement of agreement or disagreement with items reviewed, including the means for resolving disagreements
- If questions remain unresolved beyond the end of the review, the means for closing the questions must be identified.

The Technical Leader will implement the Technical Review Group recommendations following the approval of the Project Manager. Proper implementation of recommendations should be verified by the Quality Assurance Officer (e.g., in subsequent audits).

3.1.2 Peripheral Computer Codes

Peripheral codes will be developed or modified using methods described in Sections 3.2 and 3.3 following. The determination of required code development elements and documentation will be made by the code developer/user and approved by the Project Manager and the Quality Assurance Officer. Elements to be considered will be selected from the items contained in Tables ITC0010-1 and ITC0010-2.

A code listing and computer backup should be maintained, as necessary, by the code developer to document major steps in the development process. A final code listing or hard copy of spreadsheet cell definitions/formulae and floppy disk(s) of each peripheral code will be included in the project or generic computer program files.

3.2 Documentation

Program documentation serves several functions, including:

- Providing operating instructions for the program
- Detailing the theoretical basis for the program computations
- Providing a reference source for individuals checking program input and use
- Providing sufficient information to allow modification of the program.

Documentation consists of user-oriented information, programmer reference information, and the program abstract. User-oriented information may consist of user reference material (e.g., a user manual) and program theory material (e.g., a theory manual). Programmer reference material may consist of a program listing for the latest revision, lists showing changes to the program for each revision, a flow chart, and other programmer information. Program reference material is relevant especially to programs on internal IT computer systems. The program abstract notifies a user of the status of the program and includes verification status, revision number, system on which it operates, and knowledgeable users. The abstracts also may provide

a summary of the program capabilities. Abstracts will provide fast, accurate access to information concerning corporate computer capabilities.

Details of potential program documentation are presented in Tables ITC0010-1 and ITC0010-2 below.

Computer codes developed, modified, or commercially acquired by an IT office should be documented in sufficient detail to meet the needs of the project and the intended use of the code. For this reason, a case-by-case determination of required documentation will be made. The individuals and the code categories for which these individuals have documentation responsibilities are the following:

- Technical Review Group: Major codes either developed or modified to the extent that the numerical capabilities or intended use of the codes have been changed (Section 3.1.1).

- Code User: Major codes acquired by an IT office and used without modification of either intended use or numerical capabilities.

- Code User/Developer: Peripheral codes developed, acquired, or modified in an IT office (Section 3.1.2) and for minor or project-specific modifications to major codes (e.g., changes to input/output formats or simple system compatibility changes).

Each determination will be approved by the Project Manager and the Quality Assurance Officer. Information to be included in the documentation should be selected from the items presented in Tables ITC0010-1 and ITC0010-2. The results of Technical Review Group reviews will be documented as indicated in Section 3.1.1.

Computer output (including listings) will be completely documented, regardless of the nature of the analysis or the computer used. Each output will be clearly identified as to project number, program name, analysis or run title, unique identification number or time (only for output from large computer systems), user's name and date performed, and checker's name and date. The complete output, showing all input and results, shall be printed and either directly incorporated into calculations or kept separately with the project records. When a project is completed, or at intermediate stages depending on the phases of the work, large sets of computer output should be placed in binders having a table of contents. If it is necessary to void computer runs because of changes in model or input parameters, the output will either be destroyed or marked "void" with an explanatory note included, if appropriate.

3.3 Verification/Validation

Verification is the process by which output results of a computer code are determined as "correct." Verification implies that the code solves the numerical problem as intended by the author. Validation implies that the code theory is a correct representation of the process or system for which it is intended. In-house computer codes and purchased, unverified, external codes will be verified in one or a combination of the following ways, depending on the needs of the project and the intended use of the code:

- Independent hand calculations can be performed to verify program algorithms (hand calculations must be documented and verified according to SQP ITC0011.

- The code results can be compared to the results of an "independently developed" code which performs the same calculation. Independent development could mean a code developed outside IT or by a different internal group. If possible, a code should not be checked against a second code developed by the same people unless the methodology is totally different. The input to both the code being checked and the code used for checking should be independently checked.

- The code results can be compared to analyses published in textbooks and journals or the results of testing activities. A complete reference for such material should be provided. This method includes comparison against closed-form analytical solutions.

A case-by-case determination of the required verification/validation will be made. The individuals and the code categories for which these individuals have verification/validation responsibilities are the following:

- Technical Review Group: Major codes either developed or modified to the extent the numerical capabilities or intended use of the codes have been changed (Section 3.1.1).

- Code User: Major codes acquired by an IT office and used without modification of either intended use or numerical capabilities.

- Code User/Developer: Peripheral codes developed, acquired, or modified in an IT office (Section 3.1.2) and for minor or project-specific modifications to major codes (e.g., changes to input/output formats or simple system compatibility changes).

Each determination will be approved by the Project Manager and the Quality Assurance Officer.

Verification must occur prior to transmittal of associated results or their use in subsequent activities, unless the results are clearly marked "Preliminary." Each independent option of a code must be verified.

External programs, which are widely used and documented with sample problems and are considered "industry standards," require limited IT verification. These programs, when acquired, should be tested to demonstrate that the sample problem results are obtainable with the particular hardware/software combination being employed by the user.

Verification efforts will be completely documented. This documentation will include, as appropriate:

- Description of verification method used
- Identification of the specific options verified
- Set of verification comparison materials (e.g., checked hand calculations)
- Verification runs, i.e., checked copy of the computer output
- Results.

Validation documentation, as necessary, will consist of published conclusions comparing model predictions, as embodied in the software, with data from laboratory experiments, field experiments, natural analogues, and published conclusions made by peer review groups. Information regarding conditions for which the model is valid will be documented.

3.4 Software Control

Software control and computer code security will be implemented at each IT office using assigned Code Custodians and requirements for documentation, approval, and distribution of code changes (configuration management). A standard copy of each major code will be maintained by the responsible Code Custodian. Software maintained on personal computers (PCs) should comply with the manufacturer's requirements for commercial code purchases.

3.4.1 Computer Code Custody and Security

Management will formally designate appropriate technical staff as Code Custodians for each major code developed or commercially acquired. In addition, custodians may be assigned for peripheral codes if determined necessary by management or the Quality Assurance Officer. A current Code Custodian assignment list will be maintained and distributed by the Quality Assurance Officer, or designee. The assignment list will be reviewed and revised as necessary.

It is the responsibility of the Code Custodian to maintain a standard (controlled) copy of the assigned code. Standard copies of codes will be protected from unauthorized alteration by use of a security system. This security system may be established within computers or by physically locking or otherwise securing disks containing codes designed for PC use. Access to standard

copies of codes for other than "read-only" use must be authorized by the responsible Project Manager (or Business Unit Manager for generic, multi-purpose codes).

An additional backup copy of each standard code should be maintained by the Quality Assurance Officer, or designee (unless prohibited by copyright or other restrictions).

3.4.2 Configuration Management

Configuration management provides unique identification for software developed or procured by an IT office and maintains a documented chronology of changes made to computer codes.

All computer codes will be assigned a unique identifier. For major codes, this unique identifier should be in the form of "version number/release number." A unique version number (e.g., 1.0) is assigned to a code each time its numerical capabilities or intended use is modified. A new release number (e.g., 1.1) is assigned to a code each time errors are corrected in a previous release. The unique identification should be included in the output and listings of the code.

Each major code version developed or commercially acquired by a given office will be entered into a Software Configuration Log (Figure ITC0010-1) maintained by the responsible Code Custodian. Any subsequent revisions to these codes will also be recorded on the log. Once a code version has been entered into a log, changes to the code may only be made to personal working copies. Changes to standard copies of codes (Section 3.4.1) may only be made upon approval of the responsible Project Manager (or Business Unit Manager for generic, multi-purpose codes) and Quality Assurance Officer. Changes to standard copies of codes and changes to working copies of codes that are utilized in project analyses must be documented and verified in accordance with Sections 3.2 and 3.3, respectively.

Software and documentation associated with superseded codes should be clearly marked "void" or otherwise removed from general use.

3.4.3 Software Inventory

An inventory of all major codes (both internally developed and commercially acquired) residing in a given office will be maintained by management, or designee, and made available to office personnel. The inventory should be updated at least quarterly.

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3.5 Code Applications

The application of computer codes to obtain solutions to project-specific problems includes the interpretation of existing data to develop a conceptual model and the documentation and verification of input/output files following the computer simulation.

3.5.1 Conceptual Model

Conceptual models are required for all code applications. The conceptual model is a translation of existing data into an understanding of the physical system, described mathematically and simulated with a computer code. The conceptual model may also include the effects of human activities.

The responsible Project Manager will review the intended model requirements, relevant data, and important processes (e.g., groundwater flow, contaminant transport, pathway chemical reactions, source-term solubilities, creep closure, air dispersion, etc.) and choose the appropriate computer code to be used. As necessary, the Project Manager may consult with the code Technical Leader, Code Custodian, or knowledgeable staff in making this determination. The Project Staff will develop, document, and verify the conceptual model in accordance with requirements contained in the SQP ITC0011. The final documentation of the conceptual model will be reviewed by the cognizant Project Manager prior to any computer simulations.

3.5.2 Application Documentation

The results of computer analyses will be completely documented. Each analysis output will be clearly identified as to project number, program name, analysis title, unique run identification number of run time (only for output from large computer systems), user's name and date run, and checker's name and date checked. The complete output, showing all input and results, will be printed and either directly incorporated into calculations or kept separately with the project records. Large sets of computer output should be placed in binders having a table of contents. If it is necessary to void computer runs because of changes in model or input parameters, the output will be destroyed or marked "void" and an appropriate explanatory note included.

3.5.3 Application Verification

Computer input will be formally checked using the standard process outlined in SQP ITC0011. A single exception to this process is that the checking may be performed on the input originals. Verification (checking) shall include a conceptual review of the program itself based on the problem being solved, a review of the computer model employed, a check that the program has been verified, and a formal check of the input data.

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3.6 Records Management

All records generated during software development, application, and control will be maintained according to applicable requirements in Section 6.0 of the IT EES QA Manual, and in particular with SQPs ITEES0006 and ITEES0007. Documentation associated with project-specific codes should be maintained in the project files, either as separate files or incorporated directly into associated calculations. Documentation associated with generic codes (i.e., codes applicable to more than one project) should be maintained in a Generic Computer Program file. This file will be organized by computer code name and subdivided into categories as shown in Table ITC0010-2.

Because of its bulk, large computer output may be stored separately from the central files. The output will be identified and indexed (e.g., as a calculation) in the appropriate file index.

4.0 Format/Forms

The potential documentation and the format for such documentation are presented in the following tables.

5.0 References

None.

Table ITC0010-1
Computer Program Abstract Form[1]

PROGRAM:[2,3]

CATEGORY:

REVISION NUMBER:[2,3]

DATE REVISED:[2,3]

DESCRIPTIVE SUMMARY:[2,3]

RELATED PROGRAMS:

OPERATIONAL DEMANDS:[2,3]

CLASSIFICATION

STATUS:

ORIGIN:

AUTHOR:

PROGRAMMER:

KNOWLEDGEABLE PERSONS:

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See footnotes at end of table.

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Table ITC0010-1
Computer Program Abstract Form[1]
(Continued)

DOCUMENTATION:

A. USER INFORMATION

1. Input Data[2,3]

2. Output Description[2,3]

3. Data Files

4. System Interface

5. Subroutines

6. Flow Chart

7. Error Processing

8. Options

9. Initialization

10. Restart Capabilities

11. Sample Problems

B. THEORY INFORMATION

1. Model Development
2. Mathematical Derivations[2,3]

See footnotes at end of table.

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Table ITC0010-1
Computer Program Abstract Form[1]
(Continued)

C. PROGRAMMER INFORMATION

1. Software Configuration Log[3]
2. System Dependent Properties
3. Listing (or cell formula definition)[2,3]

D. VERIFICATION[2,3]

1. Sample Problems
2. Test Data
3. Benchmarking
4. Line-by-line Check of Listing
5. Option Matrix

E. REFERENCES

F. OTHER

ABSTRACT PREPARED BY:[3]

_____ DATE: _____

MANAGEMENT APPROVAL:[3]

_____ DATE: _____

QA APPROVAL:[3]

_____ DATE: _____

[1]An abstract is required for each version of a major code.

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Table ITC0010-1
Computer Program Abstract Form[1]
(Continued)

[2]Minimum requirements for peripheral codes. This abstract form or other appropriate means of documentation (e.g., calculations) may be used.

[3]Minimum requirements for major codes.

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Table ITC0010-2
Computer Program Abstract Definitions[1]

PROGRAM:[2,3] Program name.

CATEGORY: The general type of software and subject matter.

REVISION NUMBER:[2,3] Indicates program version/release. If number = 0.0, original program is unchanged. Each time the program goes through a major change, it received a new version number (e.g., 1.0) whereas minor changes such as error corrections are indicated by a new release number (e.g., 0.1). A new abstract is required for all major changes.

DATE REVISED:[2,3] The date indicates when the current program source code was finalized.

DESCRIPTIVE SUMMARY:[2,3] What does the program solve? What are the purpose and scope of the program? Indicate the mathematical techniques, assumptions, etc., that the program uses in order to solve the problem. What are the limitations of the program?

RELATED PROGRAMS: Pre- and post-processors and parallel programs, including names of other programs from which this program was derived.

OPERATIONAL DEMANDS:[2,3] Enter the machine model name for which the program was developed and the compatible IT systems. Specify the required memory, run time, program size, and languages.

CLASSIFICATION: Indicate whether unrestricted, proprietary, or other.

STATUS: Indicate whether program is operational, in development, or obsolete (name replacement program).

ORIGIN: Indicate whether in-house or external. If external, give the name and address of the organization or persons who originated the program.

AUTHOR: Person(s) who decided and/or modified program specifications.

PROGRAMMER: Person(s) who coded the problem in a computer program language.

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See footnotes at end of table.

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Table ITC0010-2
Computer Program Abstract Definitions[1]
(Continued)

KNOWLEDGEABLE PERSONS: In-house users familiar with the program who may be contacted concerning its application.

DOCUMENTATION: Indicate whether or not documentation exists for each of the following, and if it does, either supply the required information or reference the material and its location.

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See footnotes at end of table.

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Table ITC0010-2
Computer Program Abstract Definitions[1]
(Continued)

A. USER INFORMATION

1. Input Data (e.g., description[2,3] variables, format, default values, record identifier, need, repetition, range)

2. Output Description[2,3] (e.g., variables, units, format)

3. Data Files (e.g., organization, content, execution of files)

4. System Interface (e.g., required hardware, compilers, load options, command files)

5. Subroutines

6. Flow Chart (e.g., the relationship of routines within the code and the relationship with other codes)

7. Error Processing

8. Options

9. Initialization

10. Restart Capabilities

11. Sample Problems

B. THEORY INFORMATION

1. Model Development (e.g., the purpose, scope, assumptions, limitations, stability/accuracy, notation and derivation of the model. Include mesh generation, boundary conditions, and convergence criteria as appropriate.)

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See footnotes at end of table.

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Table ITC0010-2
Computer Program Abstract Definitions[1]
(Continued)

2. Mathematical Derivations[2,3] (e.g., a step-by-step derivation of the problem solution process or reference to standard routines.)

C. PROGRAMMER INFORMATION

1. Software Configuration Log[3]
2. System Dependent Properties
3. Listing (or cell formula definition)[2,3]

D. VERIFICATION[2,3]

(One or more method of verification, Items 1-3 below, must be performed on each program and each revision.)

1. Sample Problems (Comparison of the program output to hand calculated or published solutions.)

2. Test Data (Comparison of the program output to physical test results.)

3. Benchmarking (Comparison of the program to other, similar codes.)

4. Line-by-line check of listing.

5. Option Matrix (An option versus verification matrix to show which specific program options have been verified.)

E. REFERENCES

List any references applicable to the program development and use.

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See footnotes at end of table.

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Table ITC0010-2
Computer Program Abstract Definitions[1]
(Continued)

F. OTHER

Provide any other documentation not described above.

ABSTRACT PREPARED BY:[3]

_____ DATE: _____

MANAGEMENT APPROVAL:[3]

_____ DATE: _____

QA APPROVAL:[3]

_____ DATE: _____

[1]An abstract is required for each version of a major code.

[2]Minimum requirements for peripheral codes. This abstract form or other appropriate means of documentation (e.g., calculations) may be used.

[3]Minimum requirements for major codes.

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Table ITC0010-3
Generic Computer Program File Organization

Index

A. - Abstract

B. - Revision/Verification Master Log

C. - Correspondence

D. - User Information. Can include user's manuals, input/output descriptions, flow charts, data file descriptions, error messages, option descriptions, etc.

E. - Theory Information. Can include sample problems, calculations relevant to model/code development, assumptions, limitations, symbols, and discussion of accuracy and stability.

F. - Programmer Information. Can include program flow chart and listing.

G. - Verification. Can include checked hand calculations, test problem input/output, comparison materials, option verification matrix, etc.

H. - References

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IT _____

SOFTWARE CONFIGURATION LOG

COMPUTER PROGRAM NAME: _____

PAGE ____ OF ____

PROJECT NO.: _____

Version/Release or Development Step	Logged By	Date Logged	Description	Associated Documentation	Verification Status

Figure ITC0010-1
Software Configuration Log

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ved by:

STANDARD QUALITY PRACTICE

FIGURES, TABLES, AND LOGS

1.0 Scope and Objective

The Standard Quality Practice (SQP) describes procedures for developing and verifying figures, tables, and logs.

2.0 Definitions

2.1 Figures

Any graph, map, schematic, illustration, or scientific or engineering drawing that is included in an IT report, proposal, work or sampling plan, etc., is referred to as a figure. Such a figure is given a figure number (e.g., Figure ITC0012-1) for the purpose of referencing it in the text of the report or other document. Simultaneously, each such figure is to have a drawing number (e.g., C03508-B1) which uniquely identifies that figure among all figures produced in IT. The drawing number is essential to retrievability.

Figures may be subdivided into two categories, i.e., informative and design. Each category will be subject to different quality assurance requirements.

2.2 Tables

Listings of data which are identified as separate entities within a report, proposal, etc.

2.3 Logs

These are illustrations of subsurface conditions (i.e., boring logs).

2.4 Drawings

One category of figures is drawings that are used in engineering and/or science to convey technical data. Drawings may be developed from a number of sources, including tabulated data and detailed design calculations.

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The term "drawings" will be limited to figures of the engineering and scientific variety which contain technical data.

2.5 "Stand-alone" Criterion

The concept of this criterion is that each figure, table, or log is to contain sufficient identification to uniquely identify the project, report, proposal, plan, etc., to which the item belongs. For figures, the drawing number and title information satisfies the criterion. For logs, the information requested on the IT boring logs also satisfies this criterion. For tables, however, the information must be provided by the project staff. Table information is to include as a minimum, table title, project name, and project number. Additional title information such as document type (e.g., proposal, draft report, report, work plan), site location, work task, and workphase may be supplied as a function of project complexity and/or work volume for a given client.

3.0 Methodology

3.1 Preparation and Verification of Figures

The two basic categories of figures and the types of figures that occur in each category are identified in Figure ITC0012-1.

Informative figures may be considered to be completely checked if the originator has reviewed such figures in detail and is satisfied with the contents. This is particularly applicable to figures that are transcriptional in content (e.g., figures composed of a graph from verified calculations). There may be instances, however, which may require that an informative figure receive independent checking (i.e., nontranscriptional verification).

In contrast, design drawings are to be checked according to the principle used in the checking of calculations, i.e., by someone of equal or greater knowledge and/or experience compared with the designer (originator) of such drawings. Design drawings undergo nontranscriptional verification only.

3.1.1 Informative Figures

Informative figures are to be prepared in accordance with the requirements of IT's Standard Format Manual and other applicable graphics standards of IT Corporation's Drafting Departments. Exceptions to this requirement shall be according to client request only. In any

case, each figure shall have a unique drawing number issued by the drafting department and each figure shall be logged and filed in the drafting department.

The procedure for developing and verifying informative figures is the following:

- Deliver to the drafting department original data, maps, graphs, sketches, or magnetic drafts of any of these. Select the drawing size from the four standard sizes used by IT, namely A, B, E, and M.

- The drafting department is to present to the originator a stamped checkprint which the originator is to check against the original data using a yellow marker and red pen in the standard QA manner, i.e., elements that are correct shall be marked yellow and corrections shall be marked in red.

