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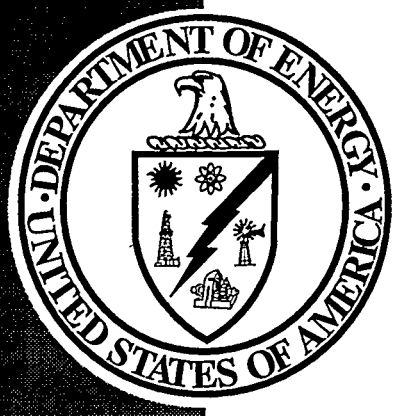

SAMPLING QUALITY ASSURANCE GUIDANCE

IN SUPPORT OF

EM ENVIRONMENTAL SAMPLING AND ANALYSIS ACTIVITIES

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May 1994

MASTER

WPI.94-0189

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PART I

PROGRAM DESCRIPTION

1.0 INTRODUCTION

The basis for the Department of Energy's (DOE) Office of Environmental Restoration and Waste Management's (EM) Analytical Services Program (ASP) is contained in the charter and commitments described in Secretary of Energy Notice (SEN) 13-89, EM program policies and requirements, and commitments to Congress and the Office of Inspector General (IG). EM's commitment to the development and implementation of an ASP by the Analytical Services Division (EM-263, ASD) is in response to concerns raised by the Chairman of the Congressional Environment, Energy, and Natural Resources Subcommittee on Energy and Commerce regarding the production of environmental data. The development and implementation of an ASP also satisfies the IG's audit report recommendations (IG Reports IG-0293 and IG-0295) on environmental analytical support, including development and implementation of a national strategy for acquisition of quality sampling and analytical services. These recommendations were endorsed in Departmental positions, which further emphasize the importance of the ASP to EM's programs.

This document describes the environmental sampling and analysis (ESA) program activities considered to represent the minimum activities necessary to achieve the intended goals.

The Analytical Services Program's ESA program strategy is designed to comply with DOE Order 5700.6C and the EM Quality Assurance Requirement and Description (QARD) document to ensure the production of data readily acceptable to regulatory agencies. This Order and the QARD establishes quality assurance requirements for EM.

1.1 Requirements to Establish Sampling Guidance

Requirements for the establishment of Sampling Quality Assurance Guidance originate from several sources: EM's need to address compliance with environmental and safety laws and regulations and to enhance the technical validity of EM programs and projects as part of its overall responsibility to achieve environmental protection; direction from the Secretary of Energy in 1989 to establish an analytical quality assurance program to support environmental restoration and waste management activities in response to DOE/IG findings; DOE Order 5700.6C, which establishes Quality Assurance (QA) requirements for DOE; and SEN-6E, which establishes assessment and self-assessment requirements for DOE.

1.2 Purpose

This document introduces quality assurance guidance pertaining to the design and implementation of sampling procedures and processes for collecting EM environmental data. The guidance is consistent with and supports DOE (Order 5700.6C) and consensus American National Standards Institute/American Society for Quality Control (ANSI/ASQC E4-1993) QA requirements.

The document addresses several goals:

- identifying key sampling issues and program elements to EM headquarters and field office managers;
- providing non-prescriptive guidance consistent with regulatory and DOE requirements and a compilation of pertinent references;
- introducing environmental data collection program elements that are the technical basis for EM-263 assessment documents; and
- providing guidance for the development of checklists (audit plates) for the assessment of environmental sampling and analysis activities.

The guidance presented is not prescriptive. However, the elements and processes presented can be integrated into an effective environmental laboratory operation. EM Headquarters management concern is functionality, not form. Field assessments will reflect this emphasis on cost-effective quality and performance of all sampling activities.

1.3 Scope

Specific sections of this guidance apply to EM program managers at headquarters and field offices (e.g., field sampling operation issues). Detailed technical guidance applies to DOE contractors and subcontractors designing environmental collection activities and reviewing sample collection activities performed by others.

This guidance describes the implementation of Sampling QA elements within a functional QA program. The development of the QA program and of project-specific Data Quality Objectives (DQOs) are outside the scope of this guidance and not addressed in this document. Additional EM guidance covering these and other technical areas (e.g., Field Screening and Analysis) is being developed.

1.4 Relationship to Regulatory Requirements and Existing Programs

Guidance and concepts provided in this supplement are designed to be compatible with existing regulatory QA requirements. However, this guidance may not address all specifications and requirements detailed in various local, state, and Federal programs such as the Department of Transportation (DOT) and the Nuclear Regulatory Commission (NRC). To ensure that all specifications and regulatory requirements are met, the sampling organization should consult its specific regulatory program requirements, quality assurance program requirements, project plans, and any other applicable site documents.

The references provided in this document do not confer requirements on EM programs and projects. They are provided to identify existing materials and as sources of information for use by EM field management.

The sampling QA plan is required as a statement of the organizations's approach to ensure that materials are collected that will support the generation of quality data. The organization performing the sampling should have a QA plan in place that should be designed to cover its responsibility at

any given location. Sampling organization networks or corporations may develop umbrella corporate QA plans, however, it is anticipated that the unique aspects of each site's implementation of this plan would be encompassed by a site-specific QA plan or attachment to the corporate QA plan.

The purpose of this document is not to require a separate QA program. QA elements found in this guidance document may already be incorporated into various existing sampling organization documents and need not be located in one document. All items addressed in this guidance document need not be incorporated into the sampling organization's documents, however, documentation as to why items are incorporated or are not incorporated into sampling documents should be maintained. A summary document identifying where the QA elements are located in existing documents should be developed and maintained if one does not already exist.

While this document does not cover DQO or QA Plan development, employees and management should be trained sufficiently to give them a thorough knowledge of applicable QA project plans (QAPjPs) and DQO requirements and concepts. The concepts of Total Quality Management (TQM) and continuous improvement should be applied throughout the planning, implementation, oversight, and assessment phases of projects. Training should emphasize that the over application of controls not needed to satisfy project requirements, resulting in excessive project costs, is an important consideration.

1.5 Sample Collection Contracting and Subcontracting Guidelines

To support integration of needs requirements and to assure the collection of acceptable laboratory products, all EM project management offices should contract for Environmental Sampling and Analysis through a local sample management facility associated with the EM's National Sample Tracking System (NSTS). This will support national EM program needs and assure that local EM contract selection and monitoring procedures are consistent with DOE and regulatory standards.

Free access to audit reports from other DOE organizations and Federal agencies and States is necessary. Contracted sampling organizations should agree to support free exchange of audit materials between organizations to decrease redundant audits.

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PART II

TECHNICAL GUIDANCE

2.0 SAMPLING SYSTEMS GUIDELINES

EM project management, in conjunction with personnel knowledgeable in the relevant analytical criteria, should develop, establish, and update requirements for sampling organization and personnel, personnel training, site guidelines, sampling methods, standard operating procedures, corrective actions, document control, and field assessments. Documented procedures should be in place. If EM project management determines that existing sampling Standard Operating Procedures (SOPs) are sufficient to meet or exceed project needs, new documents need not be developed. For most projects, existing sampling SOPs will meet or exceed project requirements.

