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Environmental Restoration Program

FIRE FIGHTING TRAINING AREA REMOVAL ACTION OPERABLE UNIT 5 WORK PLAN

MOUND PLANT
MIAMISBURG, OHIO

Volume II – Appendix E

June 1994

Final
(Revision 0)

U.S. Department of Energy
Albuquerque Operations Office

EG&G Mound Applied Technologies

APPENDIX E

QUALITY ASSURANCE PROJECT PLAN

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1. INTRODUCTION

1.1. OVERVIEW

Quality assurance is a measurement system established to ensure that a desired product meets a defined level of quality. This Quality Assurance Project Plan (QAPP) presents the system of quality assurance to be implemented for the Fire Fighting Training Area (FFTA) Project at the Mound Plant. The QAPP is based on EG&G Mound Remedial Investigation/Feasibility Study Operable Unit 9, Site Wide Quality Assurance Plan (OU-9 QAPP).

A quality assurance system consists of two elements: quality control and quality assessment. Quality control is a system of procedures performed to control the quality of the product, usually with defined standards of performance for those procedures. Quality assessment is a program of activities to evaluate the performance of implemented quality control procedures and the quality of the product.

This QAPP describes the quality control procedures for construction, treatment, and sampling activities (construction, treatment, and sampling procedures in Section 4 and sample custody in Section 5), for field screening and field measurements (Section 6), and for laboratory analyses (Section 6). Specific quality control steps for laboratory analysis and field measurements, defined as quality control checks, for these activities are discussed in Section 8. The standards of performance, defined as acceptance criteria, for these checks are presented in Section 3. Quality control procedures for calibration of field and laboratory instrumentation are outlined in Section 7. The procedures for data reduction, validation, and reporting are included in Section 9. As part of the quality control program, preventive maintenance procedures for equipment and instrumentation are summarized in Section 11. Corrective actions for the planned field and laboratory activities are necessary for a quality control program in order to ensure that the quality of generated data is maintained. The corrective actions for these activities are provided in Section 13.

Quality assessment activities for this project include evaluation of field and laboratory quality control data, performance and system audits, and issuance of quality assurance reports to management. Procedures for these activities are described in Sections 12, 10, and 14, respectively.

In fulfilling its role of ensuring that the goals of the project are met, the quality assurance program relies on the structure of the project organization and on the effectiveness of key individuals in carrying out their responsibilities. Section 2 describes the project organization and identifies the individuals who are responsible for assessing the collection and generation of data and for ensuring that this data meets the defined quality.

1.2. ENVIRONMENTAL RESTORATION PROGRAM DESCRIPTION

In 1984, the U.S. Department of Energy (DOE) Albuquerque Operations Office (AL) established the Environmental Restoration (ER) Program (formerly known as the Comprehensive Environmental Restoration Program and the Comprehensive Environmental Assessment and Response Program (CEARP)), in order to fulfill its obligations under the following environmental laws:

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 300).
- The Resource Conservation and Recovery Act (RCRA) (40 CFR 260-270).
- The National Environmental Policy Act of 1969 (NEPA) (volume 83, page 852 of the U.S. Statutes and chapter 42, section 4321 of the U.S. Code).
- The Atomic Energy Act of 1954 (AEA) (volume 68, page 1919 of the U.S. Statutes and chapter 42, section 2011 of the U.S. Code).

The authority to implement the ER Program is derived primarily from the following DOE and DOE AL orders:

- CERCLA requirements (DOE Order 5400.4).
- Hazardous, Toxic, and Radioactive Mixed Waste Management (DOE Order 5480.2).
- Prevention, Control, and Abatement of Environmental Pollution (DOE Order 5480.1, Chapter XII).
- Environmental Protection, Safety, and Health Protection Information Reporting Requirements (DOE Order 5484.1).
- Proposed DOE NEPA implementing procedures (10 CFR 1021).

The ER Program consists of three phases patterned after the U.S. Environmental Protection Agency (EPA) CERCLA program. Phase I, preliminary assessment/site inspection, was completed at the Mound Plant in 1986 and reported in the installation assessment (DOE 1986). Phase II, the remedial investigation/feasibility study (RI/FS), is currently under way at the Mound Plant. Phase III, remedial design/remedial action (RD/RA), will implement the remedial alternatives chosen in the FS of Phase II. The RD/RA phase includes

selection of a remedy; the production of a record of decision (ROD), which describes the chosen remedial action; the design of the remedial action; and the actual performance of the remedial action.

1.3. MOUND PLANT ER PROGRAM

The Mound Plant was placed on the CERCLA (Superfund) National Priorities List (NPL) in November, 1989. Pursuant to that status, a CERCLA Section 120 Federal Facility Agreement (FFA) was signed between DOE and EPA (Administrative Docket Number V-W-90-C-075), and became effective October 12, 1990. Therefore, the RI/FS process at Mound Plant, as outlined in this Work Plan, follows the methodology that the Superfund program established for characterizing the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. This approach is a flexible process that is tailored to specific circumstances of individual sites and can be adjusted as additional information becomes available.

The goal of the ER Program at the Mound Plant is to reduce adverse impacts on public health and the environment by:

- Reducing releases of hazardous or radioactive materials.
- Bringing all inactive wastes sites requiring remediation into compliance with existing state and federal regulations and requirements.

These goals will be accomplished, in part, by activities stemming from the RI/FS process:

- Investigating the nature and extent of contamination.
- Performing risk assessment(s) to identify and evaluate potential threats to human health and the environment.
- Developing and evaluating remedial action alternatives to reduce these threats to acceptable levels.
- Implementing the selected remedial actions.

The FFA between the DOE, USEPA Region V, and the Ohio EPA contains both the procedural and substantive requirements for RI/FS work (USEPA Administrative Docket Number OH 890:008 984).

The FFA defines the Mound Plant Site as follows:

> "'Site' shall mean any area where hazardous substances, pollutants or contaminants have come to be located, due to the activities at the Mound Plant (hereafter referred to as the Site). The U.S. EPA, after consulting with Ohio EPA and U.S. DOE, may change the Site designation on the basis of additional investigations to more accurately reflect the areas contaminated by hazardous substances, pollutants or contaminants, related in whole or in part to the Mound Plant. The work to be performed in this Agreement will conform to the definition of the Site as established by U.S. EPA."

Consistent with this definition, the DOE is proposing RI/FS activities for a broad geographic area, including the area within the Mound Plant as well as areas beyond the Mound Plant boundaries.

1.4. PROJECT DESCRIPTION

The work at the Fire Fighting Training Area (FFTA) near Building 34 at the EG&G Mound Site in Miamisburg, Ohio entails construction of treatment pads and staging area; removal of sediments, excavation and treatment bioremediation of soil, and decommission of underground fuel supply and drain lines containing petroleum hydrocarbons; and backfilling, grading, and restoration of excavated areas with backfill soil material as specified.

2. PROJECT ORGANIZATION AND RESPONSIBILITY

Project organization and responsibility are divided among the DOE ER Program Group, which includes: the DOE Albuquerque Field Office; the DOE Dayton Area Office and its operating contractor, EG&G Mound Applied Technologies, Inc. (EG&G); and the ER Program EG&G subcontractors. The currently identified EG&G subcontractor for FFTA is Roy F. Weston, Inc. (WESTON). If additional EG&G subcontractors are identified at a later date, this section of the QAPP will be revised.

DOE AL has primary responsibility for overall ER Program implementation activities: The Dayton Area Office is responsible for program direction and review. WESTON will coordinate and perform the investigation and removal action of the FFTA area.

Figure 2.1 illustrates the specific lines of authority and communication for FFTA. EPA Region V is responsible for review and approval of this QAPP. The EPA Region V Central Regional Laboratory and/or Central District Office Regional Laboratory are responsible for performing external audits of the FFTA field activities. The Central Regional Laboratory is also responsible for performing external audits of all laboratories. Additional review and approval is provided by the Ohio EPA.

2.1. OPERATIONAL RESPONSIBILITIES

The DOE is organized into divisions that have tiered elements at DOE Headquarters, DOE AL, and the Dayton Area Office. One of these divisions is the Environment, Safety, and Health Division, which includes the Environment and Health Group. The DOE AL has an ER Program Group that is responsible for ER Program implementation at all seven installations within the DOE AL. Descriptions of the operational responsibilities of each entity are as follows:

- DOE Dayton Area Office. The DOE Dayton Area Office (DAO) is the signatory to the FFA with EPA. The Remedial Project Manager (RPM), Mr. Arthur William Kleinrath reports through the DAO. As the agreement signatory, the DAO is directly accountable for all substantive procedural requirements of the agreement, including quality assurance.

- EG&G Mound Applied Technologies, Inc. EG&G serves as the operations and maintenance (O&M) contractor at the Mound Plant and has an environmental compliance structure.

Figure 2.1 FFTA organizational chart.

FIRE FIGHTING TRAINING AREA
REMOVAL ACTION

JOHN THORSEN, P.E. - PROGRAM MANAGER

JOHN PRICE, P.G. - ALTERNATE PROGRAM MANAGER

GORDON HORN, P.E. - PRINCIPAL INVESTIGATOR

ANDY FANDOZZI - FIELD ENGINEER

ANDY SPERRY - FIELD ASSISTANT
KAREN ARTHUR - FIELD ASSISTANT
WINDLE McDONALD - FIELD ASSISTANT

ANDY SPERRY - ON-SITE H & S COORDINATOR

CRAIG STOLL - LABORATORY COORDINATOR

CEMANTHA DAVISSON - QUALITY ASSURANCE/QUALITY CONTROL

EG&G has a manager responsible for safety and health (Curt Fellers) and a subsidiary manager responsible for environment (Charles Friedman). The Mound Plant environmental assessment and planning group functions include environmental compliance and waste management. Alan Spesard is responsible for the project management of FFTA. The EG&G employs a technical support subcontractor, WESTON, based in Cincinnati, Ohio. WESTON will perform oversight of FFTA remediation activities.

The WESTON Project Manager, John W. Thorsen, P.E., is responsible for implementing contracted ER Program activities. His primary responsibilities are to provide access to the resources of the subcontractor organization and to ensure project quality, timeliness, and cost-effectiveness. The project manager is also the primary point of contact between EG&G and WESTON.

The WESTON Alternate Project Manager, John Price, is responsible for the daily management of the project and support staff. In addition to being responsible for the work plan and schedules, the project manager coordinates the work and serves as the liaison to the EG&G manager. Based upon reports from the Quality Assurance Manager (QAM), the Alternate Project Manager will ensure that sampling and analyses are conducted in full compliance with the QAPP and will initiate corrective actions, if necessary, that are suggested by the QAM.

The WESTON Site Manager, Gordon Horn, is responsible for day-to-day implementation of the work plans and quality assurance plans. The site manager is responsible for coordinating daily activities and providing to EG&G Mound the status of current accomplishments and concerns.

The WESTON Quality Assurance Manager (QAM), Cemantha Davisson, is responsible for the development and implementation of the project QAPP. The QAM also conducts internal performance and system audits of laboratory, field, and project activities, and ensures corrective action(s) are performed.

The WESTON Quality Assurance Officer (QAO), Jake Alexander, is responsible for implementing QA procedures, and conducts systems and performance audits at field and office locations to verify that published QA procedures are properly followed.

The WESTON Data Administrator is responsible for receiving field and laboratory data, ensuring that the data is filed and distributed, and verifying data entry into a database or spreadsheet.

DOE AL. DOE AL has line management authority over DAO. It is responsible for program management and has a designated Project Manager, Mr. David Flynn.

2.2. FIELD TEAM RESPONSIBILITIES

The subcontractor field team responsibilities for the FFTA Project will consist of performing the field activities specified in the FFTA Work Plan. The field team will have four identified positions: the field team leader, site health and safety coordinator (SHSC), field technicians, and sample document control administrator. The field team leader is responsible for directing the field activities specified in the Work Plan and Sampling and Analysis Plan (SAP) and communicating progress and any issues to the subcontractor site manager. The SHSC is responsible for ensuring that the health and safety guidelines specified in the Health and Safety Plan (HASP) are followed. He or she will be trained in first aid and CPR. It is the responsibility of the SHSC to ensure safe work practices are implemented and to report all incidents that occur during the field activities.

The field technicians are responsible for conducting field activities, as specified in the Work Plan, under the supervision of the field team leader.

A member of the field team will be designated as the sample document control administrator. He or she will be responsible for tracking the locations sampled and for ensuring that samples are properly labeled and documented prior to shipment to the laboratory. The administrator will ensure that the sample control procedures specified in this QAPP are followed. It is possible that one individual may perform several functions.