- To complete the checking process, the checkprint is to be marked "CP1" (Checkprint No. 1), initialed, and dated on the lines allocated. The drafting department is not to proceed with alterations without having this checkprint procedure completed.

- The drafting department is to use a blue marker to signify completion of alterations indicated by red markings on the checkprints and a new checkprint along with the previous checkprint is to be issued to the originator. The originator is to signify that the corrections were made by marking in yellow the alterations that were made (to the extent the alterations were made correctly). To complete the checking process, the second checkprint is to be identified as "CP2," initialed, and dated.

- Whenever the checkprint issued by the drafting department is in complete agreement with the originator's intentions regarding the contents, the figure may be included in a report or proposal for overall review.

- Should further changes arise from the review process, alterations should proceed as given above.

- Before inclusion in the report or proposal, the original drawing is to be initialed and dated in the assigned locations (checked by ___ and approved by ___) by both the originator and project manager.

- Checkprints are to be placed in Category "0" of the project records in the central files. Three options exist at the discretion of the project manager: all the checkprints showing the sequence of corrections may be filed, or the final checkprint may be yellowed completely and filed and all prior checkprints discarded, or the final checkprint may be marked across with a yellow line and the final corrections yellowed, initialed and dated, and all prior checkprints discarded.

- The project group is responsible to the project manager (who is ultimately responsible) for timely filing of the drawing checkprints in the central files.

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3.1.2 Engineering and Scientific Design Drawings

The procedure for developing and verifying design-related drawings is as follows:

- The originating engineer is to deliver detailed and dimensional sketches to the drafting department and also select the drawing size from the four standard sizes used by IT, namely A, B, E, and M.

- The drafting department is to present to the originator a stamped checkprint which is to be checked against the original data using a yellow marker and red pen in the standard QA manner, i.e., elements that are correct shall be marked yellow and corrections shall be marked in red.

- To complete the checking process, the checkprint is to be marked "CP1" (Checkprint No. 1), initialed, and dated on the lines allocated. The drafting department is not to proceed with alterations without having this checkprint procedure completed.

- The drafting department is to use a blue marker to signify completion of alterations indicated by red markings on the checkprints and a new checkprint along with the previous checkprint is to be issued to the originator. The originator is to signify that the corrections were made by marking in yellow the alterations.

- The originator at some point in the checking process is to submit a checkprint to an independent party who has been designated by the project manager to verify the drawing and who is qualified to check all aspects of the design. The originator may choose to submit the second checkprint, or any subsequent checkprint for this review. After the independent party has reviewed the checkprint, the checkprint numbering is to be incremented by one (e.g., CP2, CP3) and the initials of the independent checker and the date of checking are to be written on the checkprint.

- Whenever the checkprint issued by the drafting department is in complete agreement with the design and the originator's and checker's intentions regarding the contents, the drawing may be included as a figure in a report or other document for overall review.

- Should further changes arise from the review process, alterations should proceed as given above.

- Before inclusion in the report or proposal, the original drawing is to be initialed and dated in the assigned locations by both checker and project manager.

- Checkprints are to be placed in the Category "0" of the project records in the central files. Three options exist at the discretion of the project manager: all the checkprints showing the sequence of corrections may be filed; or the final checkprint may be completely marked in yellow and filed and all prior checkprints discarded; or the final checkprint may be marked across with a yellow line and the final corrections yellowed, initialed and dated, and all prior checkprints discarded.

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- The project group is responsible to the project manager (who is ultimately responsible)

for timely filing of the drawing checkprints in the central files.

3.2 Preparation and Verification of Tables

Tables shall be prepared in compliance with the requirements of IT's Standard Format Manual for proposals, reports, covers, resumes, and correspondence. The table title should include, as a minimum, description, project name, and project number. Additional title information shall be provided as a function of:

- Project complexity (e.g., multiple task or phases)
- Deliverables (e.g., proposals, draft report, final report, work plan, sampling plan, community relations plan, etc.), or
- Work volume (e.g., multiple project sites).

Exceptions to the foregoing requirements shall be according to client requests only.

Tables presented in IT documents may be divided into two categories according to the type of verification required. The types of tables in each category (transcriptional and nontranscriptional) are identified in Figure ITC0012-2. The procedures of the following subsections for each table category apply to tables generated either on separate pages of a document or within the text of a document.

3.2.1 Transcriptional Tables

Transcriptional tables may arise as complete tables already existing in checked calculations, laboratory reports, etc., or may be a compilation of data from several places in checked calculations or laboratory reports. The procedure for verifying these tables is as follows:

- The draft of a table is to be typed.
- The typed copy is to be checked against the checked calculations from which the data originated. This checking may be done by the originator of the table.
- Everything written on a table is either to be marked yellow, signifying agreement, or is to be corrected using a red pen.
- The checker is to initial and date in red the checkprint of a table and return the checkprint (CP1) to the word processing department for correction.
- Corrections are to be made to the table by the word processing department and a new checkprint issued with the previous checkprint(s) attached.

- The foregoing steps are to be repeated until the table satisfies the intentions of the originator.

- The project group is responsible to the project manager (who is ultimately responsible) for the timely filing of table checkprints in Category "0" of the project files.

3.2.2 Non-Transcriptional Tables

This category of tables typically arises from estimates and calculations of various sorts and may be generated by hand calculations or by computer spreadsheets. Tables resulting from data sorts and which involve technical decisions are also included in this category. The procedure for preparing and verifying these tables is as follows:

- Hand-calculated tables are to be typed and the typed draft should then be submitted for checking to someone other than the originator. This is important particularly for cost estimates. The checkprint should be initialed and dated in red.

- Everything written on a table is either to be marked yellow, signifying agreement, or is to be corrected using a red pen.

- Tables generated on standard verified spreadsheets (e.g., Lotus spreadsheets designed by IT for cost estimation) should have the input verified by someone other than the originator. Subsequent to the non-transcriptional verification of the spreadsheet, the typed copy can be checked by either the originator or checker of the spreadsheet.

- Tables generated on nonstandard, unverified spreadsheets should have the input and all generated data verified by a checker. Subsequent to the verification of the spreadsheet, the typed table can be checked by either the originator or the checker of the spreadsheet.

- The project group is responsible to the project manager (who is ultimately responsible) for the timely filing of table checkprints in Category "0" of the project files.

3.3 Preparation and Verification of Logs

Completed field logs for classifying soils, rock, or other subsurface materials that are drafted as figures in a report or other document are subject to transcriptional verification. The procedure for preparing and verifying figures of field logs is similar in principle to that of transcriptional tables. It is as follows:

- A log is to be drafted from the field records.

- A checkprint is to be verified against the field records from which the draft originated. This verification may be done by the originator of the field records or by any qualified engineer or geologist.

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- Everything drafted on the log is either to be marked yellow, signifying agreement, or is to be corrected using a red pen.

- The checker is to initial and date in red the checkprint of a log and return the checkprint (CP1) to the drafting department for correction.

- Corrections are to be made to the log by the drafting department and a new checkprint issued with the previous checkprint(s) attached.

- The foregoing steps are to be repeated until the log satisfies the intentions of the originator.

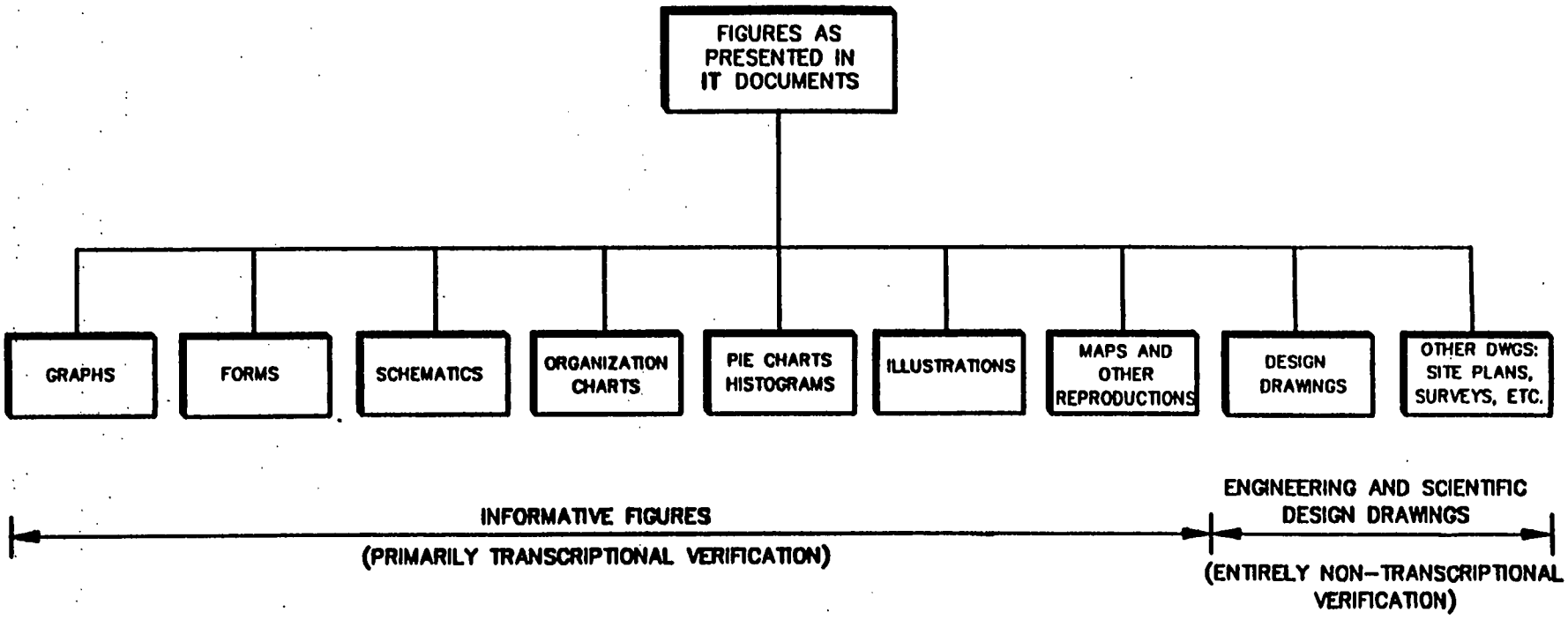
- The project group is responsible to the project manager (who is ultimately responsible) for the timely filing of the checkprints in Category "O" of the project files.

4.0 Format/Forms

None.

5.0 References

None.



NOTE:

EACH FIGURE IS TO HAVE A FIGURE NUMBER AND A DRAWING NUMBER.

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FIGURE ITC0012-1

FIGURE TYPES AND REQUIRED VERIFICATION CATEGORIES

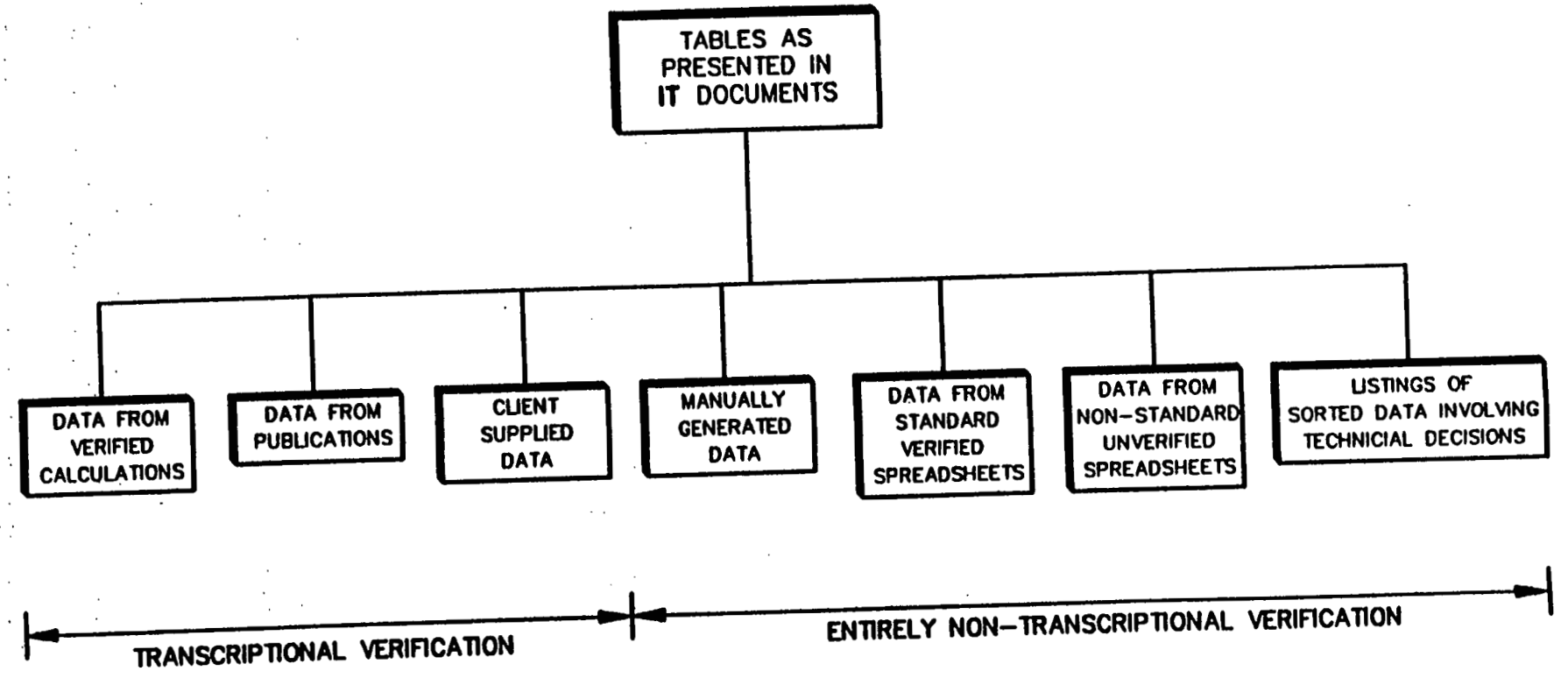

FIGURE ITC0012-2

VERIFICATION CATEGORIES FOR TABULATED DATA

Preface

In accordance with corporate policy, Quality Assurance (QA) Manuals are prepared for each division. The PCE Division, without exemption, also has a QA Manual which implements and describes the Divisional QA Program. Attached is that Manual, Corporate and Divisional Standard Quality Practices (SQPs), and standard forms for documenting QA/QC activities.

The PCE Division is dynamic, evolving to meet the changing needs of our clients and the rapidly expanding environmental services marketplace. This manual is also designed to be a flexible document, easily revised in order to build quality into our products and services, yet retain control of our QA Program. This manual is a "stand-alone" document and is intended to be used as:

- An initial overview, for new employees, of the QA Program
- An introduction of the QA Program to potential clients
- An addendum to proposals
- A program definition for external auditors

This manual and the supporting Corporate and Divisional SQPs define quality activities to ensure that quality is built into our products and services.

With the implementation of this manual, a new phase in the QA Program at IT Corp. is developing. The design, of this manual, has been based on the ANSI/ASQC Q91, ISO 9001 document *Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing*. Other QA Manuals at IT have been based on the ASME NQA-1 QA document or the EPA/QAMS 005/80 QA document, the result of which has been manuals which are part policy, part procedure with no real direction in the implementation of QA/QC activities. The PCE QA Manual however, provides policy while the accompanying procedures provide real instruction in carrying out QA/QC activities. Additionally, individual procedures are easily modified, if necessary, and reissued in order to more effectively communicate changes and modifications in the QA Program.

The format of the manual follows ISO 9001, and with the accompanying procedures, covers the activities that are performed daily within PCE. Also included in Appendix A are cross reference matrices which reference the points of ISO 9001 with Corporate and Divisional SQPs and the NQA-1 document.

It is hoped that this new format is more "user friendly"as quality practices are presented in a more comprehensive manner. Please take the time to review this document and return any comments to Mike Barton. If you have any questions please do not hesitate to contact Mike Barton, Coy Lauer or Paul Wooden.

Listing of Corporate Standard Quality Practices (SQPs)

The following lists Corporate Standard Quality Practices (SQPs), their ID number and status. This list will be updated as SQPs are added.

SQP Name	SQP Number	Status
Control & Distribution of QA Manuals	ITC0001	Rev. 0
Development, Approval, & Distribution of Standard Quality Practices	ITC0002	Rev. 0
Qualification and Examination Requirements for Lead Auditors	ITC0003	Rev. 0
Procurement Document Content, Control, and Review	ITC0004	Rev. 0
Subcontractor Prequalification	ITC0005	Rev. 0
Subcontractor/Supplier Performance Verification and Rating	ITC0006	Rev. 0
Audit, Inspection, & Surveillance Reporting Requirements	ITC0007	Rev. 0
Change/Nonconformance Control, Requisite Documentation, Review, and Approval	ITC0008	Rev. 0
Transcriptional and Nontranscriptional Verification	ITC0009	Rev. 0
Computer Software Development and Usage	ITC0010	Rev. 0
Manually Performed Calculations	ITC0011	Rev. 0
Figures, Tables, and Logs	ITC0012	Rev. 0

Approved by: Bob R Beaulo

STANDARD QUALITY PRACTICE

QUALITY ASSURANCE TRAINING FOR ENVIRONMENTAL ENGINEERING AND SERVICES ASSOCIATES

1.0 Scope and Objectives

During the first month of employment Environmental Engineering and Services (EES) personnel are provided orientation training in Quality Assurance (QA) requirements and Standard Quality Practices (SQPs), as necessary for their work activities. The objective of the systematic training process is to provide uniform quality practices throughout the division.

2.0 Definitions

None.

3.0 Methodology

3.1 Orientation Training

During the first month of employment new Associates are provided training by their Profit Center Quality Assurance Officer (QAO). This training is to include all Standard Quality Practices (SQPs) applicable to their responsibilities. Training is to include appropriate Corporate, Division, Region, and office-specific SQPs. Individual QA training records include:

- Name of Associate
- Date of hire
- Date(s) of QA training
- Topics covered in each training session.

These records are to be maintained in the Profit Center/group QA file. It is the responsibility of the QAO and General Manager to schedule and document all QA training. If an Associate changes jobs within the Corporation, and new QA material (SQPs) is required for the new position, the QAO must schedule and document the additional required training.

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3.2 Continued QA Training

When new or additional SQPs are added to the QA Manual for a specific office, or when new Federal or State requirements are released, the QAO or member of the staff should present a short training session on the new requirements for the office/Profit Center/group. Documentation of these training sessions, including topics and addendees should be maintained in the office/group QA file.

4.0 Format/Forms

An example form for the documentation of QA training is provided in Figure ITEES0003-1. An example of a completed form is presented in Figure ITEES0003-2.

5.0 References

None.

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DOCUMENTATION OF QA TRAINING

Name:_____

Hire Date:_____

Position:_____

Date	QA Training Provided

Figure ITEES0003-1

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DOCUMENTATION OF QA TRAINING

Name:_____

Hire Date:_____

Position:_____

Date	QA Training Provided

Figure ITEES0003-2

Approved by: Bob R Beardsley

STANDARD QUALITY PRACTICE

RECORD TYPES AND FILE CATEGORIES

1.0 Scope and Objectives

This Standard Quality Practice (SQP) describes the practices utilized by the Environmental Engineering and Services (EES) Division of IT to identify and file project specific records. Within the exceptions noted, the filing system is uniformly instituted throughout the division. This allows for effective, uniform storage, retrieval, and exchange of records between business units, Profit Centers, and offices within the division. Record control, status, and retention are described in SQP ITEES0007.

2.0 Definitions

None.

3.0 Methodology

3.1 Record Types

Records originating from clients, subcontractors and IT personnel are classified according to fixed filing categories. The actual types of records will be dependent on the contractual requirements and the scope of work. The types of records controlled and maintained in the IT filing systems are presented in Table ITEES0006-1.

3.2 Record Filing Systems

Four types of files are maintained as part of the IT central filing system.

- Project central file
- Original drawing file (including magnetic media)
- QA file (for non-project-specific quality assurance records)
- Non-project-specific computer program documentation and verification file.

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3.2.1 Central File

Each office within the EES division is required to develop and maintain a central filing system. An Associate within the office is assigned the responsibility for central file maintenance.

3.2.2 Original Drawing File

Original drawing files are organized by drafting personnel. Ultimately, the organization and maintenance of the drawing files is the responsibility of the Drafting Supervisor. File types, control, status, and retention of Computer Aided Drawings (CAD) are discussed in SQP ITEES0010.