2.1 Sampling Organization and Personnel

Each sampling organization supporting EM efforts should clearly define corporate- and site-specific operational organization and lines of authority. This may be accomplished through an organizational diagram or chart illustrating lines of authority and reporting responsibilities.

Direct and ultimate responsibility for assuring quality sample collection resides with line management (e.g., chief executive officer, site manager, field team leader). QA functions provide technical support to management for review and assurance of data quality. Every effort should be made to create independent lines of authority and reporting routes for QA functions within the organization.

All significant changes in the sampling organization and personnel should be reported to EM project management. Such changes may include facility mergers or acquisitions, expansions, relocation, management adjustments, and changes in primary technical or QA personnel. Regulatory actions toward the sampling organization or its parent corporation, such as suspension of contracts with other Federal agencies, as well as all notices of investigations and legal actions against the organization or its personnel should be reported immediately.

2.1.1 Personnel Qualification

Years of sampling experience may often outweigh or gain equivalency to academic achievement. Each organization should gauge and document the competency of experienced individuals. Each sampling organization should establish policy and requirements to establish individual qualifications and competencies for the position held (e.g., sampler, technician, engineer) following organizational requirements that may exist.

The sampling organization should maintain comprehensive information on each employee regarding the individual's formal education, training, and experience. This may include such documentation as copies of up-to-date individual résumés, degrees earned, certificates of courses completed, and records of in-house training. It may also include continuing records of the individual's performance. In-house or contracted training may be documented

through attendance records, individual instruction verified through the instructor's signature or certificate, or actual written or practical testing sources.

2.2 Personnel Training

EM project management should assure that all personnel performing tasks and functions have the needed education, training and experience, and are aware of and perform, quality work. Personnel should be provided continued training to ensure that job proficiency is maintained.

Generally accepted sampling practice includes personnel training requirements to assure that:

- Personnel receive awareness training regarding the hazards associated with the specific site to be investigated and the specific tasks to be performed;
- Training includes both education in principles and enhancement of skills; and
- Training emphasizes correct completion of work and provides understanding of why specific project quality requirements exist. Training is to provide an understanding of the fundamentals of the work and its context to the QA Plan and project DQOs. Training instruction is to address potential consequences of improper work, for both over application of requirements as well as under application of requirements, and focus attention on "doing the right thing right the first time."

Subcontractors should maintain comprehensive records on each individual's training.

Minimum training requirements include applicable Occupational Safety and Health Administration (OSHA) Site Health and Safety training. Radiation control training should be required if a laboratory handles radioactive materials or is located on a DOE facility that requires radiation control training. Department of Transportation training should be required for any field personnel that package samples for transport.

2.3 Facilities Guidelines

Generally accepted sampling practice requires the following requirements be met:

- Site facilities should be secure. The buildings, field laboratories, and controlled sampling points (e.g., monitoring wells) should have access limited to authorized personnel;
- Instrumentation, equipment, and utilities should be maintained to perform the required/contracted sampling operation. Safety equipment should be available and readily accessible. Equipment should be kept secured when not in use;

- Surface disturbances such as pits, holes, excavations and trenches should be clearly marked or barricaded. Addition of new surface features such as well heads, pumps, piping, and electrical traces should be clearly marked;

- Sampling designs should minimize interactions between high and low concentration areas, as well as minimize common utilization of equipment, instrumentation, and facilities. A formal, active contamination control program should exist that minimize the potential spread of contamination between sample processing and sample storage areas. Specially controlled facilities or areas should be considered for the receipt of highly contaminated materials, and storage of waste; and

- Design and implementation of sampling programs should address situations or conditions necessary for the controlled use, storage, and disposal of sample material rejects (e.g., soil discards, purged waters), equipment decontamination residues, remnants of samples. It should also assure that all activities that may impact environmental data are documented and recorded in a field logbook.

2.4 Sampling Methods

Documentation of sampling procedures is critical to the technical defensibility and the legal defensibility/admissibility of the resulting data. Generally accepted practice is that, whenever possible, industry-recognized sampling methods from agency published source documents such as DOE, EPA, and American Society for Testing Materials (ASTM) should be employed. Sample collection and processing procedures may also use methods published by the U.S. Geological Survey (USGS), Department of Agriculture (USDA), and professional groups like the American Water Works Association (AWWA). Current DOE, EPA, and ASTM methods are detailed in the following sources.

- DOE Methods for Evaluating Environmental and Waste Management Samples, DOE/EM-0089T, October 1992.

- DOE EML Procedures Manual, 27th Edition, Feb. 1992.

- DOE Environmental Survey Manual. Appendix E, Field Sampling Protocols and Guidance, Office of Environmental Audit, 1987.

- U.S. Environmental Protection Agency, Representative Sampling Guidance, Vol. 1 Soil, 1991.

- U.S. Environmental Protection Agency, Soil Sampling Quality Assurance User's Guide, 1989.

- U.S. Environmental Protection Agency, Sampling of Water and Wastewater, 1977.

- U.S. Environmental Protection Agency, Practical Guide for Groundwater Sampling, 1985.

- U.S. Environmental Protection Agency, Compendium of Superfund Field Operations Methods, 1987.

- ASTM, Sampling Surface Soils for Radionuclides, ASTM C-998-83, 1983.

- ASTM, Standard Practices for Sampling Water, Method D 3370-76, 1977.

Methods employed that are not found in the above references should be thoroughly reviewed and approved by the EM project management prior to implementation. Complete and well documented method references should be available for all methods. In lieu of specific method references, appropriate chapters of documents, such as suppliers manuals, equipment manufacturer instructions, and instrumentation specifications should be used. Such documents should include adequate descriptions and criteria to assure the required quality of work.

2.5 Standard Operating Procedures

Generally accepted sampling practice is that SOPs should encompass administrative, operational, and sampling procedures of the organization. When SOPs are developed or reviewed, the following areas should be considered:

- references to source documents published by agencies such as the EPA and the ASTM should be included;

- document control of SOPs; and

- review and revision of SOPs as required to address changes in data quality requirements, technology and equipment changes, and/or changes in regulatory requirements.

2.5.1 Operational Standard Operating Procedures

The number and type of operational SOPs instituted by a particular sampling organization will vary greatly, depending on the focus of the operation.