2.3. LABORATORY RESPONSIBILITIES

Laboratory responsibilities for this project will consist of performing analytical services according to guidelines presented in this QAPP, reporting all laboratory nonconformances should they occur, and transmitting quality-assured data packages. The currently designated project analytical laboratories are noted in the OU-9 QAPP laboratory specifications attachments. The OU-9 QAPP laboratory specifications attachments includes those topics discussed in the QAPP, including laboratory responsibilities, which are specific to a given laboratory. Those topics are 1) analyses to be performed, 2) laboratory responsibilities,

3) laboratory sample custody procedures, 4) laboratory quantitation limits (outside the project required limits), 5) laboratory data reduction procedures, 6) laboratory data validation procedures, 7) preventive maintenance, and 8) specific procedures to assess precision, accuracy, and completeness (if different from the QAPP).

This section identifies the various general responsibilities within the analytical laboratories. Specific laboratory responsibilities and position titles vary with each laboratory and, therefore, are discussed in the OU-9 QAPP laboratory specifications attachments. The quality assurance program defined in this QAPP takes precedence over equivalent sections in the laboratory quality assurance manuals, unless otherwise referenced. Sections of the laboratory quality assurance manuals may be referenced in the laboratory specifications attachment where they directly apply and when more information is available in the manuals.

The laboratories identified for this program must assume the following general quality assurance responsibilities.

- Laboratory management will:
  - Approve the quality assurance manual, project specific requirements, and standard operating procedures.
  - Approve laboratory reports.
  - Implement the quality assurance program (QAP) for the laboratory.
  - Oversee the training program.
  - Evaluate analytical techniques, instrumentation, and quality control procedures.
  - Assure that project QAPPs are implemented in the laboratory.
  - Develop and approve corrective actions to out of control situations.
- Supervisors for a given analytical group will:
  - Supervise analysts;
  - Schedule analyses;
  - Review analytical data; and
  - Report out of control and nonconforming situations to management.

- The quality assurance group will:
  - Monitor the implementation of the QAPP.
  - Prepare quality control samples to be inserted into the sample stream.
  - Notify management of out of control situations.
  - Perform quality assurance audits.
  - Perform quality assurance training program.
  - Perform statistical analyses on the quality control results.
- Analysts/technicians will:
  - Report out-of-control situations.
  - Perform their assigned tasks in accordance with the established and requested protocols and procedures.
  - Perform data processing.

2.4. QUALITY ASSURANCE RESPONSIBILITIES

Quality assurance for the project is the responsibility of all ER Program personnel. Responsibilities include detailed monitoring and review of all procedures used to perform every aspect of the remedial investigation. All personnel involved with ER Program activities will strictly adhere to the implementation of the QAPP, Mound Plant ER Program SOPs, analytical laboratory procedures, data acceptance criteria, and data reporting schedules.

Primary responsibility for project quality rests with the ER Program EG&G subcontractor project manager. Specific responsibilities include the management of quality assurance issues as they relate to the ER Program, ensuring that nonconformances are corrected, and ensuring the overall quality, timeliness, and cost-effectiveness of the activities performed by ER Program EG&G subcontractors.

The Quality/Assurance project officer (QAO) is independent of project line management to ensure no conflict of interest in implementing and monitoring the Quality Assurance/Control Program. The direct tie to the subcontractor's Corporate QA also ensures consistent interpretation and application of various QA guidance documents and programs (e.g., EPA, DOE, ASTM, USATHAMA, TQM, etc.).

The responsibilities of the QAO for the project are:

- Prepares and implements project QA procedures to provide controls consistent with the requisite quality of project deliverables. Identifies appropriate QA/QC source documents (such as EPA QAMS-005, DOE ER Program SOPs, ASME NQA-1) and applicable elements.
- Ensures, through document review, that the project execution documents, such as work plans, adequately reflect the guidance from the source documents.
- Verifies, through systems and performance audits at field and office locations, that published and approved QA/QC procedures are properly and completely followed and appropriate for the technical activities performed. All audits result in documentation of the findings, recommendations for improvement, and/or corrective measures for any deficiencies. Reports of surveillance, audits, and corrective actions are given to the Project Manager, his staff, and the Corporate Director of Quality Assurance.

The QAM has responsibility for quality assurance/quality control within the project. This person will document compliance with this QAPP and Mound Plant SOPs. The project QAM's responsibilities include the following:

- Performing internal system and performance, laboratory, audits.
- Development and implementation of the QAPP.
- Ongoing review of individual quality assurance procedures.
- Overall quality assurance for project activities.
- Ensuring that laboratory activities are consistent with the objectives and requirements of this QAPP.
- Coordination of quality assurance training.
- Quality assurance for field activities.
- Serve as field/laboratory liaison to resolve custody and sample problems.
- Overall coordination of the quality assurance/quality control plan.
- Project quality assurance/quality control.
- Periodic reports to management, including suggestions for performing and verifying corrective actions.

Although it is the QAM's responsibility to ensure compliance with this QAPP, it is the responsibility of the installation and site managers to implement the quality assurance program and to maintain a strong line of communication with the QAM.

The QAO, QAM, and the designated auditor will have the following minimum qualifications:

- Bachelors degree in an appropriate scientific discipline and five years of work experience in RI/FSs with a focus on quality assurance, and
- Two years of experience in performing field activities (for field auditors), or
- Two years of experience in an environmental analytical laboratory (for laboratory auditors).

The QAM is also responsible for validating and assessing analytical data. Either the QAM or his or her designee will perform data validation. The following minimum qualifications are required to perform data validation:

- Bachelors degree in chemistry,
- Two years of work experience in an environmental analytical laboratory, and
- Two years of experience in performing data validation activities.

If a validator having all three qualifications cannot be obtained with all reasonable attempts, a validator having at least one of the qualifications will be obtained and the work product will be reviewed by an individual with all the minimum qualifications.

Subcontractors generating data for the FFTA Project are responsible for ensuring that the precision, accuracy, completeness, and representativeness of their data are known and documented. To ensure that responsibilities are uniformly met, each subcontractor will be required to adhere to this QAPP and to Mound Plant ER Program SOPs.

An ER Program EG&G subcontractor internal kickoff meeting will be held before field work begins to review the specific project work and quality assurance plan(s) and procedures. The kickoff meeting will be attended by, at a minimum, the following ER Program EG&G subcontractor personnel: the project manager or deputy project manager, the field manager, the project QAM, and all personnel assigned to the field effort. Attendance at this meeting will be documented to provide evidence of quality assurance indoctrination for the field activities to be conducted during the RI at Mound Plant. Such documents are to be maintained by the QAM and filed in the Mound Plant project file.

2.5. CONSTRUCTION AND REMOVAL RESPONSIBILITIES

Construction and removal activities for which the subcontractor is responsible include:

A. Construction

- Two (2) composite, multi-media (soil, geomembrane), contaminated soil bioremediation treatment pads. Approximate dimensions: (1) 46' x 90', (2) 46' x 55'.
- Leachate and runoff collection piping.
- Two (2) precast concrete manholes, each with an impermeable interior coating or lining.
- Installation of sump pump with controls.
- One (1) single slope roof structure including footers.
- An aboveground spray irrigation system for the treatment pads.
- Temporary soil staging area.
- Decontamination area. (Concrete pad is provided.)
- Electric and water service to treatment pad roof structure.
- Electric service to south exterior wall of the Building 34 addition.
- Electric service (40 amp 12 circuits) to precast concrete manholes.
- Access roads (2) to treatment pads.
- Erosion, sediment control, and safety measures.

B. Removal

- Earthwork operations.
- 310 cubic yards of petroleum-contaminated soil excavated and transported to temporary soil staging area.
- Training pits sediment removal, fuel supply and drain lines decontamination and removal.
- Scarification and removal of concrete training pits.
- Backfill.
- Transport of contaminated water to Mound WWTS. It is expected that water will be transported every 2000 gallons collected and to a distance of 1/4 mile from the site. In the unlikely event of radiation contamination, the tanker truck will be surrendered to Mound and the Contractor will receive adequate compensation for a comparable replacement vehicle.

3. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

The overall quality assurance objectives for remediation, field sampling, field measurements, and laboratory analysis are to produce data of known and sufficient quality. Appropriate procedures and quality control checks will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. This section defines the objectives (goals) for accuracy, precision, completeness, representativeness, and comparability for measurement data. These goals are primarily expressed in terms of acceptance criteria for the quality control checks performed. The field and laboratory quality control checks planned for this investigation are presented in Tables 3.1 through 3.3 and are defined in Section 8 of this QAPP. Quality assurance goals for field measurements and field screening are also discussed.

3.1. ACCURACY

3.1.1. Definition

Accuracy of measurement data is defined as the degree of a measurement, X, with an accepted reference or true value, T. It is usually expressed as the difference between the two values, X - T, the difference as a percentage of the reference of true value, 100(X - T)/T, and sometimes expressed as a ratio, X/T. These expressions give a measure of the bias in a system.

3.1.2. Accuracy Goals for Field Screening and Field Measurements

Field measurements will include pH and total petroleum hydrocarbon analysis. Field screening will include organic vapor and combustible gas levels, low energy gamma radiation, and alpha surface contamination. Accuracy is measured with a calibration check (source check for radiation measurements) for all of these parameters except water level and temperature. Table 3.1 summarizes the quality control checks, acceptance criteria, and corrective actions taken for accuracy.

3.1.3 Accuracy Goals for Laboratory Measurements

Accuracy of laboratory analyses will be assessed using the following quality control checks: calibration standards, surrogate spikes of all samples, blank spikes and matrix spikes of selected samples collected in the field. Surrogate spike, blank spike, and matrix spike results will be expressed as a recovery of an analyte added to the sample at a known concentration:

Table 3.1 Summary of Quality Control Procedures for Field Screening and Field Measurements

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Horiba IR SOP	TPH	Blank Check	After Calibration	< 1 ppm and ≥ 0 ppm	Re-check with fresh blank if 2nd check out, re-calibrate
		Calibrate	Once per day	NA	NA
		Continuing Calibration Check	After each calibration, and after every 10 samples	± 10% of true value	Re-calibrate
SW 9045	Soil pH	Calibration with two buffer solutions (pH 4 and 7 or 7 and 10) (for accuracy)	Every 20 samples	± 0.1 units of true value	Re-calibrate; check pH meter; replace probe and meter if necessary
		Duplicate sample	Every 20 samples	NA	Evaluate variability
		Check standard (with buffer solution)	Every 10 samples or at end of day, whichever is more frequent	± 0.1 units of true value	Re-calibrate prior to further sample analysis
SOP 2.2	Temperature	Duplicate sample (for precision)	One per ten or fewer field samples collected	± 1°C	Evaluate data usability
		Calibration (for accuracy)	NA	± 2°C (manufacturer's specification)	NA
SOP 6.1	Combustible gas level	Calibration (1 standard) (for accuracy)	Once per day	± 10% of true value	Re-calibrate
		Duplicate standard (for precision)	Once per day	± 20% of initial calibration	Remeasure
SOP 6.2	Organic vapor level (PID)	Initial calibration (for accuracy)	Once per day	± 10% of the true value	Re-calibrate
		Duplicate standard (for precision)	Once per day	± 20% of the initial calibration	Remeasure
SOP 6.3	Organic vapor level (FID)	Calibration (for accuracy)	Once per day	± 10% of the true value	Recalibration
		Duplicate standard (for precision)	Once per day	± 20% of the initial calibration	Remeasure

NA - Not Applicable

$$\% \text{ Recovery} = \frac{(SSR-SR)}{SA} \times 100\%$$

where

SSR = spiked sample result
SR = sample results (not applicable for surrogate recovery)
SA = amount of spike added.

Calibration check standards are expressed as a percent difference from the true value, i.e., 100 (X-T)/T.

Tables 3.2 and 3.3 summarize the frequency and acceptance criteria for the accuracy quality control checks for soil and water analyses. Accuracy goals for these analyses are based on established laboratory control limits and guidance in the analytical methods.

Additional quality control checks to be performed that monitor accuracy of results are trip blanks, laboratory method blanks, and equipment (rinsate) blanks. Trip blanks are analyzed for volatile organic compounds to check for cross-contamination or contamination from ambient conditions that might occur during sample shipping and storage. Method blanks are performed as part of the applicable analytical methods to monitor for contamination due to laboratory procedures. The frequency of these blanks for each analysis are presented in Table 3.2.

3.2. PRECISION

3.2.1. Definition

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed as a standard deviation among a group of measurements or as a relative percent difference between two measurements.