3.2.3 Quality Assurance File

The development and maintenance of the non-project-specific Quality Assurance (QA) file is the responsibility of the Profit Center/office Quality Assurance Officer (QAO). File material should include documentation of QA training for office employees, calibration records for externally calibrated equipment, QA correspondence, and meeting notes from office committees and meetings concerning improving quality practices.

3.2.4 Non-Project-Specific Computer Program Documentation and Verification File

Non-project-specific computer documentation and verification file development and maintenance is the responsibility of the QAO or designee. File materials should include a record of the computer programs in use including revision number and manufacturer, verification of program hardware compatibility for each type of computer running the software, and software verification on a set of verified input.

3.3 Record Filing Categories

Project central files are organized into the categories listed in Table ITEES0006-2. Other file types do not have a fixed category system.

3.3.1 Modification to Central Filing Categories

When required, modifications to the central filing categories are made to accommodate client or regulatory requirements.

Central filing categories can also be modified in situations where smaller projects do not support sufficient documentation to make extensive categorization effective (e.g., Underground Storage Tank projects). Category modifications require the preparation of office/business unit specific SQPs describing the modification or combination of filing categories. SQPs describing

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modifications to filing categories must be approved by the Regional Quality Assurance Manager (RQAM).

Additional central file categories may be added as required. An office-specific SQP shall be developed describing the content requirements for the new categories.

4.0 Format/Forms

None.

5.0 References

None.

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Table ITEES0006-1

EXAMPLES OF RECORDS TO BE CONTROLLED AND MAINTAINED

- Bid Requests
- Proposals
- Purchase Orders
- Bids and Proposals
- Contracts
- Contract Change Orders
- Records of Technical Change
- Nonconformance Reports
- Applicable Codes and Standards
- Licenses and Permits
- Project Requirements and Specifications
- Quality Assurance Plans
- Project-Specific Work, Test, and Sampling Plans
- Project-Specific Procedures and Review Copies
- Personnel Qualifications, Certifications, and Training Records
- Health and Safety Records (e.g., training, personnel monitoring, air monitoring, accident reports)
- Test Equipment Operations Manuals

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Table ITEES0006-1
EXAMPLES OF RECORDS TO BE CONTROLLED AND MAINTAINED
(Continued)

- Test Equipment Calibration/Maintenance Records
- Laboratory Certifications and Results of Performance Evaluation Programs
- Project Correspondence (e.g., letters, memorandums, telexes, telephone records)
- Field Activity Daily Logs
- Field Investigation Data and Results (e.g., geological field logs, field collection forms, subsurface boring logs, test data sheets and tapes, analysis request and, sample custody forms)
- Photographs and Negatives
- Laboratory Testing Data, Results, and Summaries
- Laboratory Raw Data for Non-ITAS Laboratories
- Data Reductions, Numerical Analyses and Designs, and Associated Checkprints
- Computer Program Input and Output
- Computer Program Documentation and Verification
- Computer Data Disks
- Drawings, Tables, and Associated Checkprints
- Peer Review Reports by IT Associates and Results of Reviews by External Organizations
- Final Reports and Other External Data Transmittals
- Quality Assurance Records (e.g., audit plans, checklists, audit reports, audit responses, audit closures)

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Table ITEES0006-1
EXAMPLES OF RECORDS TO BE CONTROLLED AND MAINTAINED
(Continued)

- Documentation from the Quality Assurance Review Committee
- Data Quality Objectives Development Worksheets
- Reference Materials (e.g., maps, papers, reports, newspaper articles)

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Table ITEES0006-2
PROJECT CENTRAL FILE CATEGORIES

CATEGORY	LETTER DESIGNATION	CONTENT EXAMPLES
Correspondence	A	Incoming and outgoing letters, memos, telexes, telephone conversation records, etc. Subcategories will, as a minimum, include: "A1" - General in-house correspondence "A2" - Outgoing correspondence "A3" - Incoming correspondence
"Blank"	B	This category may be used for a project-specific need.
Originals	C	Typed originals for reports, regulatory submittals, applications, specifications, proposals, etc. Oversized tables should be folded and placed in the same folder as the report after the report has been printed. Camera-reduced copies of oversize tables should be included in the body of the report originals.
Bids, Contracts, and Specifications	D	Copies of bids, proposals, contracts, project-specific purchase requisitions and purchase orders, and specifications; whether they are submitted by IT to a client or subcontractor, or vice versa.
Field Data and Field Data Checkprints	E	Subsurface logs, test data forms, calibration records, field activity daily logs, sample collection forms, waste handling data, waste manifests, inspection reports, instrument installation data, subcontractor data, etc. This includes information generated by the field personnel at the site, with the exception of health and safety records.
Calculations and Calculation Checkprints	F	Calculations and checkprints. Each set of calculations and checkprints should be placed in the same folder, if possible.
Reports From Others	G	Reports received from clients or reports by other organizations.
IT Reports	H	Copies of IT prepared reports containing the results of project activities and prepared by IT, except submittals filed in "L."
Photographs	I	Each photograph is to be identified by project number, date taken, and description. Photographs should be accompanied by their negatives.
Miscellaneous	J	Only for those extreme instances when an item cannot be placed in any other category.
Laboratory Data and Laboratory Data Checkprints	K	Laboratory test data and results for both field and office laboratories. In general, this will include only data prepared by laboratories external to IT. IT laboratories will maintain their data in the laboratory files. This category may be used for data summaries issued by IT (Certificate of Analysis) and external laboratories.
Regulatory Submittals and Licensing and Permitting Applications	L	Copies of documents, including responses to questions, issued by IT to regulatory agencies either on behalf of a client or IT. Also included would be submittals made by a client using information provided by IT.
Reference Material	M	Reference materials such as client drawings, newspaper articles, journal articles, etc., which pertain to a particular project.
Site Monitoring Records	N	Site monitoring records related to industrial hygiene such as personnel, area, and perimeter sampling and monitoring. These records should include only those not specified for maintenance with IT corporate health and safety records.
Drawing and Table Checkprints	O	Checkprints for drawings, figures, sketches, and tables.
Management Records	P	Management records related to the projects progress, including monthly job tracking reports.
Quality Records	Q	Project quality records including nonconformance reports, technical change logs, audit reports and responses, internal report review checklists, records from the Project Quality Assurance Review Committee, and DQO Development Worksheets.

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Approved by: Bob R Beardsley

STANDARD QUALITY PRACTICE

RECORD CONTROL, STATUS, AND RETENTION

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1.0 Scope and Objectives

This Standard Quality Practice (SQP) delineates record control, status, and retention used within the Environmental Engineering and Services (EES) Division of IT. Filing categories and types of records maintained are described in SQP ITEES0006. The filing system is designed to provide an organized system for the secure storage and retrieval of project-related records as well as meet regulatory guidelines for record retention. The system can be modified, when required, to meet special client or regulatory needs.

2.0 Definitions

Project File Index. A numbered Project File Index (Figure ITEES0007-1) is prepared and continuously updated by designated support personnel. The Index shall list the individual file folders and identify the records therein. The Index shall be kept in a separate folder at the front of each project file. When appropriate, information and location of project material not stored in the project central file (e.g., bulk computer output) should be recorded on the Index. The project file shall include only the categories applicable to the project. For example, if field work has not been performed, there will not be an Index required for Category E. For larger files it is appropriate to have a separate index for each applicable file category.

3.0 Methodology

3.1 Record Control

The control of records provides for the flow of information both internal and external to IT. Typical controls applied by IT for the various record controlling functions are described in the subsections below.

3.1.1 Receipt of Records

Project-related materials which are incoming to IT in the form of correspondence, drawings, sketches, logs, authorizations, or other information shall be marked with the date received and routed to the Project Manager. The Project Manager determines which personnel shall review the incoming materials and shall route the materials accordingly.

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3.1.1.1 Correspondence

Telephone correspondence shall be documented on an IT Record of Telephone Call (Figure ITEES0007-2). Telephone records must record items discussed and any required action to be taken on the part of IT or subcontractors.

As soon as practical, correspondence originals shall be placed in the project central file. If the correspondence is required by an IT Associate for reference, a copy should be retained and the original placed in the project file.

3.1.1.2 Drawings

Drawings provided by clients should be placed in the project central file when they are received. The Project File Index shall indicate the date received, drawing number, and revision number. If revised issues of drawings pertinent to a project are received, superseded drawings shall be marked "void," "see revision ____," or with a similar notation.

3.1.2 Transmittal of Records

Project-related materials transmitted external to IT including correspondence, reports, drawings, and sketches shall be appropriately reviewed, approved, and, as required, signed prior to transmittal.

3.1.2.1 Correspondence

Outgoing project correspondence require Project Manager review prior to transmittal. If, because of scheduling difficulties, it is necessary to transmit correspondence prior to Project Manager review, the Project Manager may assign a staff member the review authority or the document can be reviewed by a line supervisor to the Project Manager. The office copy of project correspondence should bear routing information which is to include the project files, or, as an alternative, individual copies of the correspondence may be transmitted with the distribution indicated on the original.

Project correspondences shall, as a minimum, be signed by the Project Manager or designee. If joint signatures are desirable, the originator of the correspondence, when different than management, may also sign. Correspondence involving Quality Assurance (QA) issues shall be signed by the Corporate Director, Quality Assurance (CDQA) or designee, Regional Quality Assurance Manager (RQAM), Quality Assurance Officer (QAO), or Lead Auditor, as appropriate.

3.1.2.2 Drawings

Drawings issued in the final form shall be approved, by signature, prior to issuance, by the Project Manager or designee. Drawings which are issued as "preliminary" do not require approval prior to issue; however, they shall be clearly marked to indicate preliminary status. Drawings issued as a separate transmittal shall be accompanied by a transmittal letter listing each drawing by number. If a drawing is preliminary, it shall be stated in the letter. When a manually produced original drawing is transmitted to a client at their request, a good quality reproduction of the drawing shall be prepared prior to transmittal and filed in the original drawing file. Transmittal of computer-aided drawings shall follow the procedure given in SQP ITEES0010.

3.1.2.3 Reports

Report issuance, review, and approval are described in SQP ITEES0014.

3.1.2.4 Proposals

Proposal issuance, review, and approval is described in administrative procedures.

3.1.3 Transfer of Records to Filing Systems

Following receipt of information from external sources, completion of a phase or task of a project, completion of numerical computations and design, and issuance of reports or other transmittals, associated records shall be submitted to the appropriate filing system (SQP ITEES0006). Records shall be legible and readily identifiable. In addition, field records and records being sent between IT locations shall be adequately protected from damage and loss.

Indexing and filing of records shall be performed by the designated file clerk. For smaller offices and project site offices, filing may be performed by project personnel.

Materials transferred to the central files are documented on the Project File Index. It is the responsibility of the project staff to indicate on a Record Maintenance Form (Figure ITEES0007-3) the proper filing category or subcategory for the placement of the record. It is the responsibility of the file clerk to place incoming records into the appropriate project and category.

Project files will be maintained by project number. In general, division codes and office designations will not be used to divide a project file. Different phases within a project can be used to separate the project file if this is deemed by the Project Manager as a means for providing clarity in the file system.

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For the project central file, individual file folders for each project shall be divided into appropriate categories based on content, and shall be numbered and filed sequentially within each category (such as F-1, F-2, F-3). Folder tabs should be marked to indicate project number, project name, folder number, and file title (as it appears on the project index). Color-coded systems may also be used. For larger offices the implementation of a bar-coding system for the identification of file categories and controlling the checking in and out of files is an efficient, acceptable, alternative system.

Field records and checkprints, laboratory data summaries, external laboratory raw data and summaries, numerical calculations and checkprints, project-specific computer input and output, reports and other data transmittals, project-specific health and safety records, copies of proposals, bids, project-specific purchase orders and requisitions, contracts and contract change orders, correspondences, memorandums, telephone records, client drawings, photographs, magnetically stored project data, reference material, and project specific QA records shall be transferred to the central file. IT computer input and output is too bulky, they should be stored in the central file area and a reference to the location included in the project file.

Internal drawing checkprints requiring storage may be maintained in the project central file or stored by Drafting personnel in separate checkprint files. Drawing checkprints, for non-nuclear related projects may be discarded after the drawing or drawing revision is issued as "Final."

Documentation and verification of project-specific computer programs are transferred to the central files. Documentation and verification of non-project-specific computer programs is the responsibility of the Profit Center QAO.

3.1.3.1 Project Files at Multiple Locations

When project work is performed by more than one IT location, one office will be designated as the Host Profit Center. The central file in the Host Profit Center will be the repository for all project records. Records must be purged from the support Profit Centers at the end of a phase or task. As with the transfer of any original documents the support offices should make copies of the originals prior to transmittal.

3.1.3.2 On-Site Project Files

Site-specific Standard Quality Practices (SQPs) delineate requirements for record control during on-site field investigations (including project site offices). A file, similar to the project central file, is established and maintained by field or site office personnel. When the field program or project phase is complete, the on-site file is transferred to, and integrated with, the Host Profit

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Center central file. To allow integration of site and Host Profit Center files consistent filing categories must be used.

3.1.4 Storage Facilities

IT utilizes storage facilities which provide a suitable environment to minimize deterioration, damage, and loss. The facilities shall, where possible, have controlled access and shall provide protection from excess moisture and temperature extremes. Records will be maintained chronologically in each filing category and will be well organized in labeled file folders.

The removal and replacement of project records shall be controlled. Before associates may remove either central files records, or non-project-specific computer program documentation and verification files, or on-site files, a sign-out record must be completed. Sign-out documentation shall include the project number, the categories of files borrowed, the borrowers name, and the date. If records are needed for an extended period of time, a copy should be made instead of holding the original. Drop-in oversized placards may be used as an alternative to a sign-out sheet or computerized file maintenance system. The placard is inserted in the space originally occupied by the borrowed folder. The placard includes the same information as is required on the sign-out sheet.

Storage of Records for Nuclear Waste Repositories and Chemical Waste Disposal Facilities. Projects involving site characterizations and designs for nuclear waste repositories and chemical waste disposal facilities require that records be maintained for the life of the facility. For projects involving nuclear related site characterizations and waste repository design, provisions must be made for permanent records to prevent damage from moisture, temperature, and pressure. Special provisions must be made for radiographs, photographs, negatives, microfilm, and magnetic media to prevent damage from excessive light, stacking, and electromagnetic fields. Offices performing this type of project work are required to have an office-specific SQP describing any modifications to the storage facility to meet regulatory or client requirements.

3.2 Record Status

To prevent the inadvertent use of obsolete or superseded project-related information, all members of the Project Staff are responsible for reporting such information to the Project Manager. In turn, the Project Manager, as appropriate, shall notify Project, Laboratory, Quality Assurance, and other affected personnel of the resulting status change in project documents such as drawings, specifications, and procedures. The source of such documents may be IT, regulatory agencies, 116

or clients. Notification of personnel of Status Changes in project Quality Assurance procedures shall be the responsibility of the CDQA, RQAM, or QAO, as appropriate.

To purge outdated material from use, notification of personnel by the Project Manager should be in writing and should indicate the means for removal from use. In general, drawings and other documents shall be marked "void." However, the Project Manager may request destruction of the copies. It is recommended that one copy of void documents be maintained for historical purposes with the reason for and date of voiding clearly indicated. For expedience in informing field personnel of the status change in project documents, the Project Manager may communicate document changes verbally. Subsequent to this, the field personnel shall receive copies of the new documents.

To identify calculations, drawings, and other materials which have not been formally checked, or which are based on information that has not been checked, or which do not contribute to final project information, the word "preliminary" shall be stamped or written on each page of such documents.

3.3 Record Retention

The length of storage for project-related material shall be based on regulatory and contractual requirements and IT policy. The determination of record retention time for each project shall be made by the Project Manager and Quality Assurance personnel. Typical time periods for record maintenance following completion of a project are as follow:

- Records prepared as part of site mitigation (e.g., RI/FS) activities - 10 years
- Records associated with facilities governed by the Resource Conservation and Recovery Act (RCRA) - 5 years after closure, if the project was performed prior to closure; or for the 30-year monitoring period following closure, if the project was performed for the purpose of closure monitoring.
- Records associated with nuclear projects (e.g., site characterization, geological repository design, and repository seal design) - life of facility.
- Conventional project records - 7 years.

If a specific contractual requirement, project demand, or government regulation requires that records be maintained for a longer period of time, the project files will be kept as required. For projects that must be kept for longer than the normal retention periods stated above, the Project File Index shall be marked to indicate the required retention period.

When off-site storage of completed project files is required, the file clerk, Drafting Supervisor, and Quality Assurance Officer, as appropriate, will verify that records sent for storage contain all the requisite information, and notation of such will be indicated on the Project File Index. The termination date for the files stored should be clearly marked on files sent to off-site storage.

3.4.1 Retrieval of Records

Storage systems must provide for the prompt retrieval of information for reference or use outside the storage areas. IT project records must be accessible to the client, if so stipulated in the project contract, for the life of the records.

4.0 Format/Forms

None

5.0 References

None

PROJECT FILE INDEX

PROJECT NUMBER: _____
PROJECT NAME: _____
FILE CATEGORY: _____

FILE DESIGNATION	DESCRIPTION

Figure ITEES0007-1

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INTERNATIONAL TECHNOLOGY CORPORATION

RECORD OF ☐ TELECON ☐ MEETING

Project Name	Number	Phase	Task	Subtask

Date	Time

CALL FROM ☐ NAME:
CALL TO ☐

Other Participants — Name/Location/Representing:

CALL FROM ☐ NAME:
CALL TO ☐

Telephone Number:

Company Name:

Address:

City

State | Zip Code

Topic

Summary (Decisions & Specific Actions Required by Named Persons):

Required Action:

Prepared by (Signature):

Distribution:
Original to Project File
Copy to Project Manager
Copy to Preparer

☐ Other Distribution (By Preparer)

PAGE ___ OF ___

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Figure ITEES0007-2

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RECORD MAINTENANCE

PROJECT NO. _____

PROJECT NAME: _____

PHASE/TASK: _____

SUBMITTED BY: _____

SUGGESTED FILE CATEGORY: _____

_____

TITLE OF DOCUMENT: _____

_____

_____

Figure ITEES0007-3

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Approved by: Bob Beaulieu 1-4-93

STANDARD QUALITY PRACTICE

DOCUMENTATION OF FIELD ACTIVITIES

1.0 Scope and Objective

This Standard Quality Practice (SQP) describes the documentation of activities typically associated with field investigations. Documentation of activities which are typically performed for many projects will be described in complete detail. Documentation of project-specific and infrequently performed activities are outlined in principle only.

The objective of documentation of field activities is to demonstrate that field activities have been performed in accordance with requirements. Documentation must include sufficient, relevant, and accurate detail that anyone reviewing the documentation may determine that requirements were met satisfactorily. Documentation of any field activities must provide sufficient record of the work so that the results are unequivocal. Also, any field activities must be recorded so that it can determined which project the work was performed for (project name and number), samples taken and their location, date and time of sampling, and IT associate(s) performing the work.

This SQP is applicable field activities performed in the EES division by IT and its subcontractors.

2.0 Definitions

None.

3.0 Methodology

3.1 Basic Requirements

Documentation of field activities has to satisfy certain basic requirements. These include:

- Appropriate header information such as project name, project number, descriptive title, inclusive pagination, and identification of originator.

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- Legible entry of data, which in general may best be achieved by scripting. Whenever corrections are to be made, a single line is to be placed through the incorrect entry. The correction is to be written in the proximity of the original entry or a reference made to the location of the correction. Such corrections are to be initialled and dated.

- Completing field records with enough detail that field activities may be reconstructed by someone other than the originator.

- Supplying specific data requested on field forms such as weather conditions, boring elevations, and coordinates, etc. Information that is not applicable should be noted as such using the symbol "N/A."

- Completing field records with indelible ink and the originator signing and dating completed records.

- Using preprinted forms whenever possible because of the prompts included for supplying pertinent information.

- Filing field records in Category E of the central files or as specified by a client on a project-specific basis.

It is to be noted that the philosophy of documentation is that if an activity or process is not documented it never occurred.

3.2 Specific Requirements

3.2.1 Field Activity Daily Logs

Information pertinent to field activities are to be recorded in the Field Activity Daily Log (FADL). Entries in the log are to be made in permanent ink and are to include as a minimum and as applicable:

- Fulfillment of the basic requirements of Section 3.1 above.

- The names and affiliations of field personnel and visitors to the site.

- A general description of the day's field activities showing the chronological sequence of events. It is preferable to use the military method of noting time e.g., 9:00 am is 0900 and 5:00 pm is 1700.

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- Documentation of weather conditions and any significant changes during the day's activities.