Generally accepted sampling practice is that the following operational SOPs be in place:

- sample identification;

- chain of custody;

- sample preservation;

- sample packaging and shipping;

- sample tracking;

- field notebooks;

- documentation control and documentation practices;

- logbooks (temperature logs, balance logs, equipment maintenance logs, instrument run logs, sample storage logs, standards logs, health and safety logs etc.);
- document control including: the review, approval, and signature authority of both the management and QA function of the sampling team; availability to personnel at the appropriate work stations; maintenance of a log of all SOPs in use; and the maintenance of a file of all revisions of SOPs used in the past;
- equipment cleaning, maintenance and decontamination procedures;
- establishing and maintaining clean and "dirty" zones;
- site access and controlled entry;
- emergency response;
- work area monitoring, personal protective equipment and medical monitoring;
- data management and handling;
- data review and verification;
- QA and QC procedures;
- corrective actions to contractual deficiencies found during DOE authorized on-site inspections, surveillances, audits or other oversight functions;
- subcontracting procedures for EM samples; and
- waste disposal.

2.5.2 Sampling Standard Operating Procedures

Sampling activities will be conducted at the sites using a variety of equipment and procedures, (e.g., well drilling procedure for ground water sampling, soil sampling procedures, sampling from wells, pipes, pits, and lagoons, sampling containerized wastes [tanks, trucks, drums etc.]). Each sampling method performed in the field should have an SOP associated with a given particular activity. The equipment and procedures should be selected on a site specific basis depending upon the media and the nature of the contaminant to be sampled. The SOP should describe in detail the equipment needed, how to use the equipment properly, and how to maintain the equipment. The SOP should address typical difficulties associated with the sampling activity and any precautions required to complete the task successfully. The SOP should also specify the required documentation necessary to make the activity acceptable under the established criteria.

Generally accepted sampling practice is that the following areas are considered for each sampling SOP:

- the applicability of method to the matrix or sample type;
- surveying and identification of sample collection points;
- preparatory procedures, such as subsampling, should address the various individual sample matrices and the associated heterogeneity;
- accuracy, precision, and sensitivity of the procedure;
- equipment performance specifications and proper operating conditions;
- equipment decontamination;
- related QC sample type, frequency, and acceptance criteria; and
- sample packaging and shipping.

2.6 Variances to Standard Operating Procedures

Sampling should be performed in accordance with established and EM approved SOPs unless specific needs dictate a temporary and immediate variation from the approved SOP. Whenever possible, any variations to EM approved SOPs should be approved by EM project management in advance of implementation. When advanced approval is not possible, EM project management should be notified of the variation by the sampling team at the earliest possible opportunity. The reason for the variation and all specific actions associated with the variations to the approved SOP should be documented. All data associated with a method variation or a temporarily modified method should be evaluated for useability based on project DQOs.

2.7 Out-of-Control Events and Corrective Actions

Any deviations from the SOPs not covered by a variance may be considered an out-of-control event. Equipment malfunctions, misidentifications, or mishandling of samples are examples of deviations. Deviations should be documented at the time of occurrence and reported to the field team leader/site manager and EM project management.

Generally accepted practice is that the following areas should be considered for corrective action SOP:

- the capability to effectively deal with errors or defects at any point in the sampling activity;
- protocols for reporting, format and content of reports, timing of reports and actions, specification of individuals responsible for corrective measures, and lines of communication to management;
- the ability to identify, tally, and track defects to their origin; to plan and implement measures to correct identified defects; and to document the results of the corrective actions with the use of corrective action forms or reports;

- corrective action forms or reports should be maintained and controlled by the field QA function, and documentation of events affecting sample data should be reported with, and archived in, sample records; and

- corrective action reports should contain at least the following information:

    - when and where the out-of-control event occurred;

    - who discovered the out-of-control event and who has taken or will take responsibility for corrective action;

    - an explanation for the out-of-control event. Copies of relevant information, control charts, sample data, etc. may be included as part of the corrective action report;

    - identification of all samples affected, and a discussion of sample problems and possible effects; and

    - corrective actions should be described and measures enacted to prevent a recurrence of the problem should be identified.

2.8 Document and Record Control Guidelines

Generally accepted laboratory practice is that document and records SOPs encompass control, retention, and data correction.

2.8.1 Documentation Control System

Generally accepted laboratory practice is that the following areas are considered for document control SOPs:

- assignment of responsibility for preparing, reviewing, approving, and issuing documents;

- review process for adequacy, completeness, and correctness prior to approval and issuance of document;

- definition of the scope of the document control system;

- documentation of the document control system itself;

- identification of documents to be controlled and their distribution, archival, and disposal;

- control of superseded documents to ensure that only current documents are in use;

- review and approval of major changes to documents by the same organizations/personnel that performed the original review and approval;

- provision of pertinent background data or information to reviewing organizations;

- definition of minor and major changes to documents (i.e. editorial corrections that do not require the same review and approval as the original documents); and

- identification of personnel who can determine what constitutes minor and major changes.

2.8.2 Records Control System

A records control system should be established consistent with DOE Order 1324.2A. Generally accepted laboratory practice is that the following are considered for records control SOPs:

- specification of records of items, data, and processes to be controlled;

- preparation, review, approval, and maintenance of records to accurately reflect completed work and to fulfill statutory requirements;

- requirements and responsibilities for record transmittal, distribution, change, retention, protection, preservation, traceability, archival, retrieval, and disposal;

- preparation of storage procedures prior to records storage;

- assignment of responsibility for funding and enforcing of requirements;

- description of the storage facility and the filing system to be used;

- verification that records received are legible and are in agreement with the transmittal document;

- rules governing access to and control of the files;

- procedures for the control of and accountability for records removed from the storage facility;

- procedures for filing of supplemental information and disposing of superseded records;

- storage of records in a manner approved by the organization or organizations responsible for the records;

- construction and maintenance of records storage facilities in a manner that minimizes the risk of damage or destruction from natural disasters; and

- replacement, restoration, or substitution of lost or damaged records.

2.8.3 Documents and Records Retention

Generally accepted laboratory practice is that the field organization should maintain originals and copies of all data packages, calibration records, and other QA/QC-related records until they are delivered as per existing instructions and procedures or authorized EM personnel either asks for the records or authorizes their destruction.

2.8.4 Data Correction Guidelines

The field organization should establish a data correction SOP which should establish who is authorized to change and correct data. Changes or corrections to information, including data entries, notebook and log entries, and computer or data systems output should be corrected by drawing a single line through the incorrect information and initialing and dating the new entry. Correction tape or fluid should not be used. Changes to computerized data records should be identified such that original and corrected entries are retrievable and the individual initiating the changes can be identified.

2.9 Field Assessments

During the actual performance of field activities, in-process audits and surveillances should be performed may by either an internal or external assessment organization. These assessment will assure that the sampling organization's activities are being conducted according to approved procedures by qualified personnel using specified equipment. Results of all assessments, including the corrective actions taken, should be reported to the EM project manager on a regular basis.

The audit/surveillance of sampling activities should evaluate, at a minimum, the following subjects:

- Equipment: Collection, measurement, and test equipment should meet the applicable standards (e.g., ASTM) or have been evaluated as being acceptable to the procedures, requirements, and specifications.