3.2.2. Precision Goals for Field Measurements

Where applicable, precision of field measurements will be assessed for a selected set of parameters. Precision for total petroleum hydrocarbon will be measured with duplicate sample analysis for every 10 or fewer samples collected. For measurements of combustible gas and organic vapor, precision will be assessed by analyzing the calibration standard a second time. A replicate measurement will be made for

Table 3.2 Summary of Quality Control Procedures for Field Activities and Laboratory Measurements: Water and Soil Samples

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW8240	BTEX	Field Quality Control			
		Trip Blank	1 per shipping container to laboratory	< CRQL	Evaluate potential sources; evaluate impact on data
		Duplicate	1 per 10 or fewer field samples (water)	≤ 35 percent RPD	Evaluate data usability
			1 per 10 or fewer field samples (soil)	NA	Evaluate variability
		Equipment Blank (rinsate)	1 per 10 or fewer field samples	< CRQL	Evaluate data usability
		Laboratory Quality Control			
		Method Blank	1 per 12-hour period	< CRQL	Investigate source; re-analyze associated samples
		Surrogate Spike	All field and laboratory samples	See Table 3.3	Re-analyze once to confirm matrix affect
		Internal Standards	All field and laboratory samples	per Table 3.3	Re-analyze once to confirm matrix affect
		Matrix Spike	1 per 20 samples of a given matrix	See Table 3.3	Evaluate data for usability
		Matrix Spike Duplicate	1 per 20 samples of a given matrix	See Table 3.3	Evaluate data for usability
		Laboratory Control Sample	1 per 12-hour period	See Table 3.3	Evaluate data for usability
		Instrument Performance Check	Once per 12-hour period	SW8240	SW8240
		SPCC's	1 per 12-hour period	RF ≥ 0.3	Identify and correct problem; re-calibrate
		Continuing Calibration Check	1 per 12-hour period	%D ≤ 25 percent	Re-calibrate

r^2 - correlation coefficient of the calibration curve

Table 3.2 (Page 2 of 6)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW9071/ E418.1	TPH	Field Quality Control			
		Duplicate	1 per 10 or fewer field samples (water)	≤ 35 percent RPD	Evaluate data usability
			1 per 10 or fewer field samples (soil)	NA	Evaluate variability
		Equipment Blank (rinsate)	1 per 10 or fewer field samples	< CRQL	Evaluate data usability
		Laboratory Quality Control			
		Method Blank	1 per 20 or 1 per batch whichever is more frequent	< CRQL	Investigate source; re-analyze associated samples
		Matrix Spike	1 per 20 samples of a given matrix	See Table 3.3	Evaluate data for usability
		Matrix Spike Duplicate	1 per 20 samples of a given matrix	See Table 3.3	Evaluate data for usability
		Laboratory Control Sample	1 per 20 or 1 per batch, whichever is more frequent	80 - 120% of true value	Investigate source; re-extract/re-analyze
		Calibration	Five point calibration	$r^2 > .9996$	Re-calibrate
		Continuing Calibration Check	1 per 20 samples	80 - 120% of true value	Re-calibrate

r_2 - correlation coefficient of the calibration curve

Table 3.2 (Page 3 of 6)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
NAS 1962 NAS 1965 NAS 1960 ASTM D2460-70 EML-Am-01	Isotopic Uranium Isotopic Plutonium Isotopic Thorium Radium-226 Americium-241	Field Quality Control			
		Duplicate	1 per 10 or fewer field samples (water)	±4xSD	Evaluate data usability
			1 per 10 or fewer field samples (soil)	NA	Evaluate variability
		Equipment Blank (rinsate)	1 per 10 or fewer field samples	< 10x level in associated samples	Evaluate data usability
		Laboratory Quality Control			
		Background (1000 min.)	Once per week	For background subtraction and minimum detectable activity	Identify and correct problem
		Pulse Check	Once per day	Peak counts at 5 meV ± 3xSD	Identify and correct problem; re-check
		Method Blank	1 per 20 samples of a given matrix	≤2 x MDA	Identify and correct problem; re-analyze blank
		Method Spike	1 per 20 samples of a given matrix, or 1 per batch, whichever is more frequent	± 3 x SD normalized deviations	Identify and correct; problem; evaluate associated sample usability
		Matrix Spike	1 per 20 samples of similar matrix	± 3 x SD normalized deviations	Evaluate data usability
		Replicate	1 per 20 samples of a similar matix	± 4 x SD normalized range	Evaluate data usability

Table 3.2 (Page 4 of 6)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
E906.0	Tritium	Field Quality Control			
		Duplicate	1 per 10 or fewer field samples (water)	±4 x SD	Evaluate data usability
			1 per 10 or fewer field samples (soil)	NA	Evaluate variability
		Equipment Blank (rinsate)	1 per 10 or fewer field samples	< 10x level in associated samples	Evaluate data usability
		Laboratory Quality Control			
		Background	Once per day	+3 x SD, limit-gross contamination; background subtract	Identify and correct problem
		Source Check	Once per day	± 3 x SD	Identify and correct problem; re-check
		Method Blank	1 per 20 samples of a given matrix	≤2 x MDA	Identify and correct problem; re-analyze blank
		Method Spike	1 per 20 samples of a given matrix, or 1 per batch, whichever is more frequent	± 3 x SD normalized deviations	Identify and correct; problem; evaluate associated sample usability
		Matrix Spike	1 per 20 samples of similar matrix	± 3 x SD normalized deviations	Evaluate data usability
		Replicate	1 per 20 samples of a similar matix	± 4 x SD normalized range	Evaluate data usability

Table 3.2 (Page 5 of 6)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Nuclear Data, Inc. 1986	Gamma radiation	Field Quality Control			
		Duplicate	1 per 10 or fewer field samples (water)	±4 x SD	Evaluate data usability
			1 per 10 or fewer field samples (soil)	NA	Evaluate variability
		Equipment Blank (rinsate)	1 per 10 or fewer field samples	< 10x level in associated samples	Evaluate data usability
		Laboratory Quality Control			
		Background (10 min.)	Once per day	No identifiable peaks; ± 20 percent error	Identify and correct problem; recount
		Background (1000 min.)	Once per month	Not applicable; Stored for background subtraction	Not applicable
		Source check	Once per day	± 3 x SD	Identify and correct problem; recount
		Mixed Standard	Initial setup and as necessary	Full range energy; linearity and efficiency calibration ± 5% of known standard	Not applicable
		Replicate sample	1 per 20 samples of similar matrix	± 4 x SD normalized deviations	Evaluate data usability

Table 3.2 (Page 6 of 6)

Analytical Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
NAS 1960 Martin 1979 PHS 1965	Strontium-90	Field Quality Control			
		Duplicate	1 per 10 or fewer field samples (water)	±4 x SD	Evaluate data usability
			1 per 10 or fewer field samples (soil)	NA	Evaluate variability
		Equipment Blank (rinsate)	1 per 10 or fewer field samples	< 10x level in associated samples	Evaluate data usability
		Laboratory Quality Control			
		Method Blank	Once per day	≤ 2 x MDA	Identify and correct problem; reanalyze
		Background check	Once per week	+ 3 x SD, limit-gross contamination	Identify and correct problem; recheck
		Instrument reliability	Once per day	± 3 x SD	Identify and correct problem; recheck
		Method Spike	1 per 20 samples of a similar matrix	± 3 x SD normalized deviations	Identify and correct problem; evaluate data usability
		Matrix Spike	1 per 20 samples of similar matrix	± 3 x SD normalized deviations	Evaluate data usability
		Replicate sample	1 per 20 samples of a similar matrix	± 4 x SD normalized deviations	Evaluate data usability
		Plateau	Once per year	Not applicable	Not applicable
		Efficiency Determination	Once per year	Not applicable	Not applicable

Table 3.3 Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogate Spikes Water and Soil Samples

Analytical Method	Spiking Compounds	Spike Concentration[1]		Advisory Limits			
		Water	Soil	Percent Recovery (%)		Relative Percent Difference (RPD)	
		µg/L	µg/kg	Water	Soil	Water	Soil
VOC	Matrix Spike						
	Benzene	50	50	75 - 125	75 - 125	≤15	≤25
	Toluene	50	50	75 - 125	75 - 125	≤15	≤25
	Ethyl Benzene	50	50	75 - 125	75 - 125	≤15	≤25
	Xylene	100	100	75 - 125	75 - 125	≤15	≤25
	Surrogates						
	Toluene-d8	50	50	88 - 110	81 - 117	N/A	N/A
	4-Bromo-fluorobenzene	50	50	86 - 115	74 - 121	N/A	N/A
	1,2-Dichloroethane-d4	50	50	76 - 114	70 - 121	N/A	N/A
TPH	Matrix Spike/LCS	mg/L	mg/kg				
	Reference oil mixture	4.2	4.2	75 - 125	75 - 125	≤15	≤25
TKN	Matrix Sprike						
	EDTA Solution	40	1000	75 - 125	75 - 125	≤15	≤15
Total P	Matrix Spike						
	Potassium Biphosphate	0.25	50	75 - 125	75 - 125	≤30	≤30

[1] Spike concentration may vary slightly between laboratories

every 10 measurements for low-energy gamma radiation and alpha surface contamination. Table 3.1 summarizes the acceptance criteria for duplicate measurements, usually in terms of relative percent difference (RPD). RPD is defined as

$$RPD = \frac{C1-C2}{(C1+C2)/2} \times 100\%$$

where

C1 = Concentration of analyte in the primary sample
C2 = Concentration of analyte in the duplicate sample

3.2.3. Precision Goals for Laboratory Measurements

Precision of laboratory analyses will be assessed by analyzing duplicate samples (matrix spike duplicates), and/or by analyzing aliquots (sample replicates) of one sample. Analysis of duplicate samples measures the precision of both the sampling and analysis, whereas a sample replicate generally measures only the analytical precision (depending upon the nature of the sample matrix). Precision of the duplicate and replicate analyses will be expressed as an RPD. Table 3.2 summarizes for each laboratory analysis the frequency and acceptance criteria for duplicate and replicate samples. Precision criteria are based on CLP guidance, where available, and best technical judgement.

3.3. COMPLETENESS

Completeness is a measure of the amount of data obtained from a measurement system that achieves the project goals, compared to the amount expected under normal conditions. Completeness is affected by unexpected conditions that may occur during the data collection process. Occurrences that reduce the amount of data collected include events such as a dry well, an instrument breakdown, or a loss of sample extract. All reasonable attempts will be made to minimize loss of data (e.g., through regular maintenance of field instruments, and replacing/repairing instruments that have broken down) and to recover lost data.

Completeness will be evaluated for field measurements and laboratory analysis. The amount of valid, i.e., usable data, generated compared to the planned amount of data will be used to determine data completeness:

$$\% \text{ Completeness} = \frac{\text{Number of "valid" data points collected}}{\text{Number of data points planned}} \times 100\%$$

This calculation is performed for each type of measurement or analysis. The completeness goal for field measurements and laboratory analysis is 95 percent. If this goal is not met, the necessity for additional remediation or resampling will be determined on a case-by-case basis due to the many factors that could impact data completeness.

3.4. REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent characteristics of a population, parameter, variation at a sampling point, process condition, or environmental condition. Data representativeness for this project is accomplished through implementing approved sampling procedures and analytical methods that will generate data representative of site conditions. Sampling procedures to be used (Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A) are designed to minimally impact the sample generated so that conditions representative of the sampling location are obtained. An example of a sampling technique that achieves this is collection of a groundwater sample after a specified volume of groundwater is purged from the well so that a sample representative of the groundwater conditions is obtained. Field sampling locations (i.e., background samples, spatial distributions, sample population statistics, etc.) have been identified by evaluating removal site requirements. The rationale for the sample locations are described in the FFTA Work Plan.

Analytical methods are selected that will most accurately and precisely represent the true concentration of the parameter of interest and meet regulatory requirements. The quality control procedures implemented and instrumentation used for a given analysis, for example, affect the representativeness of the data generated.

3.5. COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. Comparability of data sets generated for this investigation will be obtained through implementation of specific protocols for sampling and analysis of samples, by the use of traceable reference materials for laboratory standards, by expressing results in comparable concentration units and by participation of the laboratories in external performance evaluation programs. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures to be used in obtaining the planned analytical data, as documented in the following sections, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and quality assurance objectives.

4. CONSTRUCTION AND SAMPLING PROCEDURES

The FFTA task will follow Mound Plant ER Program standard operating procedures (SOPs) in performing sampling and physical testing for the removal action. Activities that will be performed as part of the task include construction, excavation, treatment, and monitoring and confirmation sampling. These activities are discussed in detail in the FFTA Work Plan. The SOPs developed for the Mound Plant ER Program that will be followed are listed in Table 4.1 and are provided in Appendix A of this QAPP.

4.1. CONSTRUCTION, EXCAVATION, AND TREATMENT

4.1.1. Extent of Contamination

Prior to beginning the removal action, the area of soil to be removed for treatment will be defined through field screening for total petroleum hydrocarbons. (The procedure for measurement of total petroleum hydrocarbons is in Appendix A.) The initial sample coordinates will be defined by the nodes on a 10 foot by 10 foot grid. Exact location of coordinates will vary due to obstructions (underground lines and concrete pad). These initial coordinates will be evaluated for total petroleum hydrocarbons in the field using an infrared spectrometer. Any sample point which results in a measurement of 10 ppm or greater shall be determined to be within the extent of excavation (contamination). If an exterior grid location is determined to be contaminated, the grid will be expanded by 10 square feet intervals.