- Field equipment calibration data and identification of the calibration standard(s). Alternatively, this data may be recorded on a Calibration Log with a reference to the log placed in the FADL.

- Field measurements such as temperature, wind speed and direction, pH, conductance, and readings from personnel safety instruments and monitoring equipment. Measurements should always include units.

- References to appropriate field data forms for details of each activity performed.

- Field equipment identification such as type, manufacturer, serial number, and model number.

Figure 1 of this SQP (Figure ITEES0008-1 etc.) presents the standard forms for the recording of field activities. This record, the Field Activity Daily Log or FADL, shall contain the "master" record of field work performed. Test results can be included in the FADL or as necessary on individual data forms. For each days activities, the complete FADL should contain the number of pages needed. If required for a specific project other forms of the FADL can be prepared and used, but they must contain the same basic information.

Bound notebooks with FADLs are available and should be used exclusively whenever bound logbooks are required.

3.2.2 Tailgate Safety Meeting

A Tailgate Safety Meeting is to be conducted at the beginning of each day of field activities. The meeting is to include IT personnel, subcontractors, and visitors on site. As a minimum safety topics discussed in the Tailgate Safety Meeting form (Figure 2) are to be documented and presented.

The requirements for Tailgate Safety Meetings are fully discussed in IT Health and Safety procedures 9540.1(HS051).

Documentation is to be completed with a printed listing of the attendees at the meeting and signatures of the attendees. Other required data are:

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- Identification of the individual conducting the meeting and his/her signature.
- Identification of the project supervisor and project manager.

3.2.3 Subcontractor Preparedness Checklist

Prior to a subcontractor's commencement of field activities a review is to be made and documented of the subcontractors preparedness to perform the specified activities. For drilling and sampling a recommended checklist is shown in Figure 3. Checklists for other types of subcontracted activities may be developed according to specified requirements for subcontracted work activities.

3.2.4 Sample Collection Log

Sample collection data are to be documented on sample collection logs, a copy of which is shown in Figure 4. Entries to the log should satisfy the basic requirements of Section 3.1 and are to include as necessary the following:

- Project identification
- Sample number, location, depth, type and collection time
- Container description and sample volume
- Technical data such as pH, conductivity, temperature, head-space reading
- Pertinent technical comments
- Identification of person preparing the log.

Each sample collected is to be labeled. The information to be provided is shown on the sample label in Figure 5.

3.2.5 Visual Classification of Soils (Boring Logs)

Soil borings are to be logged using the Visual Classification of Soils Form, the recommended version of which is shown in Figures 6 and 7 (the form is two-sided). The IT engineer/geologist completing the log is to supply the following information as necessary in indelible, legible writing:

- Information included in the header.

- Descriptions of, and symbols for, soils conforming as applicable to the format given in IT Corporation's Manual of Practice for Visual Field Classification of Subsurface Materials. Elements of this format are shown in Figure 7.

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- Sample type and sample number. This data is to be entered also on the sample collection log and the sample label.

- Length of soil recovered for each sample. This dimension is to be in inches or tenths of feet.

- ASTM Standard Penetration Test (SPT) blow counts for three consecutive 6-inch intervals per test.

- Measured consistency of cohesive soils as determined by use of a Pocket Penetrometer.

- Well construction outline. Details of monitoring well installation should also be documented according to the procedure of Section 3.2.7 below.

- The "Remarks" and "Notes" sections of the Visual Classification of Soils Form may be used to record additional data such as background and sample HNu and OVM readings, drill rig make and model, names of drillers, etc.

3.2.6 Visual Classification of Rock

Rock borings are to be logged using the visual classification of rock form. The recommended version of this form is shown in Figure 8. The IT engineer/geologist is to supply the following information as necessary in indelible, legible writing:

- Information included in the header.

- Casing size and depth.

- Groundwater levels with the time and date of measurement.

- Run numbers are to be used with reference to coring. Those numbers begin with 1 and consecutively increase with depth.

- Depths at the top and bottom of each run number. These depths are to be in feet and tenths thereof.

- Length of rock recovered for each run. This length is to be in feet and tenths thereof.

- The percent recovery is to be the length of recovery divided by the run length for a given run number multiplied by 100.

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- Rock Quality Designation (RQD) is to be provided for each Run Number and is to be recorded as a percentage.

Details for supplying the foregoing information are given in IT Corporation's Manual of Practice for Visual Field Classification of Subsurface Materials.

3.2.7 Monitoring Well/Piezometer Installation

Documentation of monitoring well installation may involve a number of forms which are to be used as necessary. These forms and their functions are the following:

- The Field Activity Daily Log (FADL - Figure 1) is to be used to identify the chronology and major events of the installation activity.

- The Visual Classification of Soils (Boring Log - Figure 6) is to be used to correlate the geologic strata to the major elements of the monitoring well construction. This identifies the location of grout, bentonite seal, sand, and screen.

- The Monitoring Well Installation Sheet is to be used to identify materials, dimensions, and technical details. The recommended form is shown in Figure 9.

- The Installation Details forms are to be used to diagram materials, dimensions, and technical details. Figure 10 is the recommended detailed diagram for flush-mounted monitoring wells and Figure 11 is recommended to be used for monitoring wells with protective riser casing.

- The Monitoring Well Development Record is to be used for the data required to define well development. Because well development criteria varies, the recommended form (Figure 12) allows for data to be supplied as necessary.

- The Monitoring Well Sensitivity Test is to be used to evaluate the functionality of monitoring wells. The recommended form, Figure 13, contains the procedure for the test. Equipment which is to be used in the test is to be identified on the back of this two-sided form (Figure 14).

- The Monitoring Well Data Sheet (Figure 15) is to be used to record water levels at varying dates and at different monitoring wells on a given project.

The foregoing data sheets may be used also for piezometer installation and monitoring.

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3.2.8 Calibration Log

Field equipment calibration data may be recorded on the calibration log with a reference to the log made in the FADL. Alternatively, this data may be entered directly on a FADL.

Required calibration data includes the following:

- Information required in the header e.g., project name, project number, etc.
- Type of instrument being calibrated and identity of the instrument using model and serial numbers
- Date and time of calibration
- Standards used in the calibration, including standard identity, concentration, lot number and manufacturer of the standard
- Instrument reading with respect to each calibration standard
- Comments as necessary regarding instrument performance.

The recommended structure of a calibration log is shown in Figure 16. Further details are included in the SQP ITEES0009 entitled, "Measuring and Test Equipment Calibration and Control."

3.2.9 Photographs and Videos

Photographs are to be used as part of the documentation of field activities whenever such usage enhances the record of field activities. Photographs included in the record are to include as a minimum project name, project number, date, and description. If time is significant to a sequence of photographs, time should also be included.

Photographs may be documented either by attaching the required data to individual prints using a stamp or preprinted self-adhesive labels or by numbering each photograph and referencing the numbers to a photo log.

Videos used for field documentation are to be identified by project name, project number, and description.

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3.2.10 Analysis Request and Chain-of-Custody Record

An overriding consideration for data resulting from field collected samples (all samples) is the ability to demonstrate that the samples were obtained from the locations stated and that they reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal must be documented to accomplish this. Documentation shall be accomplished through an analysis request and chain-of-custody record that records each sample and the individuals responsible for sample collection, shipment and receipt. A sample is considered in custody if it is:

- In a person's actual possession
- In view, after being in physical possession
- Locked so that no one can tamper with it, after having been in physical custody
- In a secured area, restricted to authorized personnel.

Figure 17 shows an example analysis request and chain-of-custody record form to be used by IT personnel in collecting and shipping samples. An ITAS laboratory will not accept samples collected by IT personnel for analysis without a correctly prepared analysis request and chain-of-custody record form.

The IT analysis request and chain-of-custody record forms are preprinted with a unique six-digit control number in the upper right hand corner. The form is a two part form. The white copy always accompanies the sample while the yellow field copy is retained in the field project file. The contents of this file are eventually transferred to the project central file at the completion of the field program or at intervals designated by project requirements.

The analysis request and chain-of-custody record form shall be signed by each individual who has the sample in their possession. Notes for the preparation of the form are described on the back of the form.

The analysis request and chain-of-custody record are to be prepared for all samples shipped to a laboratory for analyses. This form is in addition to all other record forms discussed in this SQP.

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FIELD ACTIVITY DAILY LOG

DAILY LOG			
DATE			
NO.			
SHEET		OF	

PROJECT NAME	PROJECT NO.
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:

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IT PERSONNEL ON SITE:

SIGNATURE DATE:

12-A-7-86

[redacted] SAFETY MEETING

1808

Division/Subsidiary _____ Facility _____

Date _____ Time _____ Job Number _____

Customer _____ Address: _____

Specific Location _____

Type of Work _____

Chemicals Used _____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

Chemical Hazards _____

Physical Hazards _____

Emergency Procedures _____

Hospital / Clinic _____ Phone ( ) _____ Paramedic Phone ( ) _____

Hospital Address _____

Special Equipment _____

Other _____

NAME	SIGNATURE

Meeting conducted by:

NAME PRINTED _____ SIGNATURE _____

Supervisor _____ Manager _____

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FIGURE ITEES 0008-2

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FIELD CHECKLIST FOR DRILLING AND SAMPLING EQUIPMENT

1808

Project No. _____ Date _____ Project Name _____

IT Field Rep. _____ Drilling Contractor _____

Equipment Description	Quantity	Condition of Equipment	Equipment Decon			Equipment Calibration			Comments
			Yes	No	N/A	Yes	No	N/A	
Drill Rig									
Drilling Rods and Augers									
Drill Bits									
Sampling Equipment									
Well Construction Materials									
Well Development Equipment									
Other									

Drill Rig Manufacturer _____ 132

Serial No. _____

FIGURE ITEES 0008_3

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INTERNATIONAL TECHNOLOGY CORPORATION

DATE	
TIME	
PAGE ____ OF ____	
PAGE	
PROJECT NO.	

SAMPLE COLLECTION LOG

PROJECT NAME _____

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE _____

COMPOSITE _____ YES _____ NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

CONTAINERS USED	AMOUNT COLLECTED

COMMENTS:

PREPARED BY: _____

FIGURE ITEES 0008-4

1808

DATE	
TIME	
PAGE ____ OF ____	
PAGE	
PROJECT NO.	

COMMENTS: (Continued)

PREPARED BY: _____

LEGEND

1. A SAMPLE COLLECTION LOG IS TO BE COMPLETED FOR EACH SAMPLE.
2. ALWAYS COMPLETE BOTH SIDES. IF SECOND SIDE IS NOT USED, DRAW A LINE THROUGH IT AND MARK N/A. FILL IN CONTROL BLOCK AND PREPARED BY.
3. ALL ENTRIES ON LOG ARE TO BE COMPLETED. IF NOT APPLICABLE MARK N/A.
4. DATE: USE MONTH/DAY/YEAR: I.E., 10/30/85
5. TIME: USE 24-HOUR CLOCK: I.E., 1835 FOR 6:35 P.M.
6. PAGE: EACH SAMPLE TEAM SHOULD NUMBER PAGE _____ OF _____ FOR THE DAY'S ACTIVITIES FOR ALL SHEETS PREPARED ON A SINGLE DAY. I.E., IF THERE ARE A TOTAL OF 24 PAGES (INCLUDING FRONT AND BACK) NUMBER 1 OF 24, 2 OF 24, ETC.
7. SAMPLE LOCATION: USE BORING OR MONITORING WELL NUMBER, GRID LOCATION (TRANSECT), SAMPLING STATION I.D., OR COORDINATE TO PHYSICAL FEATURES WITH DISTANCES. INCLUDE SKETCH IN COMMENT SECTION IF NECESSARY.
8. SAMPLE TYPE: USE THE FOLLOWING - SOIL; WATER (SURFACE OR GROUND); AIR (FILTERS, TUBES, AMBIENT, PERSONNEL); SLUDGE; DRUM CONTENTS; OIL; VEGETATION; WIPE; SEDIMENT.
9. COMPOSITE TYPE: I.E., 24-HOUR, LIST SAMPLE NUMBERS IN COMPOSITE, SPATIAL COMPOSITE.
10. DEPTH OF SAMPLE: GIVE UNITS, WRITE OUT UNITS SUCH AS INCHES, FEET. DON'T USE ' OR ".
11. WEATHER: APPROXIMATE TEMPERATURE, SUN AND MOISTURE CONDITIONS.
12. CONTAINERS USED: LIST EACH CONTAINER TYPE AS NUMBER, VOLUME, MATERIAL (E.G., 2 - 1L GLASS; 4 - 40 ML GLASS VIAL; 1 - 400 ML PLASTIC; 1 - 3 INCH STEEL TUBE; 1 - 8 OZ. GLASS JAR).
13. AMOUNT COLLECTED: VOLUME IN CONTAINERS (E.G. 1/2 FULL).

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IT CORPORATION

Project Name _____

Project No. _____

Sample No. _____

Collection Date/Time _____

Collector's Name _____

Sample Location _____

Sample Type/Depth/Description _____

_____ Preservative _____

Analyze For _____

Bottle _____ of ____ ____ Filtered _____ Nonfiltered

FIGURE ITEES 0008-5

EXAMPLE SAMPLE LABEL

IT CORPORATION

1808

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER:	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED:
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE OF

DEPTH ( )	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS

NOTES:

FIGURE ITEES 0008-6

PRIMARY SOIL LOG FORM - FRONT SIDE

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PRIMARY SOIL LOG FORM - REVERSE SIDE **1808**

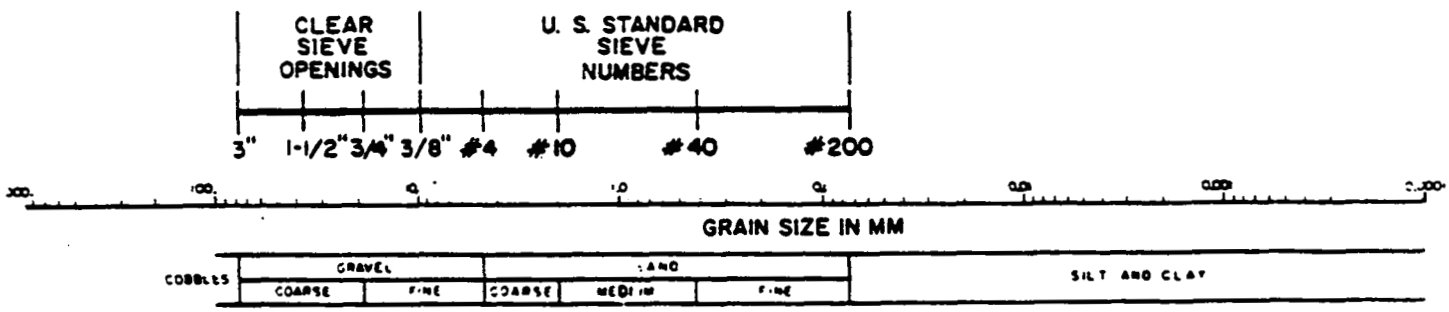
CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TONS PER SQUARE FOOT)
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.50
MEDIUM STIFF	0.50 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	MORE THAN 4.0

DENSITY OF GRANULAR SOILS

DENSITY	STANDARD PENETRATION RESISTANCE(1)
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

(1) STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT BARREL SAMPLER 12 INCHES USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES AND THE NUMBER OF BLOWS RECORDED FOR EACH 6-INCH INTERVAL. THE SUMMATION OF THE FINAL TWO INTERVALS IS THE STANDARD PENETRATION RESISTANCE.



USCS CLASSIFICATION FOR SOILS

COARSE-GRAINED SOILS

CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
	GC	CLAYEY GRAVELS GRAVEL-SAND-CLAY MIXTURES
CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES

FINE-GRAINED/HIGHLY ORGANIC SOILS

SILTS AND CLAYS LIQUID LIMIT (LESS THAN 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
SILTS AND CLAYS LIQUID LIMIT (GREATER THAN 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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VISUAL CLASSIFICATION OF SUBSURFACE MATERIAL

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER:	ELEVATION:	DATE STARTED:
COORDINATES:		DATE COMPLETED:
DRILLING METHODS		PAGE: OF
ENGINEER/GEOLOGIST:		GWL: AT HRS.

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	U.S.C.S. SYMBOL	CASING BLOWS PER ( )	ROCK RECOVERY % / RQD %	REMARKS

NOTES:

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EXAMPLE ALTERNATE (2) SOIL LOG FORM

FIGURE ITES 0008-7

INTERNATIONAL TECHNOLOGY CORPORATION

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VISUAL CLASSIFICATION OF ROCK

PROJECT NUMBER _____ FIELD ENG./GEO _____ PAGE _____ OF _____

PROJECT NAME _____ BORING NO. _____

APPROX. ELEV. _____ CORE SIZE _____ DATE _____

DRILLING METHOD _____ DATE STARTED _____

COORDINATES _____ DATE COMPLETED _____

CASING INFORMATION		GROUNDWATER LEVEL DATA			
SIZE	DEPTH	ACTUAL TIME	DEPTH	ACTUAL TIME	DEPTH

RUN NUMBER	DEPTH	RECOVERY	% RECOVERY	% RQD	DESCRIPTION	JOINT SPACING			REMARKS
						MAXIMUM	MINIMUM	AVERAGE	

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FIGURE ITEES 0008-8

BOULDER	COBBLE	PEBBLE	GRANULE	VERY COARSE SAND	COARSE SAND	MEDIUM SAND	FINE SAND	VERY FINE SAND	SILT	CLAY	INDIVIDUAL PARTICLES
BOULDER CONGLOMERATE	COBBLE CONGLOMERATE	PEBBLE CONGLOMERATE	GRANULE CONGLOMERATE	VERY COARSE SANDSTONE	COARSE SANDSTONE	MEDIUM SANDSTONE	FINE SANDSTONE	VERY FINE SANDSTONE	SILTSTONE	CLAYSTONE AND SHALE	CONSOLIDATED ROCK

WENTWORTH SCALE FOR ROCK

TERMS USED TO DESCRIBE THE RELATIVE DEGREES OF ROCK CORE HARDNESS

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

THE SPACING OF THE DISCONTINUITIES IN THE ROCK MAY BE DESCRIBED BY ONE OF THE FOLLOWING TERMS

DESCRIPTIVE TERMS	SPACING
VERY BROKEN	LESS THAN 1 IN.
BROKEN	1 IN. TO 3 IN.
SLIGHTLY BROKEN	3 IN. TO 6 IN.
MASSIVE	6 IN. AND GREATER

TERMS USED TO DESCRIBE BEDDING THICKNESS

VERY THICKLY BEDDED	THICKER THAN 1 m
THICKLY BEDDED	30-100 cm
MEDIUM BEDDED	10-30 cm
THINLY BEDDED	3-10 cm
VERY THINLY BEDDED	1-3 cm
THICKLY LAMINATED	0 3-1 cm
THINLY LAMINATED	THINNER THAN 0 3 cm

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MONITORING WELL INSTALLATION SHEET

1808

Project Name _____ Field Eng./Geo. _____ Date _____

Project No. _____ Checked by _____ Date _____

Boring No. _____

Monitoring Well No. _____ Date of Installation _____

Borehole Drilling

Drilling Method _____	Type of Bit _____
Drilling Fluid (s) Used:	Casing Size (s) Used:
Fluid _____ From _____ To _____	Size _____ From _____ To _____
Fluid _____ From _____ To _____	Size _____ From _____ To _____

Monitoring Well Description

Type _____	Riser Pipe Material _____
Diameter of Perforated Section _____	Riser Pipe Diameters:
Perforation Type:	O.D. _____ I. D. _____
Slots ☐ Holes ☐ Screen ☐	Length of Pipe Sections _____
Average Size of Perforations _____	Joining Method _____
Total Perforated Area _____	

Protection System

Riser Protective Pipe Length _____	Other Protection _____
Protective Pipe O.D. _____	

Item	Distance Above/Below Ground Surface ( )		Elevation ( )	
Top of Riser Pipe				
Ground Surface	0.0			
Bottom of Protective Pipe				
Borehole Fill Materials:				
Grout/Slurry	Top	Bottom	Top	Bottom
Bentonite	Top	Bottom	Top	Bottom
Sand	Top	Bottom	Top	Bottom
Gravel	Top	Bottom	Top	Bottom
Perforated Section	Top	Bottom	Top	Bottom
Monitoring Well Tip				
Bottom of Borehole				
GWL After Installation				