- Verification of Sampling Activities: Audits should be performed to verify that the elements of the sampling program are in compliance with the applicable technical and quality standards, specifications, and Sampling and Analysis (S&A) Plan and Work Plan requirements. The elements to be verified should include, but are not limited to, the following:

  - Implementation of the QA Program,
  - Qualification of sampling personnel,
  - Identification, control, and storage of samples and project documents,
  - Implementation of methods or procedures conforming to applicable specifications and Work Plan requirements, and

- Documentation and verification of conditions and observations.

- Completeness of Sampling Records: The audit should determine whether:

  - All samples required by the QAPjP have been processed,
  - Complete records exist for each sample set and the associated QC samples,
  - The procedures specified in the QAPjP have been implemented and that changes have been noted according to the established procedures,
  - The results of the internal completeness check have been documented, and data affected by incomplete records have been identified, and
  - Anomalous field data are identified and appropriately qualified.

- Evaluation of Data with Respect to Control Limits: The audit should check corrective action reports to determine whether samples associated with out-of-control events are identified in a written report of the sampling activities.

- Review of Holding Time Data: The audit should compare sample holding times to those required by the QAPjP and the S&A Plan. The audit should determine whether samples associated with deviation from holding time requirements are identified in a written record of the sampling activities.

- Implementation and Effectiveness of Corrective Actions: The audit should check corrective action reports to determine whether sampling activities associated with findings from previous audits/surveillances of similar activities are identified in a written report. The audit should determine if the facility response to previous findings was effective and properly implemented.

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25. U.S. Environmental Protection Agency. 1991. Representative Sampling Guidance, Vol. I: Soil. OSWER Directive 9360.4-10.

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3.0 SAMPLING OPERATIONAL GUIDANCE

EM project management, in conjunction with personnel knowledgeable in the relevant sampling criteria, should develop, establish, and update requirements for management of documentation, sample collection, waste disposal, chain of custody, subsampling, holding times, sample containers, and preventative maintenance. If EM project management determines that existing sampling SOPs are sufficient to meet or exceed project needs, new documents need not be developed. For most projects, existing sampling SOPs should meet or exceed project requirements.

3.1 Site/Field Documentation

Site and field logbooks provide a daily handwritten record of all field activities at an investigation site and are the primary record for all sampling activities. All logbooks should be permanently bound, and field logbooks should be waterproof. Logbooks should be bound and ruled with sequentially numbered pages. All logbook entries should be made in indelible ink. Corrections should be made by marking the erroneous data through with a single line, entering the correct data, and initialing and dating the changes. Correction fluid and erasers should not be used. Pages should not be removed from the site or field logbooks for any reason. Blank pages should be marked "page intentionally left blank." Only authorized persons may make entries in logbooks.

Automated data entry systems for field data collection are frequently used. Computer notebooks and data loggers reduce repetitive data entry and transcription errors. Guidance is available in the EPA report Good Automated Laboratory Practice (1990).

3.1.1 Site Logbook

A site logbook is the master reference document for all activities performed at a site. In small investigations, the field logbook may also serve as the site logbook. Entries should be made and initialled on a real time basis with summaries completed at the close of each work day. The front cover of the site logbook should bear the project name and number, contractor or subcontractor name, and contract number, if appropriate. Start and completion dates appear on the front cover.

The following items should be recorded in the site logbook:

- The day, date, time arrived on-site, weather conditions, and names, titles, organizations of personnel present on-site, and all individuals responsible for field logbooks should be listed with their assigned logbook number;
- The name, title, organization represented, and the purpose of all visitors should be listed;
- Forms, including computer data files or logbooks that register the details of tasks performed on site (e.g., well installation logs), should be referenced;

- All site activities should be briefly described. The site logbook summarizes daily activities and should therefore not be as detailed as field logbooks. All field tests should be listed;

- Chain-of-custody details, and all activities and variances relating to chain of custody should be listed;

- Equipment decontaminated, number of decontaminations, and the decontamination procedures followed when different from the QAPjP or SOPs. The site log may reference the field logbook where specific information is documented;

- Any equipment failures or breakdowns that occurred should be listed, with a brief description of repairs or replacements made. Indications of the impact equipment failure may have on the project should be noted;

- Any deviations from the QAPjP or SOPs should include the reasons for the change, the detail of the change, and a discussion of the possible impacts of the change should also be included; and

- A record of telephone calls relating to field activities should be included. If a separate phone log is maintained, the site log should reference the page containing the specific details.

The field manager or supervisor should review all entries, sign, and date the bottom of each page.

3.1.2 Field Logbook

In addition to the information contained in the site logbook, field logbooks contain area or task specific information. The field logbook cover should indicate the particular tasks or areas within the site (or the specific individuals) to which the logbook is assigned.

Information to be recorded, as appropriate, include:

- The day and date, time the task started, weather conditions, and the names, titles, and organizations of personnel performing the task;

- The name, title, organization, and visits purpose of all visitors to the task area;

- Describe all site activities in specific detail or show which forms were used to record such information (e.g., soil boring log or well completion log). It is good practice for the site engineer or geologist to duplicate the most important information in the field logbook and also on data forms. Sketches of the following are valuable additions to field notes:

  - Wells and piezometers: elevations, reference elevation, total depth, size, and length of casing and screen, casing and screen material, screen slot size, formation in which

screen is installed, drilling conditions and rate, rig type, bit size(s), and detailed lithologic data;

- Trenches, pits, and soil borings: excavation dimensions or borehole size and depth, sampling equipment or methods(s), detailed lithologic data, and samples collected;

- Soil gas and geophysical surveys: grid or line dimensions, probe or sensor spacing, depths, survey and recording equipment type and serial or identification number, and location of resulting data (e.g., strip chart, analog data record, computer file, and file name);

- Biota surveys: identification of biota types, location collected, method of collection including equipment identification, and sample identifications;

- Air surveys: diagram of sampling locations, description of collection device placement, sampling interval, sample type, and sample identifications;

- Surface- and groundwater surveys: location, method of collection, depth, and sample identifications;

- Describe, in detail, any field tests that were conducted. Reference any forms that were used, other data records, and the procedures followed in conducting the test. Results of any field activity should be annotated in the field logbook;

- Describe in detail any field calibrations and surveys that were conducted. Reference any forms that were used, other data records, and the procedures followed in conducting the calibrations and surveys. Results of any field calibrations and surveys should be annotated in a logbook;

- Describe in detail any samples collected and indicate the preparation, if any, of splits, duplicates, matrix spikes, or blanks. Reference the procedure(s) followed in sample collection or split, duplicate, spike, and blank preparation. List all label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytic request form number pertinent to each sample or sample set. Note the time and the name of the individual to whom custody of samples was transferred;

- The time, equipment type, and serial or identification number, and the procedure followed for all decontaminations and equipment maintenance carried out. Reference the page number(s) in the decontamination log and field equipment log (if any) where detailed information is recorded; detailed information should otherwise appear in the field logbook;

- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements; and

- The project field geologist or task leader should review and sign the field logbook at the bottom of each page.