After establishing a perimeter of excavation, a finer grid (5 foot intervals) will be imposed upon the identified area. Sampling points will be defined by the nodes of the finer grid. The contaminated ($\geq$ 10 ppm via field screening) locations of the finer grid will be linked to determine the area for excavation.

Twenty percent of the sampled locations will be submitted to a laboratory for confirmation analysis. The sample locations for submission will be selected to confirm the highest and lowest field TPH results and to confirm shallow and deep locations. The laboratory will perform two tests, total petroleum hydrocarbons by modified method 418.1 and Organic Volatiles for benzene, toluene, ethylbenzene, and xylene (BTEX) by modified method 8240. The results from the laboratory will be compared to the field measurements to confirm that the field measurements adequately defined the extent of contamination.

Table 4.1
Mound Plant ER Program SOPs Applicable to FFTA

Section 1 - General	Effective Date	Revision Number	Purpose
1.1 General Instructions for Field Personnel	March 1992	2	To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.
1.3 Sample Control and Documentation	March 1992	1	To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.
1.4 Sample Containers and Preservation	March 1993	4	To provide guidance in the selection and preservation of suitable containers for samples, container cleaning, required sample volumes, sample collection, times, and the recommended holding preservation techniques for water, wastes, sediments, sludges, and soil samples.
1.5 Guide to the Handling, Packaging, and Shipping of Samples	January 1993	2	To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.
1.6 General Equipment Decontamination	March 1992	2	To describe methods for the decontamination of field equipment potentially contaminated during sample collection.
1.8 Personnel Decontamination-Level D Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.
1.9 Personnel Decontamination-Level C Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.
1.15 Guide to Waste Management	February 1993	2	To provide a general guide for the management of investigation-derived materials at the Mound Plant.

Section 1 - General	Effective Date	Revision Number	Purpose
6.1 Health and Safety Monitoring of Combustible Gas Levels	March 1992	1	To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.
6.2 Health and Safety Monitoring of Organic with a Photonization detector	March 1992	1	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).
6.3 Health and Safety Monitoring of Organic Vapors with a Flame ionization detector	June 1993	2	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable flame ionization detector (FID).

4.1.2. Construction

Construction includes preparing a temporary staging area, excavating the contaminated soil, back filling the excavation, and constructing the treatment pads and roof structure. Contract documents (specifications and drawings) for the construction of these elements have been prepared and are provided in the Work Plan. Construction materials will either be visually inspected by the field engineer or physically tested for conformance to work plan specifications. Materials which do not meet specifications will be rejected by the field engineer and not used during construction.

The following materials will be subjected to testing: contact water, pit excavation soil, pit drain line soil, back fill soil, clay for the treatment pads, and the concrete used for the footers for the treatment structure. Table 4.2, summarizes the tests and criteria for each of the materials.

The contact water and concrete will be assumed to be homogeneous and one sample per batch will be adequate.

Table 4.2
Summary of Materials Testing and Criteria

Material	Test	Acceptance Criteria
Contact Water	TPH, modified method 418.1 BTEX, modified method 8240	≤ 40 ppm ≤ 5 ppm
Pit Excavation Soil	TPH, modified method 418.1 BTEX, modified method 8240	≤ 40 ppm ≤ 5 ppm
Pit Drain Line	Field TPH	≤ 10 ppm
Fill Soil	No testing necessary	Pre-approved by EG&G Mound
Treatment Pad Clay	No testing necessary Physical Soil Type ASTM D442, D4318, D2487 Moisture Content ASTM D2216, D3017 Moisture Density ASTM D698 Strength ASTM D2166, D2850 Hydraulic Conductivity ASTM SW846 Method 900	Pre-approved by EG&G Mound Per reference standard Per reference standard Per reference standard Per reference standard Per reference standard
Concrete, pre-mixed Concrete, mixed at site	ASTM C94 ASTM C94	ACI 211.1 ACI 301

Table 4.3 summarizes the number of samples and, as appropriate, location of the samples to be collected for these materials. Samples from the pit excavation and pit drain lines will be collected to verify all contaminated soil has been removed for treatment. If levels greater than the acceptance criteria are reported, then additional soil removal will be performed, until the reported results meet the acceptance criteria. Fill soil and treatment pad clay will not require chemical testing since they are to be obtained from a Mound pre-approved source. Treatment pad clay will be sampled for physical tests.

Table 4.3
Sample Quantity and Sample Location for Construction Materials

Material	Number of samples and location	Location	Total Number Samples	Rationale
Pit Soil	3 4	each wall of pit floor of pit	2 4	
Pit Drain Line	1+	each line + additional as determined necessary	1+	
Fill Soil	N/A	N/A	N/A	
Treatment Pad Clay Liner	3			

The contact water will be tested for contaminants to verify contamination is not being introduced in the EG&G Mound wastewater treatment facility, and concrete for footers will be tested to verify conformance to specifications.

4.1.3. Treatment

The contaminated soil will be treated through the process of biological degradation of petroleum hydrocarbons by microbial activity. To establish the proper conditions for remediation, the contaminated soil will be tested for total phosphorus, total nitrogen, and percent moisture by the laboratory and pH by the field team. The information obtained from the nutrient test data will be used to determine whether additional nutrients are required before adding additional microbes. The minimum and maximum levels for optimal biological degradation are described in Table 4.4.

Table 4.4
Conditions for Optimal Biological Degradation

Soil Condition	Minimum Level	Maximum Levels
Nitrogen	15 to 50 mg/kg optimum	N/A
Phosphorus	15 to 50 mg/kg optimum	N/A
Temperature	40°F	100°F
pH	6	8.5

After verifying that the contaminated soil is correctly balanced with nutrients, the microbes will be tilled into the contaminated soil.

The contaminated soil will be monitored biweekly by collecting eight samples from each treatment pad. The samples will be collected from the center of eight equal grids. The number of samples were developed from Ohio BUSTR closure requirements. The samples will be measured by the laboratory for total petroleum hydrocarbons, total phosphorus, total nitrogen, percent moisture, and pH. As necessary, the nutrients will be balanced within the acceptance criteria until field monitoring results are less than 10 ppm of total petroleum hydrocarbon at each of the eight sample locations per treatment pad. When all sample results are below the 10 ppm field action limit for petroleum hydrocarbon, eight additional samples will be collected and submitted to the laboratory for BTEX analysis. If the BTEX results are less than 5 ppm for all the target compounds, the project manager will evaluate the reported data and direct the disposal of the treated soil to a designated location. If the results are greater than 5 ppm for any analyte, the treatment will be continued. The field engineer will verify the treated material is delivered to the designated disposal location.

At the conclusion of the removal action, the project manager will transfer the treatment pads and treatment structure to the care of EG&G Mound. The transfer will be documented with EG&G Mound's acceptance of the closure report.

4.2. GENERAL PROCEDURES FOR SAMPLING

General procedures for all sampling activities address instructions to field personnel; sample control and documentation; sample containers; handling, packaging, and shipping of samples; and equipment decontamination.

4.2.1. Instructions to Field Personnel

Prior to the beginning of a sampling event, the field manager will meet with the assigned sampling personnel and review the purpose and objectives of the event. This meeting will provide final clarification of the sampling event details. Topics of review and discussion will include items such as sampling locations, types of samples to be collected, number of samples collected, sample numbering, preservation requirements, parameter(s) to be analyzed, sampling procedures, equipment decontamination procedures, and chain-of-custody requirements. Mound Plant ER Program SOP 1.1, General Instructions for Field Personnel (included in Appendix A), provides the procedures for instructions to field personnel.

4.2.2. Sample Control and Documentation

The steps required for sample control, sample identification, data recording, and chain-of-custody documentation are defined in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (included in Appendix A). Examples of completed documentation and labels for environmental samples are presented in this SOP.

Table 4.5 provides the general sample identification system that will be used for samples collected as part of this task.

Table 4.5

FFTA Field Sample Identification Plan

FIELD SAMPLES:

Sample Matrix	Identification Scheme
Soil	MND55-YYYY-ZZZZ
Water	MND55-YYYY-ZZZZ

FIELD QUALITY CONTROL SAMPLES:

Sample	Identification Scheme
Trip Blank	MNDXX-YYYY-2ZZZ
Duplicate	MNDXX-YYYY-1ZZZ
Equipment Blank	MNDXX-YYYY-4ZZZ

Notes:

MND = Mound Plant
XX = sample matrix identifier
YYYY = sample location number
ZZZZ = sample round or sample depth

Field quality control samples will be assigned a sample location number and sample round of the last sample of the associated sample batch.

4.2.3. Sample Containers, Preservation, and Holding Times

Mound Plant ER Program SOP 1.4, Sample Containers and Preservation (included in Appendix A), provides guidance in the selection of suitable containers for samples, requirements for container cleaning, required sample volumes, sample collection, holding times, and the recommended preservation techniques for laboratory analysis and filled TPH. Tables 4.6 and 4.7 summarize the required sample containers, sample volumes, preservation techniques, and holding times for each set of parameters and media to be analyzed for this investigation. The laboratory must perform all analyses and any required re-analyses within required holding times.

Sample containers will be certified clean by the manufacturer and will be cleaned by the manufacturer according to EPA standards (EPA, 1990). The manufacturer's statement of certification and analytical results will accompany each bottle lot. At least one bottle per lot number for each analysis will be retained and enclosed in the shipping boxes. These bottles will be held until analytical results are received from the laboratory. If there is an indication that a bottle lot is contaminated with an analyte, then a bottle lot blank will be prepared for analysis of the analyte of concern (Subsection 8.2).

4.2.4. Sample Shipment

Samples will be shipped by common overnight carrier or hand-delivered to the laboratory and are to be prepared for shipment according to Mound Plant, ER Program SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (included in Appendix A). This SOP was developed from U.S. Department of Transportation (DOT) hazardous materials regulations (49 CFR 100-199) and regulations from the International Air Transport Association (IATA). The current DOT or applicable IATA procedures for the transportation of samples will be determined prior to sample shipment. In general, samples are to be shipped on the same day as collected, if possible, and, at the latest, the very next day. Samples collected on-site will not be shipped until Mound Plant screening results of the samples have been received. Figure 4.1 summarizes the sampling procedures.

All sample bottles will be sealed in Ziploc®, plastic bags and packed with blue ice or ice to attempt to cool the samples. A 40 mL VOC glass vial filled with deionized water will be prepared as a "temperature blank" and packaged near the surface of the cooler contents. Immediately upon receipt by the laboratory, the temperature of the "temperature blank" will be measured. If the temperature is not between 1 °C and 12 °C, then the EG&G subcontractor site manager will be contacted immediately. The site manager will determine if resampling is necessary.

Table 4.6 Sample Container, Volumes, Preservation, and Holding Times: Water Samples

Parameter	Analytical Method	Container[a]	Minimum Volume[d]	Preservation	Holding Time[b]
Volatile Organic Compounds	SW8240	Glass vail with Teflon-lined septum (no headspace)	Three 40 mL vials	Cool 4°C	14 days
Total Petroleum Hydrocarbon	E418.1	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	HCl to pH<2, Cool 4°C	14 days 40 days[c]
Total Kjeldahl Nitrogen	E351.3	Polyethylene bottle	1000 mL bottle	H_2SO_4 to pH<2, Cool 4°C	28 days
Total Phosphorus	E365.1/E365.2	Polyethylene bottle	1000 mL bottle	H_2SO_4 to pH<2, Cool 4°C	28 days
Radionuclides Gamma Spectrometry Plutonium Isotopes Thorium Isotopes Uranium Isotopes Strontium-90 Radium-226 Americium-241	 Nuclear Data, Inc (1986) NAS 1965 NAS 1960 NAS 1962 NAS 1960 ASTM D2460-70 EML Am-01	Plastic cubetainer	Two 4000 mL containers	HNO_3 to pH<2, (15 mL 1N HNO_3 per liter)	NA
Tritium	E906.0	Glass bottle with Teflon-lined lid	250 mL	None	None

[a] Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b] From date of collection.
[c] From date of extraction.
[d] For samples identified for matrix spike analyses, fill one additional set of containers. Add "MS/MSD" on the end of the sample ID for the additional containers.