Was the monitoring well flushed after installation? Yes ☐ No ☐

Was a sensitivity test performed on the piezometer? Yes ☐ No ☐

Remarks _____

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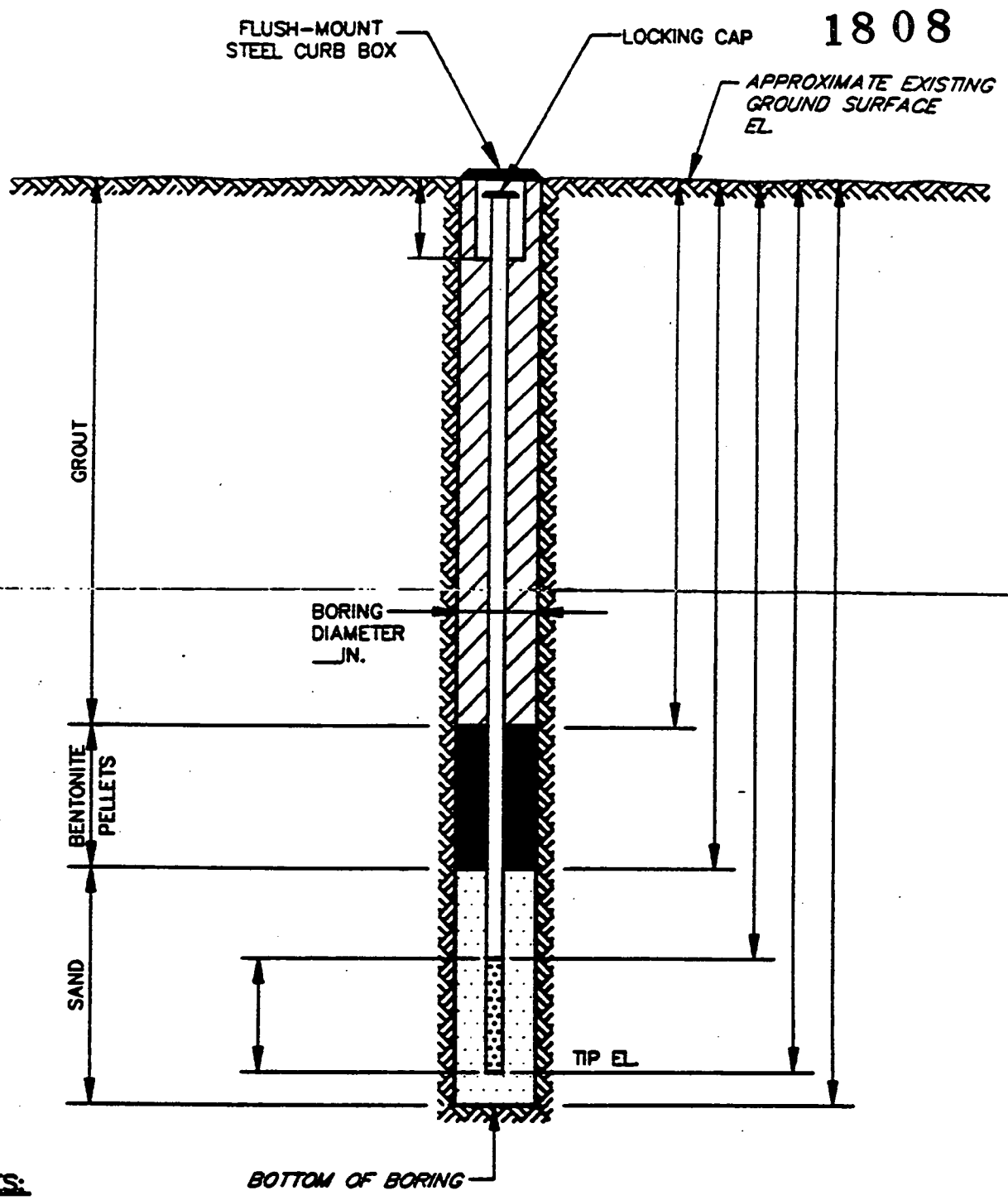
FIGURE ITEES 0008-9

1808



NOTES:

1. RISER PIPE IS __ IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS __ IN. I.D. SCHEDULE 40 PVC PIPE, CONTINUOUS SLOT SCREEN (__ IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION AT TOP OF RISER PIPE IS _____ RELATIVE TO AN ON-SITE DATUM OF 100.00'.
5. ELEVATION OF WATER LEVEL IS _____
6. WATER LEVEL READING ON _____
7. OTHER NOTEWORTHY TECHNICAL DETAILS.

FIGURE ITEES0008-10
INSTALLATION DETAILS
MONITORING WELL NO.
SITE

PREPARED FOR

COMPANY NAME
CITY, STATE

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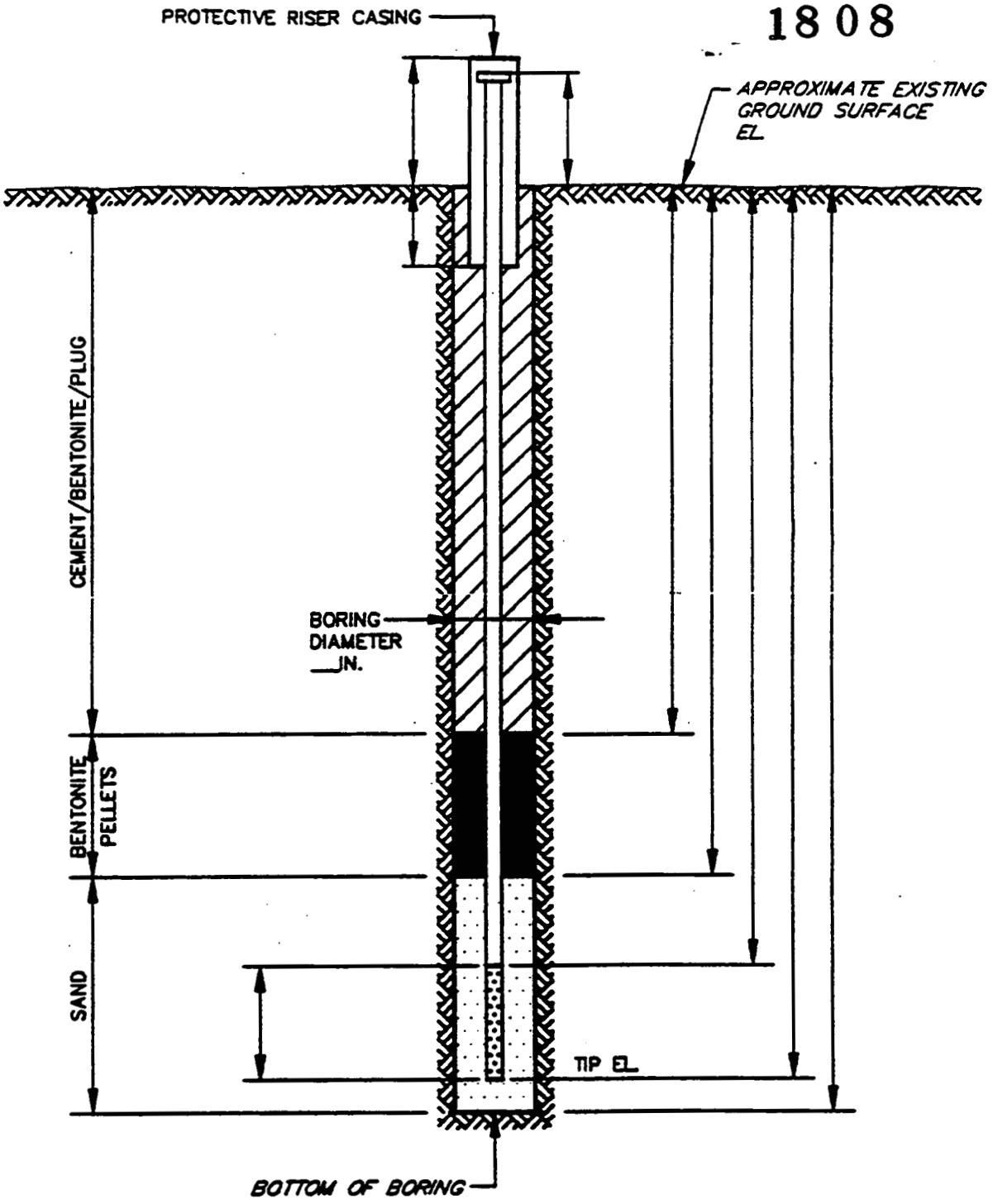
CHECKED BY
APPROVED BY
C.J.B. 7-31-92
DRAWN BY

DRAWN BY	C.J.B.	CHECKED BY	DRAWING NUMBER
	7-31-92	APPROVED BY	W1006Q-A20

1808



NOTES:

1. RISER PIPE IS ___ IN. I.D. LCS OR -SST PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS IN. I.D. SST PIPE CONTINUOUS SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL IS _____
5. WATER LEVEL READING ON _____
6. OTHER NOTEWORTHY TECHNICAL DETAILS.

FIGURE ITEES0008-11
INSTALLATION DETAILS
MONITORING WELL NO.
SITE

PREPARED FOR

COMPANY NAME
CITY, STATE

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MONITORING WELL DEVELOPMENT RECORD

1808

Project Name: _____ Project No.: _____

Well No.: _____ Date Developed: _____

Field Personnel: _____

Weather Conditions: _____

Well Development Method: _____

Total Well Depth:	Time Started:
Depth to Water Table:	Time Completed:
Height of Water Column:	Notes:
Well Diameter:	
Well Volume:	

Well Volume Removed	Temperature	pH	Specific Conductance	Turbidity
Initial Reading				

Comments: _____

Prepared by: _____ 144

Signature: _____

Date: _____

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MONITORING WELL SENSITIVITY TEST

1808

Project Name_____ Tested by_____ Date_____

Project No. _____

Boring No. _____

Monitoring Well No. _____

Test Trial No. _____

GWL Below Top of Pipe Prior to Test _____

Time Reading Taken _____

The monitoring well was filled with water. The following data show the drop of water from the top of the pipe as time elapsed.

Elapsed Time (Minutes)	Drop of Water (Feet)

Based on the above data, it is concluded that the monitoring well is:

_____FUNCTIONING PROPERLY.

_____NOT FUNCTIONING PROPERLY.

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TEST EQUIPMENT LIST

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Test _____

Equipment Number	Equipment Name

NOTE:
This list shall be completed for all tests. Only equipment subject to calibration need be listed.

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MONITORING WELL DATA SHEET

Project Name _____ Project No. _____

(1) Depth to the Water Level From the Top of Pipe
(2) Elevations Shown Are Top of Monitoring Well Pipe

Date and Recorder	Monitoring Well Readings — Feet (1)										
	# EL.(2)	# EL.	# EL.	# EL.	# EL	# EL.	# EL.	# EL.	# EL.	# EL.	# EL.

Elevation of Water Level — Feet

FIGURE ITE: 0008-14

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TEST EQUIPMENT LIST

Test _____

Equipment Number	Equipment Name

NOTE:
This list shall be completed for all tests. Only equipment subject to calibration need be listed.

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FIGURE ITEES 0008–15

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Calibration Log

Project Name _____ Page _____ of _____

Project No. _____

Date/Time	Technician	Instrument Type and Identity	Standard and Lot Number	Standard Concentrations (provide units as necessary)	Meter Reading	Comments

M:\myfigs\forms01.ged

FIGURE - ITFFS 0008-16

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ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD*

Reference Document No. 380003
Page 1 of ____

Project Name/No. [1]
Sample Team Members [2]
Profit Center No. [3]
Project Manager [4]
Purchase Order No. [6]
Required Report Date [11]

Samples Shipment Date [7]
Lab Destination [8]
Lab Contact [9]
Project Contact/Phone [12]
Carrier/Waybill No. [13]

Bill to: [5]

Report to: [10]

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ONE CONTAINER PER LINE

Sample Number [14]	Sample Description/Type [15]	Date/Time Collected [16]	Container Type [17]	Sample Volume [18]	Pre-servative [19]	Requested Testing Program [20]	Condition on Receipt [21]	Disposal Record No. [22]

COPY

Special Instructions: [23]

Possible Hazard Identification: [24]
Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐

Sample Disposal: [25]
Return to Client ☐ Disposal by Lab ☐ Archive ____ (mos.)

Turnaround Time Required: [26]
Normal ☐ Rush ☐

QC Level: [27]
I. ☐ II. ☐ III. ☐ Project Specific (specify): ____

1. Relinquished by [28] (Signature/Affiliation)	Date: Time:	1. Received by [28] (Signature/Affiliation)	Date: Time:
2. Relinquished by (Signature/Affiliation)	Date: Time:	2. Received by (Signature/Affiliation)	Date: Time:
3. Relinquished by (Signature/Affiliation)	Date: Time:	3. Received by (Signature/Affiliation)	Date: Time:

Comments: [29]

MCA 3/15/91

INSTRUCTIONS FOR COMPLETING THIS FORM 1808

1. **Project Name/Number:** Record the name of the project or client/site location, and the billing number of the project (Example - 613215; XYZ Chemical Co. WA).
2. **Sample Team Members:** List the names of all the members of the team taking these samples: team leader's name first.

   Profit Center Number: For intra company work, indicate the originating profit center number.
4. **Project Manager:** Record the project manager's name.
5. **Bill to:** Non-IT personnel should indicate the correct billing address and the person to whom the invoice should be sent. IT personnel and IT subcontractors should fill in IT office responsible for project accounting (if known).
6. **Purchase Order No.:** Non-IT personnel should use this space to record the purchase order number authorizing the analysis of these samples. IT personnel and IT subcontractors should leave this space blank if a project number has been given for billing.
7. **Samples Shipment Date:** Indicate the date these samples are shipped to the laboratory.
8. **Lab Destination:** Indicate the laboratory designated for sample shipment. Do not list more than one lab on this form. Be certain before sending samples that the laboratory you are designating is aware of the shipment and is capable of accepting these sample types and has available capacity.
9. **Lab Contact:** Give the name of the laboratory contact (typically the Lab Project Manager).
10. **Send Lab Report to:** Give the name, address and phone number of the person to receive the data report for these samples.
11. **Required Report Date :** Record the date which you and the laboratory contact have determined the results will be reported (include verbal or final report as appropriate).
12. **Project Contact/Phone:** Indicate the name of the project person to be contacted in case of any questions regarding these samples and the phone number where the contact may be reached the day the samples arrive in the laboratory.
13. **Carrier/Waybill Number:** If you are sending the samples by a commercial carrier such as Airborne or Federal Express, record the courier company name and the waybill or airbill number under which these samples will be shipped (Example - Fed-Ex/ #513631771).
14. **Sample Number:** List the complete, unique, identification number of each sample. These numbers must correspond with the identification numbers on the sample containers and the field sample collection document(s).
15. **Sample Description/Type:** Provide a short physical description of the sample and the sample type such as soil, sediment, sludge, water, wipe, air, concentrated waste or bulk.
16. **Date/Time Collected:** Record date and exact time each sample was collected. Use a 24-hour clock; i.e.,1645 not 4:45 p.m.
17. **Container Type:** Indicate the volume, color and type of the sample container used (Example - 1 gallon amber glass, 1 liter clear plastic, 40 milliliter clear glass).
18. **Sample Volume:** Estimate the amount of sample in the container. For air samples, indicate the volume of air sampled.
19. **Preservation:** Indicate what type of preservative, if any, has been used for the samples (Examples - ice to 4°C nitric acid, hydrochloric acid).
20. **Requested Testing Program:** List the analyses to be performed on each sample by method number.

    . **Condition on Receipt:** Before a custody transfer, the intended recipient should verify all samples are present and in good condition. This column may be used by the recipient to record any abnormalities found at the time of the transfer (Examples - jar lid cracked, sample bottle leaking).
22. **Disposal Record No.:** Used by the laboratory to record requisite disposal information. Not used when samples are returned to client.
23. **Special Instructions:** Use this space to record any special instructions to the lab regarding the processing of these samples.
24. **Possible Hazard Identification:** Indicate all hazard classes associated with the sample(s).
25. **Sample Disposal:** Indicate how the samples should be disposed of following analysis. All samples are held six weeks and then disposed of unless other arrangements for storage have been previously requested. Lab will charge for packing, additional archiving and disposal.
26. **Turnaround Time Required:** Check "Normal" or "Rush" as determined by the Project Manager and the laboratory contact. Rush samples are subject to a surcharge.
27. **QC Level:** These are ITAS QC levels and should not be confused with USEPA Analytical Levels.

    Level I: ITAS standard practice. Use available analytical procedures. Fifteen percent quality control (QC) samples (blank/spike-duplicate) for every 20 samples. QC samples may not be performed for a specific project but as part of compiled sets of samples. QC data not reported with analytical results. ITAS published rates apply to client samples tested.

    Level II: Use available analytical methods. Fifteen percent QC samples minimum (blank/duplicate/spike or duplicate spike) QC samples are project or client-specific. QC summary report include with analytical results. No raw data are included. Each QC sample billed as real analytical sample.

    Level III: Uses referenced regulatory procedures, and/or established/verified procedures using confirmatory techniques. Method blank plus 20 percent or tow QC summary minimum per each matrix. QC summary report supplied with supporting data. Where applicable, this is USEPA Contract Laboratory Program (CLP) package. Surcharge is added and/or QC samples are billed at sample rates. Costs based on analytical program required.

Project-specific: Defined in QAPjP, Work Plan, or other specific plan or procedure. Project documentation must be submitted to the laboratory before beginning work. Project requirements for QC samples cannot be less than Level I.

28. **Signatures:** When releasing custody of these samples, use the "Relinquished By" space to sign your full legal name, company name, date and time of release. After verifying that all samples are present, the person receiving the samples must sign the "Received By" space to take custody of the samples.
29. **Comments:** Provide any additional explanatory information that may be required (Example - samples stored overnight in temperature controlled, secure refrigerator):

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Approved by: Bob R Bearden

STANDARD QUALITY PRACTICE

FIELD EQUIPMENT CALIBRATION AND CONTROL

1.0 Scope and Objectives

Equipment used by IT and its subcontractors must be demonstrated by documentation to be in the condition required for the performance of specified field activities. This SQP therefore applies to all equipment used in the EES division for making measurements or acquiring data in accordance with given test and work procedures.

2.0 Definitions

None.

3.0 Methodology

Measuring and test equipment used in the field and IT reference equipment is to be controlled and kept subject to a formal calibration program. A system of control of the equipment is to be documented by inventory and sign-out/sign-in procedures. Equipment control is to be further maintained by storage in clean secure areas. The calibration program is to maintain equipment within design limits of accuracy and precision. An ancillary function of the calibration program is to provide information on the capability of equipment with respect to precision and accuracy so that acquired data will be compatible with project requirements and desired results. Calibration of measuring and test equipment is to be performed internally using IT reference equipment and standards, or externally by agencies or manufacturers. Calibration of in-house reference equipment and materials is, in general, to be performed externally.

Responsibility for the system of control and the calibration program for equipment owned and operated by a given office in the EES division rests with the office QAO or his/her designee. A similar responsibility occurs for the calibration documentation of equipment rented or borrowed by an EES office.

Responsibility for routine field calibration of IT equipment and for calibration of field equipment provided by subcontractors rests with Project Managers and Field Supervisors.

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The responsibility for the calibration and control of IT laboratory and associated reference equipment rests with the Laboratory Managers. Procedures are presented in the ITAS Division QA Manual, Revision No. 0, July 1989.

3.1 Equipment Control

Control of equipment is illustrated in the flow chart of Figure ITEES0009-1. All measurement and test equipment used in an office is to be maintained in an inventory listing using the form shown in Figure ITEES0009-2 or a suitable substitute. Calibrated equipment is to be uniquely identified by using either the manufacturer's serial number, an IT identification number, (for equipment over $1500 in value), or other means.

Control of equipment in and out of the equipment storage facility is to be maintained by a sign-out/sign-in procedure. A form to be used for this purpose is shown in Figure ITEES0009-3. This form provides a history of the use of equipment and is to be maintained as an appendix to the inventory file.

3.2 Equipment Calibration

To provide control of measuring and test equipment and reference equipment routinely used by IT, a formal calibration system shall be employed. Each piece of equipment within the system is to be assigned a unique equipment number and IT identification tag (as applicable) so that calibration information pertinent to the equipment can be retrieved upon request. The equipment is to have an individual calibration file and is to be calibrated prior to use or as part of operational use.

In addition to the numbering of equipment, a calibration/recalibration date label (green in color) is to be applied to each item requiring periodic calibration. Labels are illustrated in Figure ITEES0009-4.