3.1.3 Data Forms

It is often convenient to document field information on pre-made data forms. A copy of any data form to be used with a detailed key/legend describing the content of each space or block on the form should be included in the QAPjP and/or the SOP. As with logbooks, all data forms should be completed with indelible ink.

3.2 Management of Samples

EM samples may be collected from known or suspected hazardous sites which may contain hazardous organic, inorganic, and/or radiochemical materials. Sampling organizations should be aware of potential hazards associated with the handling, and disposal of these samples. The sampling team should be provided with historical and background information on the potential contaminated site to give them guidance on health and safety precautions that should be initiated. It is the responsibility of the sampling organization to take all necessary measures to ensure the health and safety of its employees, to follow all ALARA principles and to meet all regulatory requirements. All phases of sample collection procedures should be documented in SOPs.

3.2.1 Sample Identification

SOPs for sample identification should describe methods to assure samples are identified and controlled in a consistent manner. The procedures should define the responsibilities for documenting identification and tracking sample possession from collection through handling, preservation, storage, transfer to a field laboratory or an off-site laboratory, and disposal of expired samples. The identification system should assure traceability of samples from time and place of collection through shipment to authorized persons or organizations and/or disposal.

Samples should carry the project's identification numbers. The field sampling organization should assign its own unique identification numbers. This number should be recorded in the appropriate field logs with information describing the sample. Each sample is identified by affixing a gummed label or standardized tag on the container. This label or tag should contain the sample identification number, date and time of collection, source, preservative used, analysis required, and the collector initial. If a label or tag is not available, the same information should be recorded on the sample container with waterproof ink.

Good field practice is that identification records contain the following information:

- Unique sampling number;
- Date and time collected;
- Analysis required;

- Name of collector;
- Source of sample (including name, location, QA sample, etc.);
- Method of preservation (if any);
- Field data (pH, dissolved oxygen, radiation readings etc.); and
- Serial numbers and transportation cases.

3.2.2 Sample Preservation

Chemical analyses of samples should generally be conducted as soon as possible after collection. Because samples are normally transported from the field to a analytical laboratory, some preservation is necessary to maintain the integrity of the samples. Samples should be processed for preservation at the time of collection. Samples should be preserved in a manner consistent with regulatory requirements and with the established SOP. Current regulatory-based holding times are not technically grounded in analyte- or sample-specific differences. Sample preservation and extension of holding times may be negotiated with the regulators to support cost-effective collection of data with known and controlled sources of variability. This analyte- and sample-specific approach is consistent with EPA processes of Data Quality Objectives and Data Quality Assessment.

Methods of preservation are relatively limited and are intended generally to (1) retard biological action, (2) retard hydrolysis and radiolysis of chemical compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption and adsorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing. No single standard method of preservation and storage can be recommended for non-traditional samples the best general method at the present time is deep-freezing at temperatures of -80°C or below. Additional details on deep-freezing can be obtained from the references listed.

The method of preservation should be logged into the field logbook with the pertinent information required by the SOP. If a preservative is used, it should be documented on the sample label. All preservatives should be tracked by lot number, date of receipt, and date opened.

3.2.3 Sample Storage

Site storage can be minimized by coordinating a sample shipment schedule with the laboratory. When storage is necessary, the samples should be stored in predetermined physical and environmental conditions commensurate with the intended analysis and regulatory requirements specific for the analyte and matrix. Storage areas should be controlled to prevent damage and loss of samples and maintain sample container and identification integrity. Daily verification and documentation of storage temperature may need to be maintained. Measures should be taken to avoid sample contamination during storage (i.e., separate storage of VOA samples). Measures should also be taken to contain and avoid material spills during storage. Storage blanks should be used as appropriate.

3.2.4 Sample Handling and Transfer

The number of persons involved in collecting and handling samples should be kept at a minimum. One member of the sampling team should be identified as the field custodian. Samples should be turned over to the field custodian by team members who collected the samples. The field custodian documents each transaction and the sample remains in the custodian's possession until shipped to the laboratory.

SOPs should be established to control samples during handling and transfer to preclude loss of identity, damage, and loss of sample and deterioration. Chain of custody documentation accompanying all samples must be positively maintained at all times.

Every precaution should be taken not to contaminate samples or field personnel. The outside of the container should be cleaned after the sample has been placed in the container. The container should be placed in a plastic bag to ensure that the outside of the container does not become contaminated.

The sample container(s) should then be placed in a transportation case, with the pertinent field records, analysis request forms, and chain-of-custody record. The transportation case should be secured. A secured chest eliminates the need for the close control of individual samples. If this is inconvenient, the sample custodian should seal the cap of the individual sample container so that any tampering would be easy to detect. Custody seals should be used to verify that sample integrity has been maintained during transport. Custody seals should be placed on the containers to prevent opening without breaking the seal. The field sampling and analysis organization's identification number should be marked on the sample container and the chain-of-custody form which documents all changes in possession of the sample.

Samples to be shipped should be packed so as not to break, and the package sealed so that any tampering can be readily detected. Custody seals should be signed and dated by the person releasing custody. Custody tape should be selected that is not removable from the shipping container without breaking the seal. Samples should be shipped in insulated containers with either synthetic ice or ice packed in leak-proof plastic bags when samples require cooling to 4±2°C.

The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory or facility. This responsibility includes filling out, dating, and signing the appropriate portion of the chain-of-custody record, sample transfer and shipping forms (as applicable). When transferring the samples, the person who accepts them must sign and record the date and time on the chain-of-custody record. Custody transfers made to a sample custodian in the field account for each sample, although samples may be transferred as a group. Verification of sample identification and integrity should be performed prior to release of sample to another organization for testing or analysis. A copy of all forms should be retained by the originating office.

3.2.5 Sample Screening, Packaging and Shipping

SOPs should be established for proper screening, packaging and shipping of samples according to applicable OSHA and State regulations for the protection of personnel and the environment. The transportation of samples must be accomplished not only in a manner designed to protect the integrity of the sample, but also to prevent any detrimental effects from potentially hazardous samples. Regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous wastes are enforced by the DOT and described in the Code of Federal Regulations (49 CFR 171-177, in particular, 172.402h, Packages Containing Samples). All packaging and transportation of EM materials along public roads or in the public domain should be in compliance with DOT regulations and DOE requirements. All other packaging and transportation of EM materials should be in compliance with DOE requirements. All packaging and transportation of EM materials should adequately protect personnel, the public, and the environment.

All sample containers and shipping containers, except those obtained from documented non-radioactive areas, should undergo field radiological screening to determine proper shipping and handling requirements. The field sampling organization's SOPs should specify protocols for actual radioactivity screening, action levels, and shipping procedures.