Table 4.7 Sample Container, Volumes, Preservation, and Holding Times: Soil Samples

Parameter[f]	Analytical Method	Container[a]	Minimum Volume[d]	Preservation	Holding Time[b]
Total Petroleum Hydrocarbons	Field TPH	Amber glass bottle with Teflon-lined lid	100 g	Cool 4°C	28 days
Volatile Organic Compounds	SW8240	Amber glass bottle with Teflon-lined lid (no headspace)	100 g	Cool 4°C	14 days
Total Petroleum Hydrocarbon	SW9071/E418.1	Amber glass bottle with Teflon-lined lid	100 g	Cool 4°C	28 days[e] 40 days[c]
Total Kjeldahl Nitrogen	E351.3	Polyethylene bottle	100 g	Cool 4°C	28 days
Total Phosphorus	E365.1/E365.2	Polyethylene bottle	100 g	Cool 4°C	28 days
Radionuclides		Polyethylene bottle	750 g	None	None
Gamma Spectrometry	Nuclear Data, Inc (1986)				
Plutonium Isotopes	NAS 1965				
Thorium Isotopes	NAS 1960				
Uranium Isotopes	NAS 1962				
Strontium-90	NAS 1960				
Radium-226	ASTM D2460-70				
Americium-241	EML Am-01				
Tritium	E906.0				
Physical Testing		Shelby tubes or plastic bucket	5 gallon bucket	None	None
Particle Size	ASTM D422				
Compaction	ASTM D1557				
Hydraulic Conductivity	ASTM D5084				

[a] Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b] From date of collection.
[c] From date of extraction.
[d] For samples identified for matrix spike analyses, fill one additional set of containers. Add "MS/MSD" on the end of the sample ID for the additional containers.
[e] The holding time for this analysis is advisory. A regulatory holding time has not been established for this method.
[f] a 40 mL glass vial will be filled with soil for each sample requiring chemical analyses. This vial will be labelled "% moisture" and will be used to determine % moisture for reporting purposes.

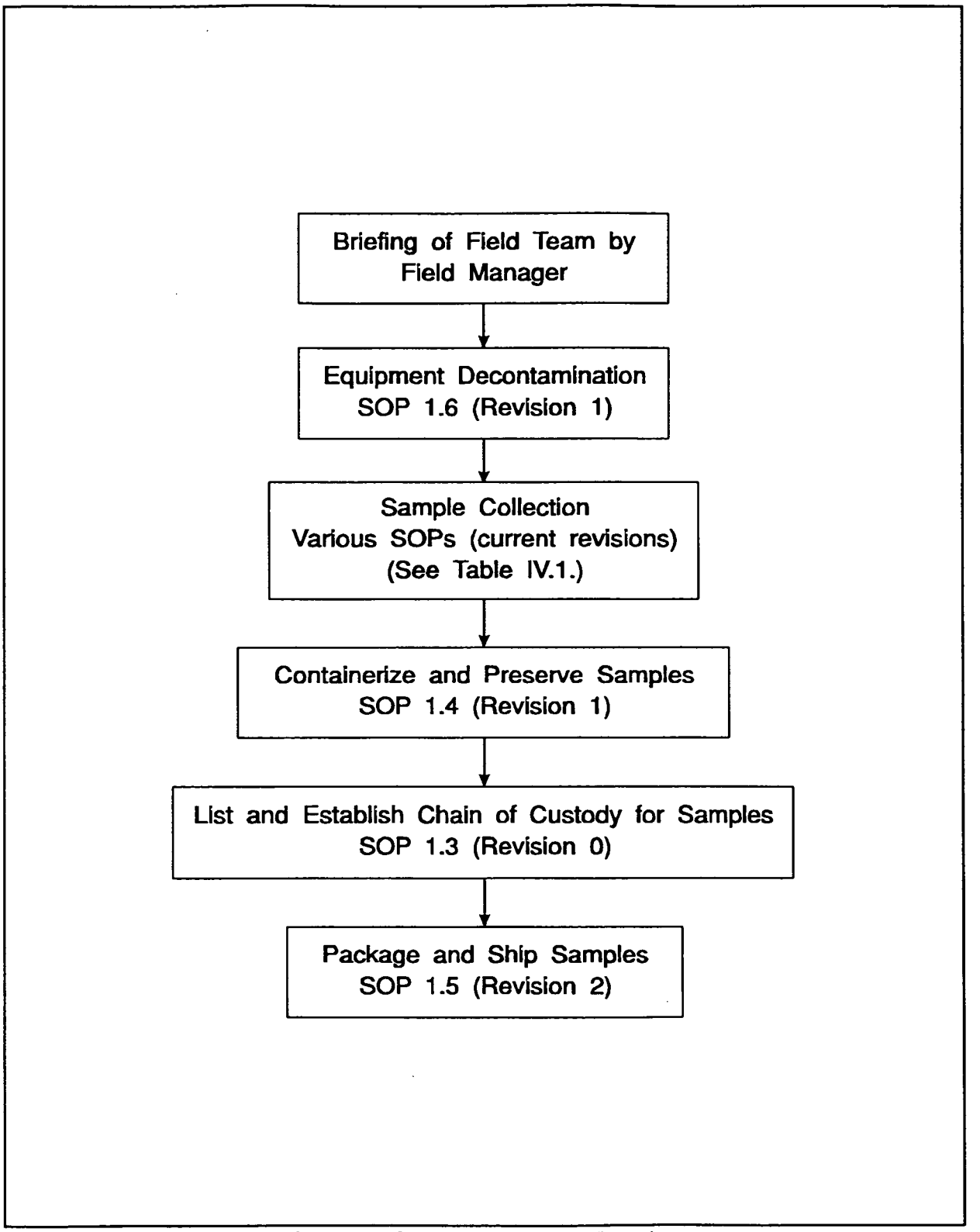

Figure 4.1. Sampling procedures flow chart.

4.2.5. Equipment Decontamination

Equipment decontamination is an integral part of the data collection and quality assurance process. The implementation of proper decontamination practices and procedures will begin in the field prior to the use of sample collection equipment. The field manager is responsible for ensuring that samples are collected with properly decontaminated equipment. All field sampling equipment will be decontaminated before use and after activities are completed at each sample location, in accordance with Mound Plant ER Program SOP 1.6, General Equipment Decontamination (included in Appendix A). Wash water and other fluids created during decontamination will be considered hazardous until determined otherwise.

4.3. WATER SAMPLING

Contact water from the holding tank will be sampled for every tank full of water. Water will be collected from the tank valve into a bucket to avoid overflow or spill onto the ground surface. The water will then be transferred carefully into sample containers, avoiding aeration of the sample. The bucket will be decontaminated according to Mound Plant ER Program SOP 1.6 prior to sampling.

4.4. SOIL/SEDIMENT SAMPLING

Surface and subsurface soil sampling procedures to be followed for this investigation are provided in Mound Plant ER Program SOPs 5.2, 5.3, and 5.8 (included in Appendix A). These procedures consist of protocols for sampling with a spade and scoop (surface and subsurface), subsurface soil sampling with a hand auger and thin wall sampler, GeoProbe™, and surface soil sampling with a stainless steel surface soil sampler.

5. SAMPLE CUSTODY

Sample custody procedures to be followed during the FFTA project activities require that the possession and handling of each sample from the moment of its collection through analysis be documented by written record. A sample is in someone's custody when one of the criteria listed below has been satisfied:

- The sample is in one's actual possession.
- The sample is in one's view after being in one's physical possession.
- The sample is in one's physical possession and is then locked to prevent tampering tamper with the sample.
- The sample is kept in a secured area that is restricted to authorized personnel only.

Samples will consist of material collected in the field, such as water, soil, or sediments, and any reagents added for the purposes of sample preservation.

5.1. CHAIN OF CUSTODY

5.1.1. Field Custody Procedures

Sample Labels

All samples will be identified with a label attached directly to the container. Examples of sample labels are presented in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (included in Appendix A). Sample label information will be completed using waterproof black ink. The labels will contain the following information:

- Sample number.
- Time and date of collection.
- Installation name.
- Parameters to be analyzed.
- Preservative (if any).
- Sample source/location.
- Sampler's initials.

Chain of Custody Record

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a chain-of-custody record (Figure 5.1) will be completed for each FFTA sample as it is collected by the field sampler. Each time the samples are transferred, the signatures of the persons relinquishing and receiving the samples, as well as the date and time of transfer, will be documented.

Chain-of-custody seals are used to determine if any tampering has occurred during shipment of samples. These signed and dated seals will be placed at the junction between the lid and the jar or cooler on all FFTA project sample containers and shipment containers (coolers) by the person responsible for packaging. If the coolers or jars are opened before receipt at the laboratory, the seals will not be intact. If the chain-of-custody seals are not intact, the laboratory project manager for the Mound Plant ER Program will notify the WESTON field manager within 24 hours of receipt of the container. The WESTON field manager will then complete a corrective action report (discussed in Section 13 of this QAPP).

Transfer of Custody and Shipment

Prior to shipment of samples, the chain-of-custody record will be signed and dated by a member of the field team who has verified that those samples indicated on the record are indeed being shipped. Mound Plant ER Program SOP 1.3, Sample Control and Documentation (included in Appendix A), describes the completion of this form and the steps necessary for sample control, sample identification, and data recording. A copy of each chain-of-custody form will be retained in the project file at the site, and the original will be sent with the samples (sealed inside the sample cooler). After packaging is completed, custody seals, signed and dated by a member of the field team, will be placed on the cooler.

WESTON Analytics Use Only

Custody Transfer Record/Lab Work Request

WESTON

Page ____ of ____

Client _____

Est. Final Proj. Sampling Date _____

Work Order # _____

Project Contact/Phone # _____

AD Project Manager _____

QC _____ Del _____ TAT _____

Date Rec'd _____ Date Due _____

Account # _____

Refrigerator #																			
#/Type Container	Liquid																		
	Solid																		
Volume	Liquid																		
	Solid																		
Preservatives																			
ANALYSES REQUESTED →		ORGANIC								INORG									
		VOA	BNA	Pest/PCB	Herb					Metal	CN								

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Lab ID	Client ID/Description	Matrix QC Chosen (✓) MS	MSD	Matrix	Date Collected	Time Collected	WESTON Analytics Use Only												

FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS

Special Instructions:

DATE/REVISIONS:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

WESTON Analytics Use Only

Samples were:
1) Shipped ___ or Hand Delivered ___
Airbill # _____
2) Ambient or Chilled
3) Received in Good Condition Y or N
4) Labels Indicate Properly Preserved Y or N
5) Received Within Holding Times Y or N

COC Tape was:
1) Present on Outer Package Y or N
2) Unbroken on Outer Package Y or N
3) Present on Sample Y or N
4) Unbroken on Sample Y or N

COC Record Present Upon Sample Rec't Y or N

Discrepancies Between Samples Labels and COC Record? Y or N
NOTES:

Relinquished by	Received by	Date	Time

Relinquished by	Received by	Date	Time

RFW 21-21-001/A-7/91 ____ L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# _____ Cooler# _____ 381-596a

Figure 5.1. Chain-of-Custody Record.

After samples are collected and screened by Mound Plant personnel, they will be transported by field personnel as soon as possible to the courier location for subsequent shipment to the laboratory or hand-delivered to the laboratory. (It should be noted that Federal Express does not claim responsibility for samples and does not sign off on the chain of custody. However, the laboratory retains the shipping ticket, indicating acceptance and delivery of shipment.) Rental vehicles used by the field personnel may be used for transporting nonhazardous and nonradioactive samples from the Mound Plant to the Federal Express® office only if the samples are properly packaged and labeled. Upon receipt of the samples at the laboratory, the receiver will complete the transfer by dating and signing the chain-of-custody record (Figure 5.1). This chain-of-custody record will remain with the sample at the laboratory.

5.1.2. Laboratory Custody Procedures

Laboratory sample custody procedures include procedures for general security, sample receipt, storage, preparation, and analysis. The OU-9 QAPP laboratory specifications attachments describe these procedures unique for the given laboratory. The following subsections describe the minimum general requirements for the laboratory.

5.1.2.1. Sample Receipt

- Samples will be checked for integrity and the temperature inside the coolers, measured in the temperature blank, will be noted on the Chain of Custody. Sample containers for VOCs will be checked for bubbles. The QAM and field manager will be notified immediately of any discrepancies or broken bottles.
- The appropriate section managers and analysts will be notified of any short holding times.
- The laboratory will have a sample custodian who will assume custody of the samples by signing the chain of custody.
- The samples will be checked against the chain of custody and discrepancies will be resolved with the field manager and QAM.
- The completed chain of custody, with all relinquished signatures, will be returned to the subcontractor with the data package as described in Section 9.2.3 of this QAPP.

5.1.2.2 Sample Storage

Samples (except those samples designated for radiological or analyses which do not have preservation requirements) will be stored in locked refrigerators which are maintained at 4° ± 2°C. When samples, extracts, or digestates are retrieved from or returned to the refrigerator, a chain of custody record is signed by the analyst.

Unused samples, sample containers, sample extracts, and sample digests are stored for a minimum of 60 days after analysis and are not disposed of without written authorization from the EG&G subcontractor.

Laboratories will have controlled access to sample storage areas.