Calibration files for the equipment controlled by the various offices and groups are to be maintained by the appropriate office or group QAO or his/her designee. Calibration files are to contain Equipment Calibration and Maintenance Records (Figure ITEES0009-5, one for each piece of equipment) IT calibration data forms and/or certificates of calibration provided by manufacturers and external agencies. Any equipment calibration failure is to be noted on the Equipment Sign-out/Sign-in sheet or on the Equipment Calibration and Maintenance Record.

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In instances of transfer of equipment between laboratories and offices, copies of the calibration files are to be sent with the equipment so that a continuous updated record may be maintained.

In general, recalibration of sensitive equipment is to be performed following the transfer.

Equipment which fails calibration must be repaired and recalibrated before it is reused, or it is to be red-labeled to indicate calibration failure and removed from service. A Nonconformance Report (Figure ITC0008-4) is to be completed and a copy kept in the equipment file for items that are removed from service for failure to satisfy calibration requirements. For nongovernment work, equipment calibration failure needs only to be noted on a Field Activity Daily Log (FADL). In all instances, failure to pass calibration is also to be noted in the Equipment Calibration and Maintenance Record.

In instances where measurement and test equipment is obtained from rental services, proof of calibration status (copies of calibration records) is to come with the equipment and made part of project records. Proof of calibration status is to be requested of the vendor in the technical requisition.

3.2.1 Calibration Frequency

Measuring and test equipment and reference equipment is to be calibrated periodically and/or routinely as part of operational use. Calibration frequency is to be based on type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, effect of error on the measurement process, and experience. Specific calibration frequencies are given in the ITAS Quality Assurance Manual and IT Manuals of Practice.

In some cases, scheduled periodic calibration will not be performed because the equipment is not continuously in use. Such equipment shall be calibrated on an "as needed" basis prior to use, and then at the required frequencies for as long as its use continues.

Subsequent to calibration, a record of the calibration is to be entered in the calibration log for the specific piece of equipment. A green label is also to be applied to identify both the calibration date and the date of the next scheduled calibration.

3.2.2 Calibration Procedures

Documented approved procedures are to be used for calibrating measuring and test equipment and reference equipment. Whenever possible, widely accepted procedures, such as those published by ASTM or EPA, or procedures provided by manufacturers are to be adopted. Where preestablished information is not available, procedures are to be developed (according to the requirements of this Manual) considering the type of equipment, stability characteristics of the equipment, required accuracy and precision, and the effect of error on the quantities measured.

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As a minimum, procedures shall identify:

- Type of equipment to be calibrated
- Reference equipment and standards to be used
- Calibration method and sequential actions
- Acceptance tolerances
- Frequency of calibration
- Date recording form/format

Calibration procedures for test equipment routinely calibrated by IT are presented in the ITAS Quality Assurance Manual and IT Manuals of Technical Practice.

3.2.3 Calibration Reference Equipment and Standards

Equipment is to be calibrated, whenever possible, using reference equipment and standards having known relationships to nationally recognized standards (e.g., National Bureau of Standards) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference standard or calibration shall be documented.

Reference equipment is to be used only for calibration and is to be stored separately from working measuring and test equipment to prevent inadvertent use. In general, reference equipment is to be at least four to ten times as accurate as the equipment being calibrated.

3.2.4 Calibration Failure

Equipment that fails calibration or becomes inoperable during use is to be removed from service and segregated to prevent inadvertent use, and is to be red-labeled (see Figure ITEES0009-4) to indicate it is out of calibration. Such equipment is to be repaired and satisfactorily recalibrated prior to further use. Equipment that cannot be repaired is to be replaced.

Results of activities performed using equipment that has failed recalibration are to be evaluated by the involved Quality Assurance personnel and the Laboratory Manager or Project Manager, as appropriate. If the activity results are adversely affected, the results of the evaluation are to be documented and appropriate personnel notified.

Scheduled calibration of measuring and test equipment does not relieve any personnel of the responsibility of using properly functioning equipment. If an equipment malfunction is suspected, the device is either to be red-labeled and removed from service or recalibrated. If it fails recalibration, the equipment is to be red-labeled and removed from service.

3.2.5 Calibration Records

Documentation of calibration of measuring and test equipment is illustrated in Figure ITEES0009-1. Calibration records shall be prepared and maintained for each piece of measuring and test equipment and each piece of reference equipment to indicate that established calibration procedures have been followed. These records are to be maintained by the office QAO or by his/her designee. Records for equipment used only for a specific project are to be documented on FADLs or Calibration Logs and kept in the project files.

Records for periodically calibrated equipment are to include as appropriate:

- Type and identification number of equipment
- Calibration frequency and acceptance tolerances
- Calibration dates
- Identities of individuals and organizations performing the calibrations
- Reference equipment and standards used for each calibration
- Calibration data
- Certificates or statements of calibration provided by manufacturers and external agencies, and traceable to national standards
- Statements concerning calibration acceptance or failure and repair of failed equipment

Much of the measuring and test equipment used for field geophysical surveys or in the analytical laboratories is calibrated or checked as part of the operational use. For such equipment, records of the calibrations or checks are to be kept in the files of projects for which the work was performed, or as part of the responsible group calibration record system.

3.3 Equipment Use

The following discussion references the flow chart of Figure ITEES0009-1. Measuring and test equipment for project use is to be signed out from the equipment storage facility of each EES office or group. It is the responsibility of all personnel to verify equipment calibration status from either the calibration labels or calibration records prior to using the equipment.

Routine field calibration is to be documented on FADLs or on Calibration Logs. Field measurements are to be documented appropriately according to project requirements. Equipment which malfunctions during usage or which fails field calibration prior to use is to be segregated and red-labeled, and a Nonconformance Report is to be filed (government projects only).

Functioning equipment returning to the equipment storage facility is to be signed in. Prior to the return of the equipment to inventory, its cleanliness is to be ascertained. Soiled and contaminated equipment is not to be placed in inventory.

Malfunctioning equipment returning to the equipment storage facility is to be signed in prior to being committed for repairs. In no case is the red label to be removed or the equipment sent to a project before appropriate repair and recalibration has eventuated. A record of the nature of the repair and the subsequent recalibration data is to be entered into the equipment record.

3.4 Rented or Borrowed Equipment

Equipment which is rented or borrowed from another IT office or group is to be accompanied by a copy of documentation concerning its calibration status. This documentation is to be placed in the files of the project(s) in which the equipment is used.

3.5 Subcontractor Equipment

It is the responsibility of Project Managers and Field Supervisors to determine and document the calibration status of measuring and test equipment used in the field by subcontractors. Documentation of calibration status is to be requested, received and reviewed prior to the use of such equipment. This documentation is to be included in the project file.

4.0 Format/Forms

Flow Chart of Equipment Control; Figure ITEES0009-1
Inventory of Measurement and Test Equipment; Figure ITEES0009-2
IT Equipment Sign-out/Sign-in Sheet; Figure ITEES0009-3
Calibration Status Labels; Figure ITEES0009-4
Equipment Calibration and Maintenance Record; Figure ITEES0009-5.

5.0 References

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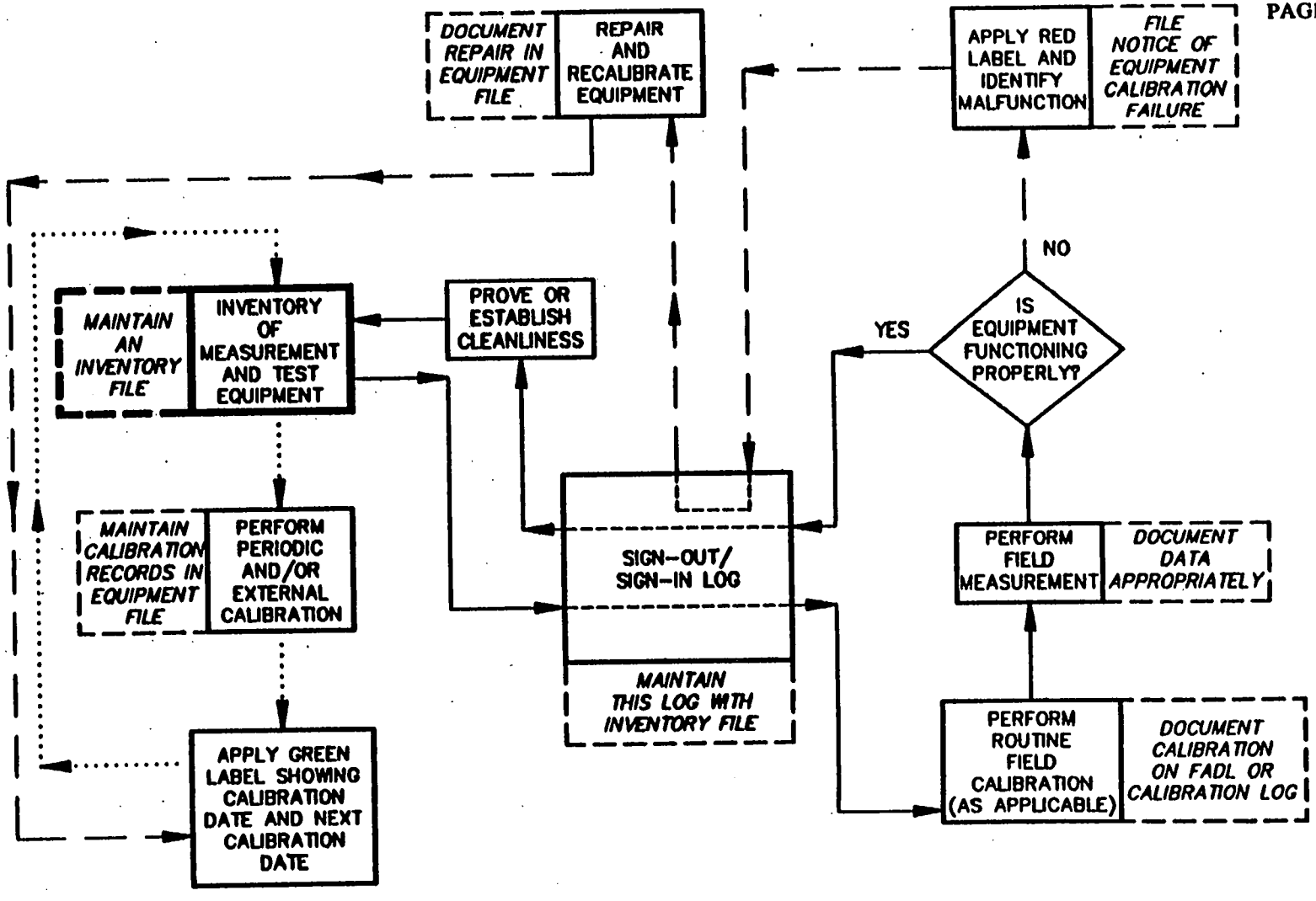
None.



18008

FIGURE ITEES0009-1

FLOW CHART OF EQUIPMENT CONTROL

INTERNATIONAL TECHNOLOGY CORPORATION

04-17-92 8:32 AM

INVENTORY OF MEASUREMENT AND TEST EQUIPMENT

Equipment Type	Description	Manufacturers Serial No.	IT Identification Number	Comments

FIGURE ITEES0009-2

INVENTORY OF MEASUREMENT AND TEST EQUIPMENT FORM

INTERNATIONAL TECHNOLOGY CORPORATION

IT EQUIPMENT SIGN-OUT/SIGN-IN SHEET

Equipment	Equipment ID	Date Taken	Duration	Return Date	Project				Signature
					Project Number	Phase	Task	Sub Task	

COMMENTS:

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DO NOT WRITE BELOW THIS LINE - FOR BILLING PURPOSES ONLY

WEFL _____

MTS _____

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FIGURE ITEES0009-3

IT EQUIPMENT SIGN-OUT/SIGN-IN SHEET

INTERNATIONAL TECHNOLOGY CORPORATION

EQUIPMENT NAME _____

EQUIPMENT ID _____

PERIODIC CALIBRATION DATE _____

NEXT CALIBRATION DATE _____

GREEN LABEL

EQUIPMENT NAME _____

EQUIPMENT ID _____

DO NOT USE PRIOR TO RECALIBRATION OR REPAIR

RED LABEL

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FIGURE ITEES0009-4

CALIBRATION STATUS LABELS

EQUIPMENT CALIBRATION AND MAINTENANCE RECORD

Equipment Type _____ Serial and/or ID Number _____

Date of Calibration	Reason for Calibration	Calibration References	Date of Repair	Reason for Repair	Comments

FIGURE ITEES0009-5

EQUIPMENT CALIBRATION AND MAINTENANCE RECORD

INTERNATIONAL TECHNOLOGY CORPORATION

Approved by: [signature]

STANDARD QUALITY PRACTICE

REPORT PREPARATION, REVIEW, AND DISPOSITION

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Attachment - ITEES0014-A

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1.0 Scope and Objectives

This SQP is applicable to all types of reports (reference Section 14.1, Part 1 of this manual) produced in the Environmental Engineering and Services (EES) Division. The objective is to produce reports that are accurate and defendable and which fulfill client and regulatory requirements. In addition, the requirements established for content and format enhances consistency of reports produced throughout the EES Division.

2.0 Definitions

2.1 Preliminary Report

A report that is issued prior to checking and review of its contents. Such a report is issued for information only and IT reserves the right to change any or all of its contents.

2.2 Internal Draft Report

A report that is developed by project staff and submitted for internal review and comment. Internal draft reports are never placed in the project files.

2.3 Draft Report

A report that has been completely checked by IT prior to issuance. This report is subject to alteration only by client or agency request.

2.4 Client- or Agency-reviewed Draft Report

A draft report issued by IT which has been returned with client or agency comment. This report and/or related correspondence is vital reference material.

2.5 Final Report

A report issued directly at/or project work or subsequent to a draft report. Such a report is completely checked and reviewed prior to issuance.

3.0 Methodology

It is the responsibility of the Project Manager or his/her designated representative to follow the outline of report preparation and review as presented in Sections 14.2 and 14.4 in Part I of this manual. Specifications to be followed regarding certain format details are to be found in the

current version of the IT Corporation Standard Format Manual for Proposals, Reports, Covers, Resumes, and Correspondence.

In addition, the Report Issuance Checklist (RIC) is to be used as a planning support. For instance, such questions as "Are recommendations sound and defensible?" and "Does this report meet regulatory requirements/guidance?" may assist in defining components of the report text. Other questions on the RIC serve as reminders of the documentation that is required in support of the completed report.

3.1 Report Preparation

Initial preparation of a report frequently occurs in different segments, each being generated simultaneously. It is the responsibility of the Project Manager or his/her designated representative to have the document coalesced into a report that is consistent with applicable requirements including such details as section, table, and figure numeration, font and grammatical consistency, and spelling.

For certain types of reports that are constrained to repetitiveness by such factors as job characteristics, geology and state regulations, it may be possible to develop report boilerplates to maximize consistency and efficiency. In such instances a special review of a boilerplate is to be undertaken to verify that all applicable regulations and requirements have been considered. Furthermore, mechanisms need to be put in place to allow for alterations of the boilerplate to occur in the event of change in regulations/requirements.

To reduce liability and to improve accuracy of expression in reports, certain words and phrases need to be avoided. Attachment ITEES0014-A has been prepared to identify liability-prone language and to provide alternative words and phrases that may be effectively substituted.

Preparation of each element of the report format is presented in the following subsections:

3.1.1 Title Page

This page identifies the document and is to contain as a minimum the following: report title, project name, project number, prepared by _____, prepared for _____, and date. For project-specific procedures, signatures will be required on the title page excepting as specifically disallowed by client or regulatory agency. Such signatures are to be included as specified in SQP ITEES0004, Section 3.4 and SQP ITEES0005, Section 3.3. Where signatures are disallowed on the title page, approval of the project-specific procedures by the specified personnel is to be documented in the project files.

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3.1.2 Table of Contents

This requires the first page number to be identified for the List of Tables, List of Figures, List of Appendices, each section and subsection of the report text, and the List of References.

3.1.3 List of Tables

This requires the sequential identification of table numbers and title. If tables are stacked after the report text no page identification is required. If tables are included in the text, each table location is to be identified consistently by one or the other of the following:

- A page number assigned to the table itself, or
- An identification of the page of text which the table follows.

3.1.4 List of Figures

This requires the sequential identification of figure numbers and title. If figures are stacked after the report text, no page identification is required. If figures are included in the text, each figure location is to be identified consistently by one or the other of the following:

- A page number assigned to the figure itself, or
- An identification of the page of text which the figure follows.

3.1.5 List of Appendices

Each appendix is to be identified by a letter designation and title. Appendices may have their own table of contents within each appendix depending on length and complexity.

3.1.6 Report Text

The report text should consist of an introduction, the body of the text, and a section that summarizes both the project work and the report, and cites conclusions and recommendations. The body of the text must be formulated based on the project scope of work, contractual and regulatory requirements, and the intent of the report.

The introduction is to identify and describe the purpose for which the project was undertaken. It should briefly discuss IT activities pertinent to the report subject. These may include: field work; consultations with the client, regulatory agencies, and others; laboratory testing; collection of data from other sources; analysis and resulting conclusions; and the formulation of recommendations.

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The body of the report is to describe the project in detail. IT and subcontractor work relating to the report subject should be discussed. The findings of field explorations and testing, literature

searches, external consultations, and observations should be included. The laboratory testing program should be described and its results should be discussed. The analytical procedures employed and designs formulated should be indicated. The results of work performed should be discussed in detail and must be traceable to the project records.

The final section of the text should consist of a summary of the purpose of the project, and IT's undertakings towards meeting that purpose. It should emphasize the results of the work and any conclusions or recommendations reached.

3.1.7 List of References

References cited in the report text are to be included whether they be external data, publications, or correspondence. The references should include the author's name, title of the publication, publisher, location of the publisher, and date, if the reference is a publication. If the reference is to correspondence, the subject, date, names of the parties contacted, and type of correspondence should be included.

3.1.8 Tables

These are used to present groups of information in an orderly manner and are to be prepared and reviewed according to the requirements of SQPs ITC0009 and ITC0012. Tables are generally included as a separate section following the List of References, but may be included with each section of the text following each first references in the text.

3.1.9 Figures

These are graphical presentations used for presenting concepts and details to report readers. Each figure is to be identified with a report figure number, an IT drawing number, and a title. Figures are generally included as a separate section following the tables but may be included with each section of text immediately following each first reference in the text. Preparation and revision of figures are to be in accordance with SQPs ITC0009 and ITC0012.

3.1.10 Appendices

These contain supplementary information pertinent to the report subject. Often the information contained in an appendix is technical in nature and is included in the report to provide details of topics discussed in the text. Each appendix should be identified by a letter of the alphabet. Pages within the appendix should be in logical sequence, but need not be numbered unless a sequence cannot be reasonably maintained without page numbers. Page numbers of an appendix should all begin with the letter designation of the appendix, followed by the number of the page

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within each appendix. The numbers begin with 1 for each appendix, such as A-1 . . ., B-1 . ., etc.

3.2 Report Review

Prior to issuance of a report, of any sort, whether it is a project-specific plan, or draft or final report, it shall be reviewed by knowledgeable members of the Project Staff and the Project Manager, or designated representative. Report review shall address whether:

- The report satisfies the scope of work, client requirements, and pertinent regulatory requirements.
- Assumptions are clearly stated, justified, and documented.
- A reference is cited for any information utilized in report preparation that was originated outside the project.
- The report correctly and accurately presents the results obtained by the project work.
- The tables and figures presented in the report are prepared, checked, and approved according to IT requirements.
- The report figures and drawings are signed and dated by the appropriate members of the Project Staff and Project Management.
- The bases for the recommendations and conclusions presented in the report are clearly documented.
- The report has been proofread and punctuation, grammar, capitalization, and spelling are correct.

Reviews will be documented prior to issuance. It follows that a report which is first issued as a draft and then as final will have two documentations of review. This documentation may be provided on a RIC (Figure ITEES0014-1) which identifies the range of quality requirements applicable to reports. Documentation by suitable substitutes are acceptable. One such substitute is the Manuscript Routing Sheet (MRS) an example of which is provided in Figure ITEES014-2. It is cautioned that greater care is required in using the MRS than in using the RIC because the MRS provides less detail concerning required elements of the review.

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Condensed forms of the standard RIC may be substituted for reviewing boilerplated reports in which many of the elements of the standard RIC have been covered in the boilerplate. A condensed RIC and report boilerplate is to have the approval of the Region Quality Assurance Manager.

It is the responsibility of the Project Manager and the QAO to determine that each discipline represented in a report has been reviewed by an individual qualified in that discipline. For instance, a report presenting information and data in hydrogeology, geochemistry and risk assessment may not be reviewed by a risk assessment expert alone. Expertise in all three disciplines is required for proper review.