The SOPs should address sample collection, preparation (if required), counting protocols, and QC considerations. The SOPs should also define action levels which will determine which samples are considered non-radioactive, which samples will require further screening, and which samples should be submitted to a licensed laboratory. The action levels should meet or exceed current Federal, state, and local regulations.

Radiological survey instruments should be calibrated every six months and standard performance checks should be run before use. Complete records should be maintained. A certified mid-range source should be used in the performance check and a background check must be performed with each use to ensure the instrument is not contaminated.

3.2.5.1 Non-radioactive Samples

Environmental samples that are not considered hazardous materials may be packaged and shipped as follows.

- Packaging/Packing. Sample containers should be properly identified and have an appropriate seal (i.e. a Teflon lid for liquid samples). They should first be contained in sealed polyethylene bag or other appropriate secondary container. Next the samples can be packed in fiberboard container or a metal/plastic picnic cooler type containers. Sufficient noncombustible, absorbent cushioning material may be used to minimize the possibility that the sample container might break;

- Marking and labeling. Sample containers should have a completed sample identification tag. The outside container should be marked "Environmental Sample" and should indicate the use and should identify all preservatives; and

- Transportation. Sample transportation should be in accordance with applicable site and DOT guidelines.

Samples expected to contain hazardous material should be considered hazardous substances and transported according to DOT requirement 49 CFR 172.101. If the material in the sample is known or can be identified, then it should be packaged marked, labeled and shipped according to the specific instruction for that material. For potentially hazardous samples with unknown contents, the selection of the appropriate transportation category is based upon the DOT Hazardous Material Classification, a prioritized system of transportation categories.

3.2.5.2 Radioactive Samples

Materials are classified by the DOT as radioactive material if the specific activity is greater than 0.002 microcurie/gram. Sample with a specific activity greater than 0.002 microcurie/gram should be transported according to DOT requirement 49 CFR 172.310 for marking, 49 CFR 172.436,438,440 for labelling and 49 CFR 172.556 for placarding and shipping.

Limited quantities of radioactive materials (whose activity per package does not exceed the limit specified in 49 CFR 173423) are excepted from the specification packaging, shipping paper and certification, marking, and labeling requirements if they meet the following requirements:

- the material is packaged in strong, tight packages that will not leak any of the radioactive material during normal conditions;
- the radiation level at any point on the external surface of the package does not exceed 0.5 mrem/hr;
- the non-fixed (removable) radioactive surface contamination on the external surface of the package does not exceed the limits specified in 49 CFR 173.443(a);
- the outside of the inner packaging or, if there is no inner packaging, the outside of the packaging itself, bears the marking RADIOACTIVE;
- the package does not contain more than 15 grams of uranium-235; and
- the notice enclosed or on the package bears the name of the cosigner or cosignee and the statement "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive materials, limited quantity, n.o.s. UN2910" or "This package conforms to the conditions and limitations specified in manufactured from natural or depleted uranium or natural thorium, UN2909" (49 CFR 173.421).

Limited quantities of radioactive materials may be transported by common carrier excluding aircraft.

Prior to shipping radioactive samples to the laboratory, the organization responsible for shipping the samples should notify the laboratory of the approximate number and radiological level of the samples. The laboratory is responsible for assuring that its license limits are not exceeded. Documents like: (1) The Environmental Implementation Guide for Radiological Survey Procedures Manual, Office of Environmental Guidance, Nov.1992 and (2) The New Jersey State Field Procedures Manual, Feb., 1988, identify appropriate screening methods that the laboratory may use to evaluate the radiological level of the samples.

3.3 Waste Disposal

Waste materials are generated during sample collection, processing and subsampling activities. The method of identification, storage, and disposal of these waste materials and unused samples should be specified. An effective waste management plan that complies with applicable Federal, State, and local regulations should be in place. A consultation with a health physicist or waste management specialist should be considered when polices and guidelines for waste management are being developed. These polices and guidelines should apply to all personnel who generate, handle, manage, and/or dispose of waste in the field activities. Specific guidance related to excess sample, purge volumes, etc, is being developed. The waste management plan should detail the responsibilities for waste management and handling, along with the approved disposal methods for derived wastes.

3.4 Chain-of-Custody

A major consideration for the legal credibility of analytical data generated from a field sampling activity and subsequent sample analysis is the ability to demonstrate that samples have been obtained by the sampling group and reached the laboratory without alteration. Evidence of collection, temporary storage, shipment to the laboratory should be documented. Documentation is accomplished through chain-of-custody procedures and records that describe and document how physical custody is maintained, how custody is transferred, the identity of individuals responsible for sample collection, processing, shipment, storage, and disposal. A sample is considered in custody if it is in the 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, or in a secured area restricted to authorized personnel.

SOPs should be established by the field sampling organization describing the interface and custody responsibilities for sample collection, temporary storage, custody transfer, shipping of the samples to the final destination, and disposal.

Chain-of-custody forms should accompany all EM samples delivered to the laboratory facility(ies) that are performing the analysis. These forms should be signed and dated upon receipt in the facility. Agreement should be reached between the laboratory and customer regarding disposition of the "original" custody form (i.e., should it be retained by the laboratory, returned immediately to the customer, delivered to the customer as part of the final data deliverable). If copies of the chain-of-custody forms associated with the samples are not maintained as part of the formal analytical data package, the reason for this should be documented by the EM project manager. Chain-of-

custody forms should be reviewed for accuracy to ensure that the proper number of field QC samples were submitted to the laboratories.

The following information should be recorded on the completed chain-of-custody form: project name, signature of sampler, sampling station, unique sample number, date and time of collection, grab or composite designation, matrix, preservatives, and signatures of individual involved in sample transfer. Chain-of-custody forms initiated in the field should be protected from tampering or other damage. This may be accomplished by placing the chain-of-custody in a plastic cover and taping it to the inside of the shipping container used for sample transport from the field to the laboratory.

When samples are relinquished to a shipping company for transport in a custody sealed shipping container, the shipping company should provide a shipping bill/receipt. Employees of the shipping firm do not sign the chain-of-custody. The tracking number from the shipping bill/receipt should be recorded on the chain-of-custody form or in the site logbook. Individuals receiving samples should sign, date, and note the time of receipt on the form. These requirements should be met unless superseded by more stringent local or regional requirements.

3.5 Subsampling

Processing and subsampling of bulk materials collected in the field are key link in the sampling and analytical chain and can have a substantial impact on the usability of resulting analytical data. When the entire content of a sample container is subjected to analysis by a given method, processing and subsampling are not required. When more than the analytical sample size is collected, however, processing and subsampling is required. It is important that all participants in a sampling effort are aware of proposed and implemented subsampling methods and their impact on data usability and the achievement of data quality objectives.

The field sampling organization should establish SOPs to:

- minimize the possibility of subsampling bias and non-representative subsampling;
- assure that processing and subsampling is completed correctly; and
- assure that the samples shipped to the laboratory are representative of the material of interest.