5.1.2.3. Sample Tracking

For samples requiring preparation, a sample preparation record is completed by the analyst/technician during the time of preparation. Sample extracts are maintained in secured refrigerator storage. Sample extracts for radiochemical analysis are stored at room temperature in a secured area. Chemical and radiological sample preparation records are stored in a bound notebook.

5.1.2.4. Record Keeping

Sample preparation and analysis information are recorded in bound laboratory notebooks. Sample tracking information includes the following:

- Project identification number.
- Sample numbers.
- Sample type.
- Date received.
- Date put into storage after analysis.
- Date of extraction or digestion.
- Date of analysis.
- Date of disposal.

Corrections to entries in laboratory notebooks are made by drawing a single line through the erroneous entry and entering the correct entry. Corrections are dated and initialed by the individual making the entry.

The laboratory archives all GC/MS magnetic tapes related to the program.

5.2. DOCUMENTATION

5.2.1. Field Logs

All data collection activities performed at a site will be documented, using waterproof nonerasable black ink, either in a field notebook or on ER Program forms. Field notebooks will be bound books and will be assigned to individual field personnel for the duration of their stay in the field. The required contents and procedures for entering into field logs are described in Subsection 9.1.3. In addition, all samples collected will be recorded in the field log with the following information:

- Sample location.
- Sample identification number.
- Date and time of collection.
- Sample matrix.
- Any unusual appearances of the sample.
- Parameters to be analyzed.
- Date and time sample was released or received.

5.2.2. Data Collection Forms

As an added means of ensuring the collection of accurate field and sampling information, standardized data collection forms will be used. These forms will be used to record data in a consistent format that limits individual interpretations or preferences. By explicitly outlining reporting methods, identifying appropriate units of measure, and specifying alternative test procedures, these forms provide a measure of quality control in the data collection process.

The standard data collection forms associated with the Mound Plant ER Program SOPs groups data and information according to problem-solving needs. They are a means of preventing the collection of invalid or redundant data and eliminating critical data gaps. Each data collection form precisely defines what data are necessary to accurately characterize a particular property or relationship. This reduces the likelihood of initiating field sampling or laboratory analyses only to discover that key pieces of information have not been collected and that further sampling is required.

Each Mound Plant ER Program SOP for a data collection activity provides examples of all of the forms required for the accurate recording of the procedure. A blank form will be used for each new location or sample, as specified by the SOP. During the field activity, each form will be completed as accurately and completely as possible, as indicated by the example contained in the SOP. All entries on the data collection form will be made using indelible black ink, with incorrect entries crossed out with a single line and initialed. Each form must be signed or initialed and dated by the person completing the form on the day of information entry. Any additional information not recorded on the form will be recorded in the field notebook. After the field activity is completed, all data collection forms will be reviewed by a technical reviewer other than the person recording the data prior to any use of the data and sufficiently soon to take any necessary corrective action. This review will ensure that forms are completed fully and accurately and will verify the integrity of the data. After the review, the reviewer will sign and date each form.

5.2.3. Corrections to Documentation

All measurements made, and samples collected, will be recorded as described above in Subsections 5.2.1 and 5.2.2. If an incorrect entry is made, the incorrect data will be crossed out with a single strike mark, the correct information entered, and the correction initialed and dated by the person making the correction. Corrections are made only to the original of documents. There will be no erasures or deletions from any type of data document record.

5.2.4. Sample Tracking

Samples collected in the field should be tracked by the EG&G subcontractor using a PC-based spreadsheet system or equivalent database. The following information will be recorded:

- Laboratory batch number.
- Field batch number.
- Sample matrix.

- Sample identification.
- Sample type (investigative vs. quality control).
- Date of collection.
- Date of receipt for laboratory data.
- Date of completion for data validation.
- Date electronic deliverable loaded.
- Requested analysis.

Completed chains of custody will be submitted at the end of each week to the data administrator for entry into the sample tracking system. The sample tracking data are then checked for accuracy and completeness by another individual. When hardcopy data packages are received from the laboratory they will be inventoried and the laboratory batch number and analysis/extraction date will be recorded in the tracking system. Electronic files from the laboratory will be verified for completeness and ten percent of the results checked against hardcopy results. When the data validators submit validated results, the date of completion will also be recorded in the sample tracking system.

5.3. SAMPLE HANDLING, PACKAGING, AND SHIPPING

All samples collected and shipped for analysis as part of the investigation of the FFTA will be considered hazardous samples and will be handled, packaged, and shipped according to this designation. DOT and IATA have established specific regulations governing the packaging of hazardous samples for shipment. Mound Plant ER Program SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (included in Appendix A), provides information and references that must be reviewed prior to selection of appropriate packaging materials, shipping containers, and shipping labels. Mound Plant ER Program SOP 1.5 and the current DOT/IATA regulations will serve as the guidelines for shipment of all samples collected during the FFTA project.

5.4. FINAL EVIDENCE FILE DOCUMENTATION

Records will be kept by the ER Program EG&G subcontractor to document quality assurance/quality control activities and to provide support for possible evidentiary proceedings. The following is an outline of project file requirements:

Communications

- Internal
- External

Quality assurance/quality control

- Procedures
- Chain of custody
- Audit reports
- Laboratory quality control reports
- Deviation notification forms
- Nonconformance/corrective action reports

Technical information

- Analytical data
- Field data
- Field logbooks
- Graphic resources
- Data quality acceptance
- Calculations/evaluations
- Data review reports
- Regulatory compliance

Management

- Schedule
- Budget

Health and safety

- Plans/procedures
- Audit reports

Documents

Plans

Reports

All evidence file documentation will be maintained by the DOE or its subcontractor under the ER Program document control system. Upon termination of the project, all records (e.g., chromatograms, spectra, and calibration records) will be archived indefinitely by the DOE. If at any time the DOE chooses to purge its files, the EPA will be advised and offered possession. The ER Program EG&G subcontractor quality assurance manager will ensure that the quality assurance/quality control records are properly stored and retrievable.

6. ANALYTICAL PROCEDURES

6.1. FIELD MEASUREMENTS

As part of the FFTA Project at Mound Plant, several water and soil sample parameters will be measured in the field. Field measurements will include total petroleum hydrocarbons, combustible gas, organic vapors, low-energy gamma radiation, and alpha surface contamination. The Mound Plant ER Program SOPs for field determination of these parameters are presented in Appendix A of this QAPP. The following subsections summarize the procedures for measurement of field parameters.

6.1.1. Horiba Infrared Spectrometer for Total Petroleum Hydrocarbon Analysis

An aliquot of soil is extracted with a solvent, Flon S-316. The absorption of the sample extract at 2930 cm^{-1} nm wavelength is then measured to determine the TPH concentration in the soils. An SOP for this analysis is provided in Appendix A. A Horibra infrared spectrometer, or equivalent, will be used.

6.1.2. Combustible Gas

Combustible gas levels will be measured using a combustible gas indicator calibrated with a National Bureau of Standards traceable combustible gas standard. The procedures for measuring combustible gas levels are described in Mound Plant ER Program SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels (included in Appendix A).

6.1.3. Organic Vapor

Organic vapor levels will be measured according to Mound Plant ER Program SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector and/or SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector (both included in Appendix A). Each detector is calibrated with a specific gas standard such as benzene (for photoionization detector) or methane (for flame ionization detector). Both detectors measure total vapors for a broad range of organic compounds.

6.2. LABORATORY ANALYTICAL METHODS

Water and soil samples collected for the FFTA project will be analyzed either in accordance with the EPA SW846 procedures or EPA MCAWW procedures. Laboratory quality control procedures are summarized in Table 3.2. The methods specified in this QAPP are based on "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," (EPA 1987) and "Methods of Chemical Analysis of Water and Wastes," (March 1983).

Laboratory data reports for each analysis will contain sufficient information to perform data validation and/or review. Reporting requirements are identified in Subsection 9.2.3.

The list of analytes for each analytical method and the program required detection limits are presented in Table 6.1 for water and soil samples. The limit of detection for each analyte is best expressed as a quantitation limit that is defined as the "lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions" (EPA 1986). This limit may vary significantly depending upon the sample matrix, and, as a final reported limit, will vary with the weight or volume of sample used, percent moisture (where applicable), and the dilution factor, if any. The limits listed in Table 6.1 are the minimum achievable quantitation limits expected from the laboratory with analysis of clean sample matrices of a given sample volume or weight. Actual laboratory established quantitation limits will be provided by the laboratory.

The following subsections summarize the analytical procedures.

6.2.1. Volatile Organic Compounds

Water samples will be acidefied to a pH<2 with hydrochloric acid.

Four volatile targets, benzene, toluene, ethyl benzene, and xylenes, will be purged and trapped by method 5030 (EPA, 1987) from waters and soils. The trapped target will then be introduced on to a gas chromatograph/mass spectrometer for analysis by method 8240 (EPA, 1987).

6.2.2. Total Petroleum Hydrocarbons

Water samples will be acidified to a pH<2 and analyzed by Method 418.1 (EPA, 1983). Briefly, each sample will be serially extracted with fluorocarbon-113 or equivalent in a separatory funnel. Interferences

Table 6.1. Analytical Methods, Parameters, and Quantitation Limits
Water and Soil Samples

Parameters	Analytical Methods		Quantitation Limit[1]	
	Water	Soil/ Sediment	Water (µg/L)	Soil/ Sediment (µg/g)
1. Volatile Organic Compounds	5030/8240[p]	5030/8240[p]		
Benzene			5	5
Toluene			5	5
Ethyl Benzene			5	5
Xylene			5	5
			mg/L	mg/kg
2. Total Petroleum Hydrocarbons	418.1[q]	9071[p]/418.1[q]	1.0	1.0
3. Total Kjeldahl Nitrogen	E351.3[q]	E351.3[q]	0.1	25
4. Total Phosphorus	E365.1/E365.2[q]	E365.2[q]	0.02	2.0
			pCi/L	pCi/g
5. Radiological				
Gamma Spectrometry	Nuclear Data,	Nuclear Data,		
americium-241 (soils)	Inc. (1986)[e]	Inc. (1986)[e]	NA	1[d]
cobalt-60			20[c]	1[d]
cesium-137			20[c]	1[d]
bismuth-210 metastable			15[c]	1[d]
bismuth-207			15[c]	1[d]
potassium-40			350	10[d]
radium-226			NA	0.3[d]
Tritium	R906.0[f]	R906.0[f]	500	50[h]
Plutonium Isotopes	NAS,1965[b]	NAS,1965[b]	1[c]	1.0
Thorium Isotopes	NAS,1960[j]	NAS,1960[j]	1[c]	1.0
Uranium Isotopes	NAS,1962[m]	NAS,1962[m]	1	0.6[i]
Strontium-90	NAS,1960[n]	NAS,1960[n]	5	1.0
Radium-226	ASTM D2460-70[k]	NA	1	NA
Americium-241	EML-Am-01[o]	NA	1[j]	NA
6. Particle Size	NA	ASTM D422[a]	NA	NA
7. Compaction	NA	ASTM D1557[a]	NA	NA
8. Hydraulic Conductivity	NA	ASTM D5084[a]	NA	NA

Table 6.1. (page 2 of 2)

[a] "1991 Annual Book of American Society of Testing Materials Standards," Section 4, Construction, Volume 04.08, Soil and Rock, Building Stones, Geotextiles," ASTM 1990.

[b] "The Radiochemistry of Plutonium," G.H. Coleman, NAS-NS-3058, National Academy of Sciences, September 1965.

[c] Based on 900-Ml sample size.

[d] Based on 650-gram dry sample.

[e] ND 9900 VAX/VMS Spectroscopy Application Package User's Manual (09-0196), Nuclear Data, Inc., Schaumberg, IL. August 1986.

[f] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," U.S. EPA, EPA-600/4-80-032, latest version.

[g] Based on 100-Ml sample size.

[h] Dependent upon percent moisture in sample, based on 10 grams.

[i] Based on 2-gram dry sample.

[j] "The Radiochemistry of Thorium," E.K. Hyde. NAS-NS-3004, National Academy of Sciences, January 1960.

[k] "Standard Test Methods for Radium in Water," ASTM, latest version.

[l] Based on 1,000-mL sample size.

[m] "The Radiochemistry of Uranium," J.E. Grindler, NAS-NS-3050, National Academy of Sciences, March 1962.

[n] "The Radiochemistry of Barium, Calcium, and Strontium," D.N. Sunderman and D.W. Townley, NAS-NS-3010, National Academy of Sciences, January 1960.
"Determination of Strontium-89 and -90 in Soil With Total Sample Decomposition," D.B. Martin, Analytical Chemistry, October 1979.
"Procedures for Determination of Stable Elements and Radionuclides in Environmental Samples," Public Health Service Publication 999-RH-10, January 1965.