Report review may be undertaken exclusively by the Project Staff or may extend to peers outside the Project Staff. Peer review should be considered for all reports and is recommended for those which present state-of-the-art technical activities, regulatory review, or the results of projects having great potential for litigation. Peer review procedures are outlined in SQP **ITEES0016** .

3.3 Report Submittal

The Project Manager is to determine the client or agency requirements for report submittal, including the number of copies required and to whom the report copies should be transmitted. Reports are to be accompanied by a letter of transmittal which states the report title, the number of copies transmitted, and the IT personnel to contact regarding questions concerning the report. The transmittal letter is to be signed by the Operations Manager, Project Director, Project Manager, or designee.

3.4 Disposition of Reports

Reports are to be filed according to the following:

- Preliminary Report - Maintain a copy in Category "H" of the project files
- Internal Draft Report - Internal drafts of reports are <u>never</u> included in the file. These are to be discarded immediately after a draft or final report has been issued.
- Draft Report - Maintain a copy in Category "H" of the project file.
- Client- or Agency - Reviewed Draft Report - Draft copies issued to clients or agencies which are returned with comments are to be maintained in Category "M" of the project files. Comments arriving in the form of regular correspondence are to be filed in Category A3.
- Final Report - Maintain at least one copy in Category "H" of the project file.

4.0 Format/Forms

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Report Issuance Checklist - Figure ITEES0014-1

Manuscript Routing Sheet - Figure ITEES0014-2

5.0 References

None

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REPORT ISSUANCE CHECKLIST

Project No. _____ Project Name _____

Report Title _____

	YES	BY	N/A
1. Have proper project team and peer reviews been completed and documented?	☐	___	☐
2. Are assumptions clearly stated, justified, and documented?	☐	___	☐
3. Are recommendations sound and defensible?	☐	___	☐
4. Does the report meet the requirements of proposal/ contract/scope of work?	☐	___	☐
5. Have changes in the original scope of work been properly documented and transmitted to the client?	☐	___	☐
6. Does the report meet regulatory requirements/guidance?	☐	___	☐
7. Does the report follow a logical sequence and is it clear in its presentation?	☐	___	☐
8. Have standard field forms been properly completed and filed?	☐	___	☐
9. Have lab data and data summaries been verified, collated, and filed?	☐	___	☐
10. Are calculational methods appropriate?	☐	___	☐
11. Have checkprints been prepared and corrections made for tables, figures, calculations, drawings, and logs?	☐	___	☐
12. Have the objectives of the QAPP/Work Plans/Sampling Plans been met?	☐	___	☐
13. Are cost estimates properly documented and presented?	☐	___	☐
14. Has a copy of the signed letter of transmittal been included in the project file?	☐	___	☐

Approval for Issuance

Project Manager _____ Date _____ 171

Project Director or Group Manager Date _____

Figure ITEES0014-1

Manuscript Routing Sheet

① Author/Editor:

② a. Project Number:
b. Copy Number:
c. Page _____ of _____
d. Date:

③ Report Title:
Date of Document:

④ Client:

⑤ a. Document Type:
_____ Report
_____ Proposal
_____ Other (Specify):

b. Status:
_____ Draft
_____ Final

c. Method
_____ Manuscript Routing Sheet
_____ Document Review Comment Record

d. Routing Sequences (reviewers)/Date Needed, Version
1.
2.
3.
4.
5.

⑥ Reviewer:

Reviewer:	Status				AREAS TO BE REVIEWED (Assigned by Project Manager)									
	Date In	Date Out	Initials of Rev.	Hours Spent	Proj. Mgr. Rev.	Editorial Rev.	Technical Rev.	Figures	Tables	QA Review	Health & Safety	Other (Specify)		Special Instructions
1.														
2.														
3.														
4.														
5.														
6.														
7.														
8.														
9.														

⑦ *Notes/Comments:

⑧ Approval For Issuance (Project Manager):

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Figure ITEES0014-2

ATTACHMENT ITEES0014-A
Correct Word Usage

The wording of our documents has liability implications both to IT and to our clients. In our reports, letters, and specifications it is therefore important to avoid words that could be misinterpreted or which could be assumed to imply more than is intended. The wording should be precise in conveying information and the state of knowledge. Opinions that are offered should be clearly differentiated from statements of fact.

Following is a list of words which should be used with caution when preparing letters, reports or specifications. Preferable or alternate words are also presented in the list and these should be used whenever possible.

Another list of words and phrases is presented which may be considered as judgmental, tendentious, or inflammatory by client or regulatory agency. These are to be avoided to the extent possible.

ENGINEERING/SCIENTIFIC JARGON AND USE OF WORDS[1]

Certain words used by engineers and scientists have very special and limited meanings. Because some are them are especially susceptible to misinterpretation or are difficult to explain to a laymen or jury, it would be wiser to use alternative wording to describe that particular activity. Consider the following examples:

Engineering/Scientific Jargon	Preferable Words
1. Approve	Review
2. Certification (after grading)	Memorandum
3. Control (the job)	Control Tests, Compaction Tests, Give Guidance
4. Or Equal	Or Equivalent
5. Essential (it is)	Considered, Advised
6. Examination	Observation, Reviewing, Study, Evaluate, Look over (the job)
7. Inspection	Observation, Review, Study, Evaluate, Look over (the job), take density tests
8. Ensure/Insure (to be sure)	So that
9. Investigation (soil)	Exploration, Reconnaissance
10. Necessary (it is)	Considered, Advised, Study, Evaluate, Observe, Review
11. Required	Considered, Advised
12. Supervise	Observe, Review, Look over (the job), Guide, Guidance
13. Assure (to insure)	So that

Usage of Superlatives, Absolutes, Positives, and Ultimate Conditions

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[1]The preceding list of words originated with the Association of Soil and Foundation Engineers

ENGINEERING/SCIENTIFIC JARGON AND USE OF WORDS
(Continued)

The training of engineers and scientists has been such that we tend to use absolutes and positive statements in our everyday communications. As a result, superlatives have become part of our jargon. Superlatives -- words or phrases that indicate ultimate, absolute conditions -- should be avoided or used with caution. A checklist of a few such words is tabulated below:

Superlatives	Suggested Alternatives
All	Some, Most, Usually
At least, all times, all circumstances	All if practicable, Sometimes, In most cases
Any	When practicable
Best	Recommended
Complete (investigation)	Scope limited to:
Critical	Might or may be...
Essential (it is)	Recommended, Advised
Extremely	(delete or use with caution)
Final	(delete or use with caution)
Inevitably	(delete or use with caution)
Maximum	(delete or use with caution
Minimum	(delete or use with caution)
Must, Must always, Must do, shall	Should
Never	Usually
No, non	Usually
Not less than (more than)	Usually
Obvious	Apparent
Possible	Practicable

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ENGINEERING/SCIENTIFIC JARGON AND USE OF WORDS
(Continued)

Properly	Recommended
Readily	May be
Safe, Unsafe	(qualify or explain or define)
Sound	(qualify or explain or define)
Stable	(qualify or explain or define)
Suitable	(qualify or explain or define)
Sufficient	(qualify or explain or define)
Thorough	(qualify or explain or define)

The preceding list of words originated with the Association of Soil and Foundation Engineers

Judgmental, Tendentious, or Inflammatory Words and Phrases

The words and phrases following may be considered to be judgmental, tendentious or inflammatory under certain circumstances.

Clean
Contaminant
Dioxin
Highly
Not of concern
Soil at the site

INTERNATIONAL TECHNOLOGY CORPORATION

Standard Operating Procedure

Title: BALANCE CALIBRATION VERIFICATION AND MAINTENANCE

Prepared by: Coy A. Lauer **Date:** 4/5/94

Reviewed by: [signature] **Date:** 4/6/94
Technical Specialist

Operations approval: Stuart B. Healy **Date:** 4/6/94
Group Leader/Manager

Interim use approved: [signature] **Date:** 4/7/94
Group Quality Assurance Officer

Management approval: Michael P. Baldell **Date:** 4/7/94
Manager, Engineering and Process Development

Final approval: Coy A. Lauer **Date:** 4/7/94
Pollution Control Engineering Quality Assurance Officer

Controlled Copy No.: _____

Regional Office
312 Directors Drive • Knoxville, Tennessee 37923 • 615-690-3211

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BALANCE CALIBRATION VERIFICATION AND MAINTENANCE

1.0 SCOPE AND OBJECTIVE

1.1 This document describes the procedure for verifying laboratory balance calibration and describes minimum maintenance requirements. The procedure is applicable to all balances used by the PCE Process Development Group and Geotechnical Laboratory.

1.2 Procedural or project specific calibration criteria will take precedence over the requirements set forth in this procedure.

1.3 Balance calibration will be checked daily prior to balance use (daily calibration check), whenever a balance is moved (daily calibration check), after maintenance requiring disassembly (quarterly calibration check), or upon initial receipt of a new balance (quarterly calibration check). Balance calibration is also verified quarterly, and preventive maintenance performed annually.

1.4 Actual balance calibration and repair will be performed by an external agency, except in those cases where the balance has an internal calibration function. Balances with an internal calibration function will be calibrated according to the manufacturer's instructions, and must meet the specifications in this procedure.

2.0 DEFINITIONS

2.1 **Mass**: For the purposes of this procedure, mass is the same as weight.

2.2 **Class S weight**: A calibrated mass, usually made of stainless steel, that meets the specifications in NIST Circular 547 for Class S weights. Class S weights are used as a primary reference for mass measurement calibration in the laboratory. Equivalent to ASTM Class 1 weights.

2.3 **ASTM Class 1 weight**: A calibrated mass, usually made of stainless steel, meeting specification ASTM E617 for ANSI/ASTM Class 1 weights. ASTM Class 1 weights will be considered equivalent to Class S weights.

2.4 **OIML Class M2 weight**: A calibrated mass, usually made of brass, meeting specifications in International Recommendation No. 1. These weights are used for verifying mass measurement calibration on a routine basis. Also referred to as a daily calibration, check or brass weight.

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2.5 **Standard balance** - A balance capable of weighing to 0.01 g.

2.6 **Analytical balance** - A balance capable of weighing < 0.01 g.

2.7 **High capacity balance** - A balance with full range capacity > 5 kg and ≤ 25 kg.

2.8 **Very high capacity balance** - A balance with a full range capacity > 25 kg.

3.0 METHODOLOGY

3.1 Summary - Laboratory balance calibration is verified quarterly by allowing the balance to warm up for at least 30 minutes, weighing a series of weights and comparing the indicated weight with the actual mass of the weight. Balance calibration is checked daily prior to use by comparing the mass of a single check weight to the weight indicated by the balance. Annual calibration verification and service may be performed internally or by an external service.

Except for very high capacity and special purpose balances, balances will be calibrated in grams (g). Very high capacity and special purpose balances will be calibrated in the units most appropriate for the intended use.

Calibration logbooks are assigned to each balance. The balance logbook will be kept with the balance when possible. If significant contamination of the logbook is likely, the logbook may be kept separately.

3.2 Quarterly Calibration - Equipment required to perform calibration includes a set of ASTM Class 1 weights, forceps, clean (lint free) paper towels (Kimwipes are suggested), and a clean cloth glove for lifting weights too heavy for the forceps.

WARNING!

Do not allow weights to contact dirty surfaces. Always use clean forceps or cloth gloves when handling weights. Minimize exposure of weights to corrosive or dirty atmospheres. Any weight(s) which show signs of corrosion or physical damage, or do not meet calibration criteria, shall be removed from service until calibration is verified. Refer to SOP PDGADM0003 for further information on handling weights.

3.3 Prior to calibration verification, ensure that the balance is level, in a draft and

vibration free environment, and allow it to warm up for a minimum of 30 minutes. Tare the balance and observe the indicated weight for one minute. If the least significant digit varies by more than ± 5, either some outside force is affecting the balance, or there is a problem with the balance. Also check for missing segments in the balance display. Excessive drift or missing display segments must be corrected before proceeding. Enter the balance identification information on a balance calibration form.

3.4 Weigh a series of no less than five ASTM Class 1 weights covering the range of the balance and record the data on a Balance Calibration form (attachment 1) . Weights will be added cumulatively to the balance pan and removed in reverse sequence to check for hysteresis effects. Record the weight used and indicated weight on the balance calibration form. Acceptance criteria are:

Balance Readability	Tolerance (use larger of the two values)
0.0001 g	±0.1% or 0.002 g
0.001 g	±0.1% or 0.002 g
0.01 g	±0.1% or 0.02 g
0.1 g	±0.1% or 0.2 g
1.0 g	±0.1% or 2.0 g
Very high capacity balances	± 2 least significant digits

3.5 The range of the weights used for calibration verification will depend on the range of the balance. A general guideline is to check calibration at the bottom, middle, top, and two intermediate points of the balance range. If weights are unavailable to cover the full balance calibration range (e.g., analytical balances, very high capacity balances) cover as much of the range as possible.

3.6 If the balance meets the calibration criteria, complete a calibration tag and attach the tag to the balance where it is easily visible. Do not place the calibration tag on the balance pan. Send the completed calibration form to the facility QAO. Make a record of the calibration verification in the logbook assigned to the balance.

3.7 If the balance calibration is unacceptable, remove the balance from the work area, tag it as out of calibration, and make a note in the balance logbook describing it's condition. Send the failed calibration form to the facility QAO and initiate balance repair or calibration. The balance will remain out of service until it is repaired and/or successfully recalibrated.

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3.8 Annual Calibration Verification and Maintenance - Annual balance calibration verification will follow the same procedures as the quarterly calibration verification. In addition, the balance will be cleaned with an appropriate solvent, the mechanism inspected for corrosion, damage, or contamination and the balance cleaned or repaired as required. The annual calibration verification and service will be performed in lieu of one quarterly calibration.

3.9 Daily Calibration check - Weigh a single daily calibration weight ranging from 1 g to 2 kg. Try to pick a weight in the middle of the range of expected balance use. Record the mass of the weight used and balance indication in the logbook assigned to the balance. Acceptance criteria is ±1% of applied weight. If the acceptance criteria is not met, check the balance calibration with ASTM Class 1 weights to determine if it is the brass weight or balance that is the problem. If the balance is out of tolerance, indicate this in the appropriate column of the logbook, label the balance as unusable, notify the QAO, and initiate repair and/or calibration action. If the daily calibration weight is at fault, remove it from service and deliver it to the QAO with an explanation of the problem.

3.10 Balances which do not meet the acceptance criteria are to be calibrated as soon as possible, and may be used only if the balance meets calibration requirements for a specific procedure. Attach a copy of the failed calibration data to the balance. Immediately send the QAO a copy of the failed calibration form, and initiate balance calibration action.

3.11 Brass Weight Mass Verification - The mass of brass weights used for daily calibration verification is not routinely checked. When a problem is suspected, compare the weight to a corresponding ASTM Class 1 weight. Acceptance criteria is ±1% of stated weight. Brass weights not meeting this standard will be discarded.

3.12 Calibration verification of very high capacity balances (> 25 kg), such as those used for pilot plant operations, shall be performed by an external calibration service either prior to use or annually, whichever is least frequent. Very high capacity balances used to weigh outgoing packages or incoming samples need not be calibrated except when used for purposes requiring calibration.

3.13 Balances not in use do not require calibration verification or service. If a balance has not been used in the last 90 days, a quarterly calibration verification must be performed prior to use. Annual calibration and service is required for all balances except those in storage.

3.14 Balance maintenance - Balances will be kept as clean as possible while in use. Frequent cleaning of balance pan and external balance surfaces is encouraged. Use soapy water or ethyl alcohol (as appropriate) to clean balance surfaces.

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Remove the pan from top loading balances and inspect as much of the weight transfer mechanism as is exposed. If corrosion or debris is found in the mechanism, note this in the logbook. Notify the QAO of the condition and initiate corrective action.

3.15 Daily Balance Use - When weighing samples or chemicals, use a weigh boat or Kimwipe to keep them from touching the balance pan. Do not allow heavy objects to be placed on the balance pan except for weighing. Excessively heavy objects can damage the balance mechanism. Do not drop items onto the balance pan.

4.0 FORMS

4.1 Quarterly and annual balance calibration verification is documented in the logbook assigned to the balance, and on the Balance Calibration form (Figure 1). After completion, the form is sent to the QAO and maintained in the Quality and Operations files.

4.2 A calibration tag (Figure 2) is attached to the balance when quarterly or annual calibration is successfully completed. Information required includes initials of individual performing the calibration verification, date performed, date next calibration verification due (3 months), and balance serial number.

4.3 Daily balance calibration checks are documented in the logbook assigned to the balance. The required data are date, weight of daily calibration weight, weight indicated by the balance, pass or fail, and initials of individual performing the check. Additional comments may be added as needed.

5.0 REFERENCES

5.1 SOP PDGADM0003, Use and Maintenance of Class S and Brass Weights.

5.2 Organisation Internationale de Metrologie Legale (OIML) International Recommendation No. 1

5.3 ASTM E898. Standard Method of Testing Top-Loading, Direct-Reading Laboratory Scales and Balances.

5.4 NIST Circular 547, Section 1. (out of print)

5.5 ASTM E617, Standard Specification for Laboratory Weights and Precision Mass Standards.

INTERNATIONAL TECHNOLOGY CORPORATION

Pollution Control Engineering

Cal. by _____ date _____

Next calibration due _____

Serial # _____

(Enlarged)

Figure 1. Calibration Tag

ATTACHMENT A

BALANCE CALIBRATION FORM

BALANCE CALIBRATION VERIFICATION

Procedure: SOP PDGADM0002 Frequency: Quarterly

Balance make and model: _____ Date: _____

Serial #: _____ PCE Inventory #: _____

Calibrated by: _____ Balance drift acceptable? ☐ YES ☐ NO

Balance Readability	Acceptance Criteria (use larger of the two values)
≤ 0.001 g	±0.1% or 0.002 g
0.01 g	±0.1% or 0.02 g
0.1 g	±0.1% or 0.2 g
1.0 g	±0.1% or 2.0 g

Balance Logbook #: _____

Balance Location: _____

WEIGHT USED, g	BALANCE INDICATION, g	ACCEPTABLE YES/NO

Comments: _____

Use back of form for additional room if necessary.

Form ADM0002, 3/94, Revision 0, Do not use previous versions

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Attachment 1. Balance Calibration Verification Form

INTERNATIONAL TECHNOLOGY CORPORATION

PROCESS DEVELOPMENT GROUP

Standard Operating Procedure

Title: Thermometer and Thermocouple Calibration Verification

Prepared By: _____ **Date:** 10/12/94

Reviewed By: _____ **Date:** 10/13/94
Technical Specialist

Operations Approval: Ernest F. Stern Jr **Date:** 10/13/94
Group Leader/Manager

QA Approval: _____ **Date:** 10/13/94
Quality Assurance Officer

Management Approval: _____ **Date:** 10/13/94
Manager, Technology Development Laboratory

Controlled Copy No.: _____

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THERMOMETER AND THERMOCOUPLE CALIBRATION VERIFICATION

1.0 Scope and Objectives

1.1 This document describes the procedures for the calibration verification of general purpose laboratory thermometers and thermocouples used by the Geotechnical and Technology Development Laboratories.

1.2 This procedure is limited to verification of temperatures from -20°C to 110°C, with an accuracy of ± 1.0°C. Verification of calibration beyond this temperature range and accuracy requires special equipment and/or procedures that are not completely addressed here. If calibration is required beyond these temperatures, or if greater accuracy is required, calibration will normally be performed by an external metrology laboratory.

1.3 Thermometers are calibrated by three different methods according to use; partial, total, or complete immersion. Although there are small differences in these calibration methods and results, these differences are insignificant for general purpose thermometers and will not be considered in this procedure.

1.4 This procedure is not to be used for thermometers requiring accuracy of < 1°C, or thermometers requiring calibration outside the limits stated in 1.2. The thermometers used with the bomb calorimeter are specifically excluded from this procedure. When greater accuracy or an extended range is needed, thermometers must be sent to a commercial metrology laboratory for calibration.

2.0 Definitions

2.1 **Partial immersion** - Partial immersion thermometers are calibrated with the thermometer to a specific depth. This depth is specified on the thermometer. The thermometer has a line marking the correct immersion depth.

2.2 **Total immersion** - Total immersion thermometers are calibrated to read correctly when the entire column of mercury is immersed. The immersion depth will vary depending on the temperature being measured.

2.3 **Complete immersion** - Complete immersion thermometers are calibrated to indicate the correct temperature when the entire thermometer is immersed.