3.6 Holding Times

Holding times identified in each project plan or scope of work for each parameter or group of parameters to be analyzed should be met when implementing work for EM projects.

- Sample shipment and delivery should be coordinated between the field supervisor/site manager and the laboratory to meet sample holding times, where applicable;

- Sample holding time begins at the time and date the bulk sample is collected in the field; and

- Regulatory holding times are not based on sample- and analyte-specific considerations (Section 3.2.2). The use of preservatives may extend the acceptable holding times. This approach can be negotiated with the regulators to support the collection of cost-effective data of known and controlled variability.

3.7 Sample Containers

The project plan and laboratory should specify those types of containers required and follow project-specific requirements. When bottles or containers are provided by the laboratory, the field sample collection record should indicate the laboratory lot number of the bottle. When commercially precleaned containers are used in the field, the name of the manufacturer, the lot identification, and certification should be retained for documentation. All containers should be capped and stored in a contaminant-free area. All samples should be collected, where appropriate, in break resistant containers. Samples in glass containers should be transported using secondary containment (e.g., bubble pack, coolers, sealed cans) as specified in the SOP.

3.8 Preventive Maintenance Program

An adequate preventive maintenance program increases the reliability of a collection equipment, and minimizes down time. Generally accepted laboratory practice is that the following should be considered:

- SOPs encompassing actions to be taken to maintain proper instrument and equipment performance and prevent instruments and equipment from failing during use; and

- A stock of critical spare parts should be maintained and documented. Preventive maintenance should be scheduled and documented and a maintenance record should be maintained for all instruments and equipment used in the laboratory.

3.9 References

1. U.S. Environmental Protection Agency. February, 1983. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS 05/80, EPA-600/4-83-004, Interim Final.

2. U.S. Environmental Protection Agency. May 1984. Soil Sampling Quality Assurance User's Guide, Environmental Monitoring Laboratory, Las Vegas, Nevada, Cooperative Agreement CR810550-01, EPA 600/4-84-048.

3. U.S. Environmental Protection Agency. March 1987. Data Quality Objectives for Remedial Response Activities, Development Process, OSWER Directive 9355.0-7B.

4. U.S. Environmental Protection Agency. September 1987. Compendium of Superfund Field Operation Methods, EPA/540/P-87/001, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-14.

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8. U.S. Environmental Protection Agency. 1990. A Rationale for the Assessment of Errors in the Sampling of Soils. Environmental Monitoring Systems Laboratory, Las Vegas, NV. EPA/600/4-90/013.

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10. U.S. Nuclear Regulatory Commission. February 1979. Quality Assurance for Radiological Monitoring Program (Normal Operations) Effluent Streams and the Environment, Office of Standard Development, Regulatory Guide 4.15, Rev. 1.

4.0 QUALITY CONTROL FOR THE SAMPLING PROCESS

Several control samples are introduced into the collection system to monitor the adequacy of the sampling system and the integrity of samples during their journey from the field collection point through laboratory analysis. These samples are defined below with their mode of collection and purpose.

4.1 Trip Blanks

Trip blanks are used to detect contamination during sample shipping and handling. A trip blank is an analyte sample container filled with ASTM Type II water which is transported to the sampling site, and returned to the laboratory with the samples. Trip blanks are filled in the laboratory and are not to be opened in the field. One trip blank should accompany each cooler containing site samples. Each trip blank should be stored at the laboratory with associated samples and analyzed with those samples. Trip blanks are sent whether soil or water samples are to be collected. Analyte-free solid matrices should be employed when collecting soil samples. If a solid matrix is not available for a trip blank, ASTM Type II water may be used.

Trip blanks are primarily used for volatile organic compounds (VOCs). Trip blanks, however, may be used for any parameter when there is concern that concentration of the parameter is biased by contamination. A trip blank will not only detect contamination during the shipping and handling of the containers, but it will also serve to detect contamination from containers (i.e., function as a bottle blank) which is important if non-certified sample containers are being used.

These samples are to be reviewed at the completion of the analysis to determine if any cross-contamination occurred that could affect sample results. All sample results should be evaluated to determine the possible effects of any contamination detected in the trip blank.

4.2 Equipment Rinsates

Equipment rinsates are samples of ASTM Type II water passed through decontaminated sampling equipment. They are used as a measure of decontamination process effectiveness. Equipment rinsates should be collected at the rate specified in the QAPjP. An equipment rinsate should be collected from each type of sampling equipment used to ensure that the decontamination procedures are applicable to all equipment types.

Equipment rinsates are analyzed for the same analytes as samples collected using that equipment. All sample results should be evaluated to determine the possible effects of any contamination detected in the equipment rinsate blank.

Equipment rinsates should be monitored throughout the course of the project to monitor the efficiency of the decontamination procedures. If contamination is detected and the field source water blank is free of the analytes of interest, it may be necessary to monitor the field crew to ensure adherence to the procedures. If it is determined that the crews are properly following the decontamination procedure, it may be necessary to change the procedure.

4.3 Field Source Water Blanks

Field source water blanks are samples of source water used for decontamination and steam cleaning. At a minimum, one sample for each source of water for a given event should be collected for analysis. Normally, there will be two field source water blanks per event: a sample of the potable water used for steam cleaning and a sample of the ASTM Type II water used for decontamination. If more than one lot number of ASTM Type II water is used or if potable water is taken from more than one location, then additional field source water blanks should be taken since these are different sources.

The field source water blanks should be monitored throughout the project to detect any possible contamination present in the decontamination water. The field source water blanks should be monitored for the same analytes as the samples being analyzed.

This may prevent the introduction of contaminants to the site samples. If contamination is detected, a different source of water should be used. All sample results should be evaluated to determine the possible effects of any contamination detected in the field source water blank.

4.4 Field Splits (Duplicates)

Field splits are two samples produced from material collected in the same location. Each will be numbered uniquely. Field splits provide information regarding the homogeneity of the matrix. A matrix constitutes soil, sediment, water, biota, or waste from a given site. Field split may also provide an evaluation of the precision of the analysis process. Field splits for soil are collected and homogenized before being divided into two samples in the field. Field duplicates will normally be collected at a frequency of 5% to 10% of the samples collected per matrix. Soil samples submitted for VOC analyses are not to be homogenized or split; instead, it is necessary to collect collocated samples as defined in section 4.5.

Field splits should be sent to the laboratory in the same manner as the routine site samples. They may or may not be identified to the laboratory as field splits. It may maximize the utility of information to submit extra samples from the field splits for the laboratory to use as duplicates. This will help distinguish between variability resulting from sample heterogeneity and laboratory manipulation.