[o] "EML Procedures Manual," HASL-300, Environmental Measurements Laboratory, U.S. Department of Energy 27th Edition.

[p] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW. 846, 3rd edition, revision 1, U.S. EPA, December 1987.

[q] "Methods for Chemical Analysis of Water and Wastes," U.S. EPA, EPA 600/4-79-020, revised March 1983.

[r] "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW. 846, 3rd edition, revision 1, U.S. EPA, November 1986.

will be removed with silica gel absorbent. Infrared analysis of the extract will be performed by direct comparison to at least a five point calibration curve having a correlation coefficient of 0.996.

Representative soil sample aliquots will be obtained by the laboratory per the soil aliquoting procedure in Appendix B. Soil samples will be prepared by modified method SW9071 (EPA 1986) and analyzed by a modification of E418.1 (EPA, 1983). Laboratory specific modifications will be approved by the QAM or designee prior to submitting samples for analysis. In general, the soil will be acidified and combined with a drying agent, anhydrous magnesium sulfate and extracted by soxhlet with fluorocarbon 113. The extract will be treated with silica gel to remove interferences and analyzed by direct comparison to at least a five point calibration curve having a correlation coefficient of 0.996.

6.2.3. Total Phosphorus

Water samples will be analyzed by converting all phosphate to a blue colored complex and analyzing using uv/vis spectrophotometry. Representative soil sample aliquots will be obtained by the laboratory per the soil aliquoting procedure in Appendix B. One gram of soil will be leached with 50g of water and the water leachate will be analyzed.

6.2.4. Total Kjeldahl Nitrogen

Water and soil samples will be analyzed for total Kjeldahl nitrogen using EPA Method 351.3 (EPA 1983). Analysis consists of converting nitrogen to ammonia, then detecting the ammonia by potentimetry using Nesslerization. Representative soil sample aliquots will be obtained by the laboratory per the soil aliquoting procedure in Appendix B. One gram of soil will be leached with 50g of water and the water leachate will be analyzed.

6.2.5. Radionuclides

Water and soil samples will be analyzed for isotopic plutonium, isotopic thorium, isotopic uranium, americium-241, strontium-90, and radium-226 according to the laboratory-developed SOPs. These methods are based on established procedures such as U.S. EPA (EPA 1980), U.S. DOE (DOE 1982), National Academy of Sciences, or ASTM (1991). With the exception of strontium-90, alpha spectrometry is used to detect alpha emissions from the isotopes of interest. Representative soil sample aliquots will be obtained by the laboratory per the soil aliquoting procedure in Appendix B. A surface barrier detector is used for

identifying plutonium, uranium, thorium isotopes, and radium-226.

Gamma spectrometry will also be performed on water and soil samples to identify specific gamma emitting isotopes.

6.2.5.1 Alpha Spectrometry

Specific isotopes from alpha spectrometry include americium-241 (waters), plutonium-238, 239/240; uranium-234, uranium-235, uranium-238; and thorium-227 (for calculation of actinium-227), thorium-228, thorium-230, and thorium-232. Soil samples are prepared using acid digestion procedures to concentrate the isotopes of interest in an aqueous matrix. The alpha emitting isotopes in these acid extracts and in water samples are precipitated from the aqueous solution. The precipitates are redissolved and subjected to a sequential separation of alpha isotopes by elution from anion/cation exchange resins. The separated alpha isotopes are counted using a surface barrier detector.

6.2.5.2 Strontium-90

All strontium present in the sample is assumed to be strontium-90 (Sr-90), due to the short half-life of strontium-89 and the knowledge of process at Mound Plant. Soil samples are subjected to acid digestions to remove interferences and concentrate the strontium as an aqueous matrix. Strontium-90 is precipitated from aqueous samples and extracts. Interferences are reduced by continued precipitations of the strontium carrier. The beta activity of Strontium-90 is determined with a gas flow proportional detector, immediately after removal of yttrium-90.

6.2.5.3 Gamma Spectrometry

Gamma spectrometry measures gamma radiation over a given spectrum and will be used to determine the gamma radiation levels in water and soil/sediment samples. Particular isotopes of interest that will be detected as gamma radiation are radium-226 (soil samples), bismuth-210 metastable, americium-241 (soil samples), cobalt-60, cesium-137, bismuth-207, polonium-210, and potassium-40. Analysis will be performed according to the instrument's spectroscopy application user's manual. Sample preparation and analysis procedures are provided in the laboratory SOPs. The quantitation limits listed on Table 6.1 are based on cesium-137 and assume no interfering lines. Quantitation limits of individual isotopes may vary. These methods are based on procedures outlined in HASL-300 (DOE 1982) and in USEPA method 901.1 (EPA 1980)

6.2.5.4 Tritium

Water and soil samples will be analyzed for tritium according to EPA Method 906.0 (EPA 1980) Beta emissions are detected using a liquid scintillation method with a fluorescence detector. A statement of work for preparation of soil samples for tritium analysis is provided in Appendix B.

7. CALIBRATION PROCEDURES AND FREQUENCY

Before any instrument is used as a measuring device, the instrument's response to known reference materials (traceable to an appropriate agency standard such as NIST, NBS, or ASTM) must be determined. The manner in which various instruments are calibrated is dependent upon the particular type of instrument and its intended use. All sample measurements are made within the calibrated range of the instrument. For laboratory analyses, appropriate sample dilution is performed if the instrument response is greater than the upper end of the calibration range.

7.1. FIELD EQUIPMENT

Applicable field instruments to be used during the investigation will be calibrated according to the specifications set forth in the respective Mound Plant ER Program SOPs (Appendix A). Instruments will be calibrated at least once per day during field use. Table 3.1 in Section 3 summarizes the calibration procedures, frequency of calibration and acceptance criteria necessary for the calibration to be valid for applicable field measurements and field screening.

Records for each field instrument used as part of this program will be maintained to ensure its capability of providing accurate and precise measurements. Records will be maintained on instrument maintenance and calibration. Such records will be reviewed prior to their use in the field. Tracking of instrument records will be accomplished by assigning a unique number to each instrument that will correspond to its records file.

The field measurement and field screening instruments that may be used in the field during the environmental investigation are presented in the following subsections.

7.1.1. Photoionization Detector (PID)

The HNu™ PID is a general survey instrument capable of detecting and measuring many organic and inorganic vapors in air. The instrument can be calibrated to a particular compound; however, it cannot distinguish between detectable compounds in a mixture of gases. The HNu has a sensitivity of approximately 0.1 parts per million (ppm) benzene. However, the instrument's sensitivity depends upon the compounds present and environmental factors such as moisture and temperature. Mound Plant ER Program SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector (included in Appendix A), provides details on the calibration frequency and procedures for the HNu PID.

7.1.2. Explosimeter/Combustible Gas Indicator (CGI)

Explosimeters, or combustible gas indicators (CGIs), are used to determine the potential for the combustion or explosion of unknown atmospheres. A typical CGI determines the level of organic vapors and other gases present in an atmosphere as a percentage of the lower explosive limit or lower flammability limit by measuring the change in electrical resistance in a Wheatstone bridge circuit. The CGI can reliably detect common combustible vapors such as methane, butane, and pentane. Some CGI models also contain an oxygen detector. The oxygen detector is useful for determining the existence of atmospheres deficient in oxygen. Mound Plant ER Program SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels (included in Appendix A), describes the details of the calibration frequency and procedures of CGIs.

7.1.3. Horiba Infrared Spectrometer

The field instrument will be calibrated using a 40 ppm heavy oil standard prepared in Flon-S-316. A second standard will be prepared by an individual other than the analyst to check the calibration. Both the calibration and the calibration check standard will be prepared fresh at least every week. A calibration check standard will be analyzed after every standard and 10 samples to verify continued instrument stability. A blank check will be performed after each calibration.

7.1.4. pH Meter

The Fisher Model No. 107 pH meter, or equivalent, is a portable pH monitoring instrument for determining pH in surface water, groundwater, and waste systems, and for other water quality applications. The calibration frequency and procedures are described in detail in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (included in Appendix A).

7.1.5 Flame Ionization Detector (FID)

The FID is a general survey instrument capable of detecting and measuring many organic vapors in air. The FID does not detect inorganic vapors. The instrument cannot distinguish individual compounds, but measures the total concentration of vapors. The FID sensitivity is approximately 0.1 ppm methane. Mound Plant ER Program SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector (included in Appendix A), provides details on the procedures for calibrating the FID.

7.2. LABORATORY EQUIPMENT

Laboratory instrument calibrations typically consist of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is commonly expressed as a correlation coefficient (e.g., UV-visible/infrared spectrophotometry) or by a response factor, amount/response (e.g., for GC, GC/MS, or high-performance liquid chromatography). Continuing calibration usually includes measurement of one or more calibration standards. The response is compared to the initial measured instrument response. Continuing calibration is performed at least once per operating shift for laboratory analyses.

Instrument calibration procedures for CLP analyses will be performed according to the CLP SOW for inorganic and organic analyses. For non-CLP analyses, calibration procedures will be performed as described in the approved analytical method and are described in the approved laboratory SOPs. Calibration procedures for all laboratory analyses, along with frequency and acceptance criteria, are summarized in Table 3.2 in Section 3. The following subsections discuss the calibration procedures for each type of instrumentation.

7.2.1. Infrared Analyses

At least a five point calibration curve with a correlation coefficient greater than or equal to 0.996 will be generated. The curve will include a standard at or near the reporting limit and a high standard which does not exceed the linear range of the instrument. The calibration curve will be verified daily and after every 20 samples using a mid-level standard. If the verification fails, a new calibration curve will be generated, and the previous 20 affected samples re-analyzed.

7.2.2. Gas Chromatography/Mass Spectrometry (GC/MS) VOC Analyses

Calibration of the GC/MS for volatile organic compounds is performed according to the method 8240 with a minimum of five concentrations of standard ranging from the method detection limit to no greater than the upper limit of the working range of the GC/MS. An internal standard of bromochloromethane, 1,4 - difluorobenzene, and chlorobenzene - d5 or similar compounds are injected into the calibration standards and samples. Response factors for the standards are calculated for each compound relative to one of the internal standards. Five compounds, referred to as System Performance Check Compounds (SPCCs), must

have a minimum average response factor as specified in method 8240. Relative standard deviations (RSDs) are calculated for six compounds, referred to as Calibration Check Compounds (CCCs), which must be less than 30 percent to consider the calibration to valid. Both the SPCCs and CCCs will include benzene, toluene, ethyl benzene, and xylene.

The GC/MS system must also meet tuning criteria established in method 8240 prior to analyses of samples. 4-Bromofluorobenzene is injected at 50 ng every 12 hour shift to demonstrate that the criteria are met.

A continuing calibration check standard at a midpoint concentration is analyzed once every 12 hours of analysis time. The SPCCs and CCCs must meet the criteria specified in method 8240 prior to sample analysis. The internal standard responses and retention times must also be evaluated during data acquisition. If the method-specified criteria for these checks are not met, then the corrective actions identified in the method are performed.

7.2.3 Total Kjeldahl Nitrogen/Total Phosphorous

At least a three point calibration curve will be determined with a correlation coefficient of greater than or equal to 0.995. The curve will be determined daily, and verified with a mid-range standard. The curve will be re-verified after every 20 samples. If a verification fails, a new calibration curve will be generated and the previous 10 samples re-analyzed.

7.2.4. Alpha Spectrometry

Alpha spectrometry will be used for measurement of isotopic plutonium, thorium, uranium, americium-241, and radium-226. A pulse check is performed once every day to determine if the detection system is functioning correctly. The background level is checked for gross contamination at a minimum of once per week with a 1000-minute count.

7.2.5. Gamma Spectrometry

For gamma spectrometry, the counting efficiency is verified once per day with a source check. A mixed standard consisting of selected radionuclides of interest is used with initial instrument setup and when necessary to perform an energy and efficiency calibration of the detection system. The background level is checked for contamination once per day with a 10-minute count. Background is established with a 1000-minute count performed once per month.

7.2.6. Liquid Scintillation

Liquid scintillation is used to measure beta particle activity from tritium. A source check is performed daily to verify calibration and efficiency. The background level is also checked daily.

8. INTERNAL QUALITY CONTROL CHECKS

Internal quality control checks are performed as part of an analysis to monitor and assess the quality of the data generated. Quality control checks are used to evaluate the accuracy and precision of field screening, field measurements, sampling technique, and laboratory analyses. Acceptance criteria for the quality control checks, and corrective actions to be taken if criteria are not met, have been established for this program so that data of known quality is obtained (Table 3.2). The following subsections summarize those internal quality control checks.

8.1. SCREENING AND FIELD MEASUREMENTS

Quality control procedures for screening and field measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings and by calibrating the instruments (when appropriate) with either internal references or external standards. The frequency of these checks and acceptance criteria are presented in Table 3.1.