2.4 **Reference thermometer** - A thermometer which is certified to be directly traceable to the National Institute of Standards and Technology (NIST)

2.5 **Thermocouple** - An device which measures temperature as a function of voltage developed by a metal junction. The are two parts to a thermocouple system, the sensor (thermocouple) and display. Each of these parts must be present to calibrate a thermocouple, but the display may be calibrated separately. There are several types of thermocouples (J, K, T, etc.). Each type requires a display that is designed for the thermocouple type.

3.0 Methodology

3.1 Thermometer readings are compared to a reference thermometer at two or three points, near 0°C and 100°C, and at room temperature. Thermometers not covering the range of 0° to 100°C may be calibrated at two points. This temperature range may be extended by using a freezer, cryogenic liquids or slurries, or ovens. To verify calibration at these extended temperatures, special procedures and/or equipment may be required.

Thermocouples are compared against a reference thermometer at room temperature, and then heated to verify proper operation. Since thermocouples operate on a physical principle, as long as the thermocouple junction is intact the thermocouple will be assumed to be operating properly. Thermocouple displays are calibrated using a millivolt source to simulate the thermocouple signal.

3.2 Working thermometers and thermocouples shall be calibrated annually against a certified reference thermometer. The reference thermometer is certified every three years with equipment directly traceable to the NIST.

3.3 The following items, or their equivalents, may be required:

Reference Thermometer - NIST traceable

Altech model 22 thermocouple source

Ice and deionized water

Hot plate, able to boil water.

Beaker or flask with sufficient capacity to properly immerse the device being calibrated

Oven or freezer capable of holding a constant temperature

3.4 Calibration verification data will be documented on a standard data collection form. An example of such a form is in Appendix A. Calibration tags will be attached around the top of each calibrated thermometer. The tag may be removed for use, but must be replaced.

3.5 **Thermometer Calibration Verification**

Inspect each thermometer for broken tips, cracks or mercury separations. Document the thermometer condition on the calibration form. If the mercury has been separated, the preferred method of rejoining the mercury column is to place the bulb into a solution colder than the lowest temperature on the column while holding the thermometer upright. When the mercury has retreated into the bulb, shake the thermometer in an arc to force the mercury to unite in the bulb. Do not immerse the thermometer any further than the bulb.

WARNING!

Overheating a thermometer may cause a buildup of pressure great enough to cause the thermometer to break. Elemental mercury from thermometers is very toxic and volatile. If a thermometer breaks, immediately notify the facility health & safety staff and QAO.

If a thermometer has an expansion chamber at the top, mercury can be reunited by heating the bulb while gently tapping the side until the separation enters the expansion chamber and rejoins the mercury column. This method may not work if the mercury separation is so low in the column that the separated area cannot reach the expansion chamber at the top.

Thermometers covering the range of 0°C to 100°C will be calibrated at three different temperatures (near 0°C, near 100°C, and room temperature) within the thermometer's normal working range. Thermometers with a shorter range, or a range that precludes calibration at these two end points may be calibrated using two points, as long as those two points are near the bottom and top (up to 100°C) of the thermometers range. Thermometers with a range extending above 110°C or below -20°C will not normally be calibrated for temperatures above or below these temperatures, but calibration will be assumed to be within ± 1°C.

Thermometers that do not meet calibration requirements, are cracked, broken, or are unreadable, will immediately be removed from service. Notify the QAO of the thermometer serial number and reason for removing from service, then contact the Environmental Compliance Coordinator for disposal instructions.

Thermometers that are coated will react slower than uncoated thermometers and must be given more time to equilibrate. Thermometers that have been significantly heated or cooled are normally slower to return to room temperature and must be given enough time to fully equilibrate.

When more than one thermometer or thermocouple is used to measure a temperature, thermal gradients may cause readings to vary. Thermometer bulbs and thermocouple junctions should be placed as close together as possible when comparing temperatures. Stirring water and ice baths will minimize thermal gradients.

Use Methods 1 - 5 to get the required calibration points. Standard procedure will be to use Methods 1, 2, and 3, but Methods 4 and 5 may be used with thermometers having extended ranges, provided a reference thermometer for that range is available. Standard acceptance criteria is ± 1.0°C.

Method 1, Room Temperature:

Place the working thermometer(s) and reference thermometer side-by-side on a bench top for at least 30 minutes to reach equilibrium. Make sure all the bulbs are facing the same direction. Read and record the temperatures. If the thermometer does not read room temperature this step may be omitted.

Method 2, Low Temperature:

Fill a large beaker with enough ice cubes and deionized water to make an ice bath. Place both the working thermometer(s) and the reference thermometer into the bath with the bottom of the bulbs at the same level. Wait until the thermometers equilibrate (usually < 1 minute), read and record the indicated temperatures.

For temperatures lower than 0°C, a bath can be made by adding sodium chloride or potassium chloride to the ice water bath. Acetone or alcohol can be mixed with dry ice in a dewar to get temperatures below -10°C. Liquid nitrogen will cool to -196°C.

If the thermometer does not read 0°C, but reads between room temperature and 0°C, the room temperature reading will be the low end calibration point. If the thermometer only reads above room temperature, a water bath may be used to obtain the low reading. Adjust the water bath temperature as needed.

Method 3, High Temperature:

Fill a large glass beaker with sufficient deionized water to properly immerse the thermometers, and bring the water to a boil on a hot plate. The working thermometer(s) and reference thermometer are immersed with the bottom of the bulbs at the same level. Wait until the thermometers equilibrate (usually < 1 minute), read and record the indicated temperatures.

If the thermometer does not read up to 100°C, use a water bath near the upper limit of the thermometer to obtain the high reading.

Method 4, Low Temperature, Alternate Method:

Place the working thermometers and the reference thermometer together side-by-side in a freezer for at least one hour. After one hour, read and record the temperatures. It may help to place the thermometers in a mass large enough to retard the thermometer from cooling while reading the temperature. A beaker of sand or liquid that does not freeze at the temperature being measured may make suitable masses. The time required for equilibration will be extended significantly.

Method 5, High Temperature, Alternate Method:

Place the working thermometers and the reference thermometer together side-by-side in an oven for at least one hour. After one hour, read and record the temperatures. It may help to place the thermometers in a mass large enough to retard the thermometer from cooling while reading the temperature. A beaker of sand or a metal block with holes of the correct diameter for the thermometer may make suitable masses.

3.6 Thermocouple Calibration Verification

Thermocouple calibration can only be verified. Thermocouple displays can be calibrated for a thermocouple type or an individual thermocouple. To get the most accurate temperature reading, the thermocouple and display must be calibrated together in a manner similar to thermometers. Such a calibration is beyond the scope of this procedure.

The *CRC Handbook of Chemistry and Physics* contains standard calibration tables for various types of thermocouples. For best accuracy, refer to these tables to determine the amount of signal developed by a thermocouple at a specific temperature, and compare it to the signal developed by the

thermocouple. This procedure requires a millivolt meter and accurate temperature source, equipment not normally found in the laboratories.

For general purpose use, thermocouples calibration is checked at room temperature against the reference thermometer using Method 1 above. Acceptance criteria is ± 1% of full scale for the type of thermocouple being checked. The thermocouple is then heated with an open flame or heat gun to verify that the junction is intact and responds in a reasonable manner.

Thermocouple displays may be calibrated using an Altech model 22 thermocouple source. This device simulates a thermocouple signal, is specific to type K thermocouples, and covers the range of -50°C to 1000°C. Follow the manufacturer's instructions for use.

3.7 Calibration Correction of Total Immersion Thermometers Calibrated by Partial Immersion Techniques

Correction of total immersion thermometers calibrated using partial immersion techniques is normally not critical. However, where such accuracy is required, a correction factor can be estimated from the following equation found in *CRC Handbook of Chemistry and Physics*, 72nd Edition, page 15-10:

$$T_c = T_o + F * L(T_o - T_m)$$

where: T_c = Corrected temperature
T_o = Observed temperature
T_m = Mean temperature of exposed thermometer stem.
L = Length of the exposed column of mercury, in °C
F = Correction factor, 0.000160 (mean value of correction factors)

4.0 Format/Forms

An example of a thermometer/thermocouple calibration form is in Appendix A. Return all completed forms to the QAO, even if the device fails to meet specifications.

5.0 References

CRC Handbook of Chemistry and Physics, 72nd Edition

APPENDIX A

THERMOMETER/THERMOCOUPLE CALIBRATION FORM

TECHNOLOGY DEVELOPMENT LABORATORY THERMOMETER AND THERMOCOUPLE CALIBRATION VERIFICATION

Date: _____

Name: _____

Reference Thermometer

Serial #: _____

Range: _____

Increments: _____

Last Calibration: _____

Thermometer Description

Serial/ID #: _____

Range: _____

Increments: _____

Manufacturer: _____

Thermocouple Description

Serial/ID #: _____

Type: _____

Display Calib.: _____

Display ID[3]: _____

Thermometer Visual Inspection

Mercury Column Separated (Y/N): Yes[1] No

Scale Legible (Y/N): Yes No[2]

Cracks or Broken Glass (Y/N): Yes No[2]

Thermocouple Visual Inspection

Junction Intact: Yes No[2]

Junction Clean: Yes No[4]

Connector Intact: Yes No[5]

Response to Heat Acceptable: Yes No

Verification Method Number	Temperature Reading		Meets Acceptance Criteria Thermometer ± 1°C Thermocouple ± 1% of Range
	Reference Thermometer	Device being Verified	
1 (Room temp.)			
2 (Low temp.)			
3 (High temp.)			
4 (Low temp., Alt.)			
5 (High temp, Alt.)			

[1] Rejoin mercury column before continuing.

[2] Discard thermometer/thermocouple. Return this form to the QAO.

[3] If not mated to a specific display, enter the ID for the display used during this test.

[4] Clean junction before continuing.

[5] Repair before continuing.

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INTERNATIONAL TECHNOLOGY CORPORATION

TECHNOLOGY DEVELOPMENT GROUP

Standard Operating Procedure

Title: PIPETTOR CALIBRATION, CLEANING and MAINTENANCE

Prepared By:	R Gregory Butt	**Date:**	9/29/94
Reviewed By:	Coy A. Lauer *Technical Specialist*	**Date:**	9/29/94
Operations Approval:	Duane K. Root *Group Leader/Manager*	**Date:**	9/30/94
QA Approval:	Coy A. Lauer *Quality Assurance Officer*	**Date:**	9/29/94
Management Approval:	[illegible] *Manager, Technology Development Laboratory*	**Date:**	9/30/94

CONTROLLED COPY

NUMBER _____

PIPETTOR CALIBRATION, CLEANING and MAINTENANCE

1.0 Scope and Objectives

1.1 This SOP specifies a procedure for IT's Technology Development and Geotechnical Laboratories to verify accurate and precise delivery of known liquid volumes from laboratory pipettors, and specify requirements for cleaning and maintenance. It applies to all automatic pipettors, adjustable or fixed volume, used when needing accurately delivered volumes of standards, reagents or samples.

1.2 This procedure does not apply to glass volumetric pipettes liquid dispensers, or syringes. However, accuracy and precision of such devices may be checked by following the gravimetric calibration procedure.

1.3 Gravimetric calibration procedures may not be accurate for very low volumes (< 10 µL). Calibration of pipettors with volumes below 20 µL is very technique dependent. Individuals with limited pipetting experience must practice pipetting technique in order to become proficient in pipetting such low volumes.

1.4 Pipetting of liquids with viscosities significantly different from water may not be accurate.

2.0 Definitions

2.1 **Accuracy** - The closeness in agreement of the mean value and the nominal value obtained by repeated measurements. Accuracy is expressed as the relative percent error.

2.2 **Precision** - The reproducibility of an operation or a stated measurement. Precision is expressed as the percent relative standard deviation.

3.0 Methodology

3.1 Laboratory pipettors are one of two types: positive displacement or air displacement. Precision and accuracy are checked by repeated pipetting and weighing of aliquots of pure water at a known temperature. Positive displacement pipettors may also be calibrated by using calibration gauges supplied by the manufacturer. Pipettors for analytical purposes must meet the accuracy and precision requirements in 3.6. General purposes pipettors are required to meet the default standard of ± 10% accuracy and precision, regardless of range.

3.2 Prior to calibration, inspect the pipettor mechanism and clean, lubricate or repair any dirty, corroded, or broken mechanisms. Disassembly and cleaning instructions are included in the manufacturer's literature received with the pipettor.

3.3 Air displacement pipettors require annual gravimetric precision and accuracy testing, cleaning and maintenance. Positive displacement pipettors require semi-annual calibration checks using the manufacture's gauges, and annual cleaning, maintenance, and gravimetric precision and accuracy testing.

3.4 **Required Equipment**

Analytical balance - Capable of reading to 1% of the lowest pipettor range.

Thermometer - Capable of reading to ± 0.5°C

Manufacturer's calibration gauge - See manufacturer's instructions provided with each specific pipette.

Deionized water - ASTM type I or II

Bottle with a lid - able to hold 10 - 20 times the nominal volume being pipetted.

Beaker or Erlenmeyer Flask - Plastic or glass approximately 150 milliliters.

3.5 **Equipment Calibration Requirements**

Balance - Verify that the balance has been calibrated according to SOP NO. PDGADM0002.

Thermometer - Verify that the thermometer has been calibrated according to SOP NO. PDGADM0008.

3.6 **Quality Control Requirements** - Pipettors must meet the following criteria for analytical use:

Range	Accuracy	Precision
≤ 10 µL	± 10%	7%
10 - 100 µL	± 3%	3%
≥ 100 µL	± 2.5%	2%

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3.7 **Gravimetric Calibration of Air Displacement Pipettors**

Disassemble clean and lubricate the pipettor before calibrating. Inspect for excessive wear of parts; worn parts may need replacement or the pipettor may need to be replaced. See manufacture's instructions for help and information on replacement of parts.

Allow about 100 ml of deionized water to equilibrate to room temperature (18 - 27°C).

Determine the temperature to 0.5°C with a thermometer and record this value on the Pipettor Calibration Data Collection Worksheet (Attachment A).

Condition the pipette tip. Place the tip into the water reservoir and depress the plunger to the first stop; release slowly to draw water into the tip, and then expel the water by depressing the plunger to the bottom stop. Repeat this process several times.

Cover the bottom of the weighing vessel with water and replace the lid.

CAUTION!

Pipetting technique and the time between taring the balance and measuring the weight of the volume of water pipetted can have significant impact on pipettor accuracy and precision. The time between tare and measurement must be kept as low as possible. After pipetting, check for drops of water clinging to the pipette tip, indicating incomplete dispensing.

Tare the vessel and rapidly but smoothly pipette a volume of water into the weighing vessel. Place the tip into the water supply, and depress the plunger to the first stop; release slowly to draw water into the tip. Inspect the tip for any air bubbles below the liquid meniscus. If air is found expel the liquid into the reservoir and redraw water into the tip. Expel the water into the weighing vessel by placing the tip of the pipette at an angle between 10° and 45° against the inside wall of the vessel and depress the plunger to the bottom stop. Repeat this step if dispensing was incomplete.

Replace the lid on the weighing vessel and weigh. Record the weight on the Data Collection Worksheet and retare the weighing vessel.

Repeat the pipetting process to obtain at least seven good weighings, making sure to retare the weighing vessel between pipettings.

For multiple volume pipettes follow this procedure at three different volumes. The three volumes should be: within 10% of the low and high ends, and near the midpoint. Do not go below or above the stated pipettor range.

Enter the data from the Data Collection Worksheet into the Excel Pipettor Calibration Spreadsheet (PIPCAL2.XLT), available from the Laboratory QA Officer. The Excel spreadsheet will automatically calculate precision and accuracy, compare them to acceptance criteria, and give a pass/fail indication. If adjustment of the pipettor is required, follow the manufacturer's instructions. If the pipettor passes calibration, attach a completed calibration tag to the pipettor.

3.8 Gravimetric Calibration of Positive Displacement Pipettors

Positive displacement pipettor calibration follows the same basic procedure as air displacement pipettors with the following operational changes:

To fill a positive displacement pipettor, place the pipette tip into the reservoir, depress the plunger to the bottom (positive displacement pipettors have no stops), and then slowly release the plunger until it stops. After 1 second the tip is removed from the water and allowed to touch the side of the vessel. Check for bubbles in the tip.

To expel the water, touch the side of the receiving flask with the pipettor tip and depress the plunger to the bottom. Check for drops on or in the tip.

3.9 Semi-Annual Calibration of Positive Displacement Pipettors

The manufacturer's method for calibration of positive displacement pipettors is as follows:

Set the pipettor to the calibration volume (25.0 µl for C series pipettes, 250 µl for J series pipettes). Remove the knurled tip and Teflon retainer.

Slide the calibration gauge onto the piston as far as it will go. The Teflon tip should be flush with the end of the gauge. If the tip is not flush with the gauge end, adjust the pipettor by following the manufacture's instructions.

Reassemble the Teflon retainer and the knurled tip and attach a completed calibration tag to the pipettor.

3.10 **Data Reduction**

Input the data into the Excel Pipettor Calibration Spreadsheet Template (file name Pipcal2.XLT) and print a copy of the completed spreadsheet. Verify that data entry was correct using a yellow highlighter to indicate a correct entry. If any entries are incorrect, correct them, reprint the spreadsheet, and reverify that all entries are correct. The final spreadsheet should have all entries marked with a yellow highlighter to indicate that they are correct.

The spreadsheet automatically calculates precision and accuracy, compares the results to acceptance criteria, and prints a pass/fail message. If the pipettor fails calibration, take appropriate corrective action (adjust, clean, replace parts, etc.).

Send all (even those that fail calibration) completed calibration worksheets and verified spreadsheets to the Laboratory QA Officer. Calibration records are maintained in the Laboratory Quality File.

A nonconformance report will be completed for any pipettor found to be grossly (> 3 times the allowable accuracy or precision) out of calibration or broken.

3.11 **Calculations**

Volume delivered:

$$V = W / d$$

where: V = Volume delivered in microliters
W = Weight in milligrams
d = Density of water at the measured temperature

Relative percent error:

$$\%E = [(V - Vn)/Vn] \times 100$$

where: V = Mean volume delivered in microliters
Vn = Nominal (stated) volume

Percent Relative Standard Deviation:

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$$\%RSD = (SD/V) \times 100$$

where: SD = Standard deviation of measurements (σ_{n-1})
V = Mean volume

3.12 **Pipettor Maintenance**

In order to work properly, pipettors must be properly lubricated, clean, and free of corrosion. Pipettors are subject to inadvertent abuse by allowing liquids to travel into the pipettor barrel. This can be caused by releasing the pipettor plunger too quickly, or laying the pipettor horizontally with liquid still in the pipettor. Disassembly, cleaning and lubrication instructions are in the manufacturer's literature received with the pipettor.

Some symptoms of a malfunctioning pipettor include dripping during use, erratic plunger operation, sticking plunger, and liquid released into the tip when the pipettor is tapped lightly tip-down on the bench. Any pipettor exhibiting these, or any other abnormal indications, must be thoroughly checked prior to use. Corrective action may include disassembly and cleaning, lubrication, or replacement of parts. Pipettors which cannot be repaired will be discarded. After maintenance, verify calibration prior to use.

Before use, it is a good idea to tap the pipettor on the bench to check for traces of liquids that have been sucked into the pipettor barrel. If liquid is observed, disassemble the pipettor, clean and lubricate, reassemble, and verify calibration.

4.0 Format/Forms

Calibration data is recorded on the Pipettor Calibration Worksheet, Attachment A.

Calibration data from the worksheet is entered into the Pipettor Calibration Spreadsheet (Excel Spreadsheet Template, file name Pipcal2.XLT), available from the Laboratory QA Officer.

5.0 References

IT PCE SOP NO. PDGADM0002 - Balance Calibration

IT PCE SOP NO. PDGADM0009 - Nonconformances

IT PCE SOP NO. PDGADM0008 - Thermometer Calibration

Perry's Chemical Engineers Handbook, Sixth Edition (density of water, Table 3-28)

Attachment A

Pipettor Calibration Worksheet

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PIPETTOR CALIBRATION DATA COLLECTION WORKSHEET

Pipet No. _____ Date: _____

Analyst: _____ Circle One: Air Displacement
Positive Displacement

Water Temperature (18 - 25 deg C): _____

Nominal Value _____		Nominal Value _____		Nominal Value _____	
n	Weight (g)	n	Weight (g)	n	Weight (g)
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	
6		6		6	
7		7		7	

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