Field splits data should be reviewed for agreement. Data should meet the precision criteria established in the QAPjP. If the splits data do not meet the established criteria, they should be examined to ascertain the source of disagreement. The laboratory QC data should be reviewed to determine if the laboratory was operating in control. If the laboratory was in control, the sampling data should be reviewed to determine if there were any matrix anomalies that could contribute to differences in the concentrations. Lastly, the process used to collect and split the samples should be reviewed to determine if it is the source of imprecision.

4.5 Collocated Samples

Collocated samples are independent samples collected as close as possible to the same point in space and time and are intended to be identical. Because of the possible loss of volatile analytes when generating field splits, it is necessary to collect soil samples for VOA analysis as collocated samples. Collocated soil cores collected for VOA analyses should be sealed immediately and shipped to the laboratory.

Collocated sample data are to be reviewed in the same manner as split sample data as discussed in the previous section.

4.6 References

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8. U.S. Environmental Protection Agency. 1989. Soil Sampling Quality Assurance Users Guide, 2nd edition. Environmental Monitoring Systems Laboratory, Las Vegas, NV. EPA 600/8/89/046.

9. U.S. Environmental Protection Agency. May 1990. A Rationale for the Assessment of Errors in the Sampling of Soils, Environmental Monitoring Systems Laboratory, Las Vegas, NV. EPA/600/4-90/013.

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5.0 SAMPLING DATA

EM project management, in conjunction with personnel knowledgeable in the relevant analytical criteria, should develop, establish, and update data deliverable requirements based on project DQOs. Each EM project or program should identify and clearly define specific data deliverables expected from the sampling organization supporting its work. These deliverables should be designed to ensure project information contains the appropriate QC and documentation. Documented procedures should be in place addressing data deliverable requirements to meet project requirements. Sampling organizations providing EM projects with samples and data should be aware of deliverable requirements and able to provide them in a consistent and timely manner. If EM project management determines that existing SOPs are sufficient to meet or exceed project needs, new documents need not be developed.

Deliverables may include a diskette. Reporting formats should be compatible with the project's system. Standard formats for transmission and database structure requirement should include consistency with interagency standards for collecting, storing, transmitting, and evaluating environmental data. When the EM Management Information Management System (MIMS) is developed, reporting formats and QC information should be compatible with, or adaptable to, this system.

5.1 Sampling Data Review

QC in the sampling process is normally provided by frequent (daily) review of the site and field logs and comparison with the data quality requirements of the project plan. Frequently, the selection of sampling points and/or samples for more detailed examination is based on field analytical data (qualitative and/or semi-quantitative) so it is necessary to review the field analytical results as well. The principal acceptance criteria for this QC review of sampling activities are that:

- the correct number and locations of the sampling points were documented;
- the selected sampling points indicate the presence/absence of the target analytes;
- samples were collected and shipped properly;
- the field records and documents are complete; and
- the data reporting requirements for the day's activity were met.

The data in the field logbook are first reviewed and signed by the person generating the data and then by the supervising field engineer or geologist leading the activity in the field. The critical data from the field logs are entered in the site log (and signed) by the field supervisor or other authorized person. The project manager should review the data in the site log as received, and then evaluate the field data against the project objectives.

5.2 References

1. U.S. Department of Energy. March 2, 1981. Order 1324.3, Files Management, Office of Administration and Human Resource Management, Washington, DC: Government Printing Office.

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5. U.S. Environmental Protection Agency. 1990. Good Automated Laboratory Practice.

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APPENDIX I

DEFINITIONS

collecting. In the context of this document, collecting is the process of withdrawing or taking samples from a designated population.

heterogeneous. Consisting of dissimilar or diverse parts or constituents.

holding time. The amount of time allowed to elapse from sample collection until laboratory analysis and/or extraction as specified by the contract, statement of work, method, or regulatory requirement.

medium (pl. media). Any material through which energy and/or chemicals move or in which chemicals are dispersed or in which a chemical reaction takes place. In the present document, the term medium refers to environmental medium. **Environmental medium.** Any of six environmental matrices in which physical and chemical reactions and other phenomena occur: air, water, soil, debris, bottom sediment, waste. See medium.

radioactive material. Any material that spontaneously emits radiation.

radioactive waste. Solid, liquid or gaseous materials, of no commercial value that emit ionizing radiation. Discarded items such as clothing, containers, equipment, rubble, residues, or soils that contain radionuclides.

representativeness. 1: Property of certain information gained from a subset or a related set that is thought to be similar with respect to the particular types of information sought. With respect to waste site remediation, representativeness is best thought of as an idealized but fundamental property that resides in a set of samples (the sample) that form a potential set of pathways of chemical flow and transformation that may be expected to significantly represent these processes for the remediation site as a whole. *Cf* sample (representative sample). 2: Qualitative variable which expresses the degree to which sample data accurately and precisely represents some characteristic of a population, variations at a sampling point, or an environmental condition.

sample. 1: Material or a set of samples drawn from a larger set or population that is taken to represent the larger. A single sample can comprise a sample; however, statistical constraints generally require that a sample be comprised of no less than three samples. 2: A portion or subset of a population selected to be representative of the population. **representative sample.** 1a: A sample of a universe or whole (e.g., waste pile, lagoon, groundwater) which can be expected to exhibit the average properties of the universe or whole.

sampling. The process of selecting a set of samples from a given population in accord with a preselected scheme for determining which samples to take and when to take them. At some level the selection of samples should be fully randomized.

sediment. Solid material deposited by water, wind or glaciers.

soil. Naturally-occurring geo-organic materials with an average particle size of less than 2mm.

subsample. That portion of an individual sample that is analyzed.

trip blank. An analyte sample container filled with ASTM Type II water which is transported to the sampling site, and returned to the laboratory with the samples. Trip blanks are filled in the laboratory and are not to be opened in the field.

APPENDIX II

LIST OF ACRONYMS

ANSI	-	American National Standard Institute, Inc.
ASD	-	Analytical Services Division
ASP	-	Analytical Services Program
ASQC	-	American Society for Quality Control
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CFR	-	Code of Federal Regulations
DOE	-	Department of Energy
DOT	-	Department of Transportation
DQO	-	Data Quality Objective
EM	-	Environmental Restoration and Waste Management
EM-263	-	Analytical Services Division
EPA	-	U.S. Environmental Protection Agency
ESA	-	Environmental Sampling and Analysis
IG	-	Office of the Inspector General
MIMS	-	Management Information Management System
NRC	-	Nuclear Regulatory Commission
NSTS	-	National Sample Tracking System
OSHA	-	Occupational Safety and Health Administration
QA	-	Quality Assurance
QAPjP	-	Quality Assurance Project Plan
QA/QC	-	Quality Assurance/Quality Control
QARD	-	Quality Assurance Requirements and Description
QC	-	Quality Control
S&A Plan	-	Sampling and Analysis Plan
SEN	-	Secretary of Energy Notice
SOP	-	Standard Operating Procedure
TQM	-	Total Quality Management
USGS	-	U.S. Geological Survey