8.2. FIELD SAMPLING

Field conditions and sampling techniques for water and soil can be assessed by the collection of trip blanks, sample bank blanks, equipment (rinsate) blanks, ambient blanks, and duplicate samples for selected laboratory analyses. Blank samples will not be labeled as such so that laboratory bias is minimized. The laboratory will be kept from using these samples for internal quality control by indicating which samples are to be used for internal quality control on the chain-of-custody record.

Trip, sample bank, ambient, and equipment blanks monitor environmental conditions or sampling techniques during sampling in order to detect potential sample contamination. Trip blanks monitor volatile organic contamination during sample transport and storage. Trip blanks are prepared in the laboratory by filling vials with organic-free deionized water (ASTM Type II quality), sealing the vials with no air bubbles, and transporting them to the site. These blanks remained unopened while stored with the collected samples (one set per sample cooler). Sample bank blanks monitor VOCs potentially present in the surrounding environment where samples are commonly handled before shipment. Sample bank blanks are prepared, after a given batch of samples are collected, with organic-free deionized water (ASTM Type II quality) in sample vials, capped with no air bubbles, and placed in the desired location during handling. Equipment blanks are used to evaluate the decontamination technique of sampling equipment that is not dedicated to a given sampling location. Equipment (rinsate) blanks are prepared by filling sample bottles with organic-

free, deionized water (ASTM Type II quality) that has been routed through a decontaminated sampling device. Trip blanks are collected at such a frequency that one set of sample vials accompanies each cooler that contains samples for volatile organic analysis. Equipment blanks are collected for every 10 or fewer samples collected in the field and will be analyzed for the same parameters as for those applicable samples collected. Those parameters include volatile, TPH, TKN, and TP.

Collection of duplicate samples can measure the precision of the sampling technique. A duplicate sample is collected for every sample group or every 10 water samples or fewer investigative samples and for every sample group or 10 soil samples or fewer collected in the field. A relative percent difference is calculated for the duplicate sample analysis as defined in section 3 and is used to evaluate sampling precision. Monitoring analytical precision is discussed in the following section, Laboratory Analyses. Acceptance criteria for precision of duplicate field samples has not been established. A high variation in soil sample results for the primary and duplicate sample is common due to the nonhomogeneous nature of soils; therefore, duplicate soil sample results will be assessed accordingly.

A bottle lot blank will be prepared if there is an indication from the analytical results that an analyte not documented by the manufacturer is a bottle contaminant. At least one bottle for each lot number of these analytes will be stored in the shipping box for this purpose. A bottle blank will be prepared by filling the sample bottle with organic-free, deionized water (ASTM Type II quality), and capping it.

8.3. LABORATORY ANALYSES

Internal quality control checks for the analyses are specified in the analytical method and in Table 3.2. Additional quality control checks for some analyses will be performed and are also summarized in Table 3.2. Frequency of the checks, acceptance criteria, and corrective actions (as presented in Table 3.2) are based on guidance in the analytical method and established laboratory control limits.

A definition of the internal quality checks for chemical and radiological laboratory analysis are presented below:

- Method Blank. The method blank is an artificial sample designed to monitor the introduction of artifacts into the analysis which could result from the sample preparation or analytical method. For aqueous sample analysis, reagent water is generally used as the matrix. For solid sample analysis, a purified solid matrix is used. The method blank is carried through the entire analytical scheme (extraction, concentration, and analysis). Method blanks will be performed for all applicable analyses at a frequency stated for the analytical method on Table 3.2.

- Method Spike/Blank Spike. A method spike is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The spike result of the sample provides information on how the method is performing.

- Matrix Spike. Predetermined quantities of specific analytes are added to a sample matrix prior to sample extraction or digestion. Percent recoveries are calculated for each analyte to assess the analytical accuracy. Matrix spikes monitor the effects of the sample matrix on the analytical results. One matrix spike for every 20 samples collected will be performed for all applicable analyses (volatile organics, total petroleum hydrocarbons, total nitrogen, and total phosphorus). The field sample to spike will be selected by field personnel and will not include a field blank sample (trip blank, or equipment blank). This will ensure that a Mound sample matrix with possible analyte detections will be spiked to obtain representative results of analytical accuracy.

- Matrix Spike Duplicate. A duplicate matrix spike of the same sample collected in the field will also be performed for every 20 samples collected. The matrix spike duplicate will assess the analytical and sampling precision by calculating a relative percent difference (as defined in Section 3) between the primary and duplicate spike recoveries. This sample will be a duplicate sample of the selected matrix spike.

- Surrogate Spike. Surrogate compounds are organic compounds similar to the analytes of interest in chemical composition and extraction and chromatographic properties, but are not normally found in environmental samples. These compounds are spiked into all field and laboratory samples (blanks, standards, and matrix spikes) for volatile organic analyses. Percent recoveries are calculated for each surrogate compound in each sample. These recoveries give an indication of the performance of the analytical method.

- Instrument Performance Check. GC/MS analyses require that the mass spectrometer be tuned prior to calibration and sample analysis. This is accomplished with analysis of a compound with similar properties but not commonly found in the environment.

- System Performance Check Compounds (SPCCs). SPCCs are specific compounds used to monitor the RRFs of the continuing calibration check compared to the initial calibration for GC/MS analysis of volatile organic compounds. A minimum RRF for each of the SPCCs must be achieved in order for the initial calibration to be valid.

- Calibration Check Compounds (CCCs). CCCs are specific compounds used to monitor the RRFs of the continuing calibration check compared to the initial calibration for GC/MS analysis of volatile and semivolatile organic compounds. A relative standard deviation of the RRF for each compound must be met in order for the initial calibration to be valid, defined in the method.

- Initial Calibration. An instrument is calibrated initially with a series of standards at predetermined concentrations to identify the response factor of the instrument over the given concentration range. This is usually performed for most instruments when there has been a change in instrument conditions or when the calibration check result is outside a defined acceptance criteria.

- Calibration Check. The initial instrument calibration is verified at regular intervals to account for potential instrument drift or other changes in instrument conditions. A standard with a concentration within the calibration range is usually analyzed after 10 sample analyses or a frequency defined in the applicable method. The standard result is compared to the initial calibration, and a percent difference or RPD is calculated. If the result is not within the

established acceptance criteria, then the analytical system is evaluated and recalibrated before continuing sample analysis.

- Retention Time Window. Retention times of target analytes for, GC/MS, analyses must be monitored for shifts during samples analysis. The allowed shift of retention time for a given analyte is the retention time window. Retention time windows are established according to the analytical method. Acceptance criteria are expressed as an established range (e.g., ±0.06 units). Shifts that occur outside the acceptance criteria indicate a change in the chromatographic system or an instrument problem and could lead to misidentifications unless corrective action is taken.

- Internal Standard. Internal standards are performed for volatile, GC/MS analyses and are used to ensure the system sensitivity and response are stable for every run. Internal standards consist of compounds that are similar in analytical behavior to the analytes and are added to the calibration standards. Response factors of these standards are used to quantitate sample results. Criteria for internal standard responses and retention times are defined in the method.

- Performance Evaluation Sample. This check is a sample prepared externally to the laboratory to assess the ability of the laboratory to accurately perform the analysis. The sample is prepared with known concentrations of analytes of interest.

- Background Check. A background check is performed for liquid scintillation analysis at a given count time and frequency to determine if the instrumentation is contaminated above a maximum acceptable level. For tritium analysis, the background check is performed once per day prior to sample analysis. The maximum acceptance level for system contamination is 3 standard deviations. If this limit has been exceeded, the problem is identified and corrected prior to sample analysis. For alpha and gamma spectrometry, background is established once per month using a longer count time, in addition to a daily background check with a short count time, such as 10 minutes.

- Source Check. A source check is a check of the counting efficiency of the detector. The check determines the reproducibility. The check is performed once per day for liquid scintillation, for tritium analysis, and for gamma spectrometry.

- Pulse Check. The pulse check is performed once per day on the alpha spectrometer to check count reproducibility. Peak counts at 5 meV must be within 3 standard deviations.

9. DATA REDUCTION, VALIDATION, AND REPORTING

9.1. FIELD AND TECHNICAL DATA

The field and technical (non-laboratory) data that will be collected during the project at Mound Plant can generally be characterized as either objective or subjective data. Objective data include all direct measurements such as field screening/analytical parameters. Subjective data include descriptions and observations.

9.1.1. Field and Technical Data Reduction

For field measurement data which require calculations to obtain final concentrations/values (e.g., alkalinity), equations used and the calculations performed will be recorded in the appropriate field log. The equations used for measurement data are provided in the respective Mound Plant ER Program SOPs in Appendix A. All calculations will be checked at least once by the field team member performing the field measurement.

Occasionally a field measurement will result in an outlier with a value significantly outside the expected range for most field conditions (e.g., a zero reading for specific conductance). Attempts will be made by the experience of the field team to identify outliers during the field measurement. All health and safety screening measurements will be considered. When identified at this time, the outlier will be recorded as would any other field measurement, and at least two additional measurements will be made and recorded to verify or invalidate the suspected outlier. When appropriate, field instrumentation and calibration will be checked, and the parameter remeasured when an outlier is discovered. If after this check the value remains the same, it is considered a valid measurement.

9.1.2. Field and Technical Data Validation

Review of objective field and technical data integrity will be performed at two different levels. On the first level, field personnel at the time of collection will check to ensure that standard operating procedures are followed, all data are recorded, and quality control checks are performed and all forms and notebooks are signed and dated on the day recorded. At the second level, data will be reviewed by a technical peer not involved with the data collection, who will check to ensure that all data are recorded and reported correctly, including calculations and sample collection information. Ten percent of all calculations will be checked. Any inconsistencies or anomalies discovered will be resolved immediately, if possible, by seeking clarification from the field personnel responsible for collecting the data.

Subjective field and technical data will also be reviewed for reasonableness and completeness by the site manager. In addition, random checks of sampling and field conditions will be made by the field supervisor, who will check recorded data at that time to confirm the recorded observations. Whenever possible, peer review also will be incorporated into the data review process, particularly for subjective data, to maximize consistency among field personnel. For example, during drilling activities, the field manager will schedule periodic reviews of archived lithologic samples to ensure that the appropriate descriptions and codes are being consistently applied by all field personnel.

After the validity of data in the field notes and on ER Program forms has been evaluated according to the procedures described above, the data administrator will tabulate the data, wherever possible, by entering the data in computer data files. All data hand-entered into computer files will be checked 100 percent by another individual. Where appropriate, the data files will be set up for direct input into the project database. Subjective data will be filed as hard copies for later review by the site manager and for incorporation into technical reports, as appropriate.

9.1.3. Field and Technical Data Reporting

All field data will be recorded by field personnel in bound field notebooks on ER Program forms (for specific measurements). For example, during drilling activities, the field team member supervising a rig will keep a chronological log of drilling activities, a vertical descriptive log of lithologies encountered, other pertinent drilling information (staining, odors, field screening, working conditions, water levels, geotechnical data), and a labor and materials accounting in the team member's bound notebook. It will be the responsibility of all field personnel to photocopy all field logs (including notebook pages and ER Program forms) generated during a given field day, at the end of that day. Copies will be given to the site manager or field supervisor, who will maintain field log files. At the completion of a work shift, copies of all field logs, notebook pages, and ER Program forms will be returned to the EG&G subcontractor's office. These copies will be presented to the ER Program site manager and entered into the project file. Entries will be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. All records of numerical analyses performed on field and technical data will be legible, reproduction quality, and complete enough to permit logical reconstruction by a qualified individual other than the originator. At the completion of a field program, field logbooks will be returned to the project files. All field records will be kept on file by EG&G for a minimum of 10 years. EPA Region V and the EG&G will be notified prior to any intent to dispose of project files.

Field notebook entries will include, on the inside cover and first pages, the following information:

- Name.
- Company name and address.
- Phone number.
- Activity or location.
- Phone numbers for supervisors, emergency response, etc..
- Table of contents.
- The procedures (SOPs) used or followed for each field activity.

Daily entries will include the following information:

- Date and time.
- Name of individual making the entry.
- Description of test/activity.
- Quantities of materials used.
- Drawings and information related to the activity.
- Conditions that might adversely affect the test/activity.
- Names of witnesses or observers present.
- Samples collected, received, or released.
- Deviations from the procedures (SOPs) used or followed.
- Data that are not recorded on the ER Program forms or are not recorded by automatic methods.
- Calculations performed.
- Deviations from procedures, plans, or protocols used.
- Date and reason for downtime or delays.
- Visitors.
- Weather condition.

All entries will be made using a regular or ballpoint pen with indelible black ink. Corrections to entries will be made by crossing out the error with one line, dating and initialing the error, and entering the correction above or beside the error. Each page entered on in the notebook will be signed and dated by the individual.

Once an entry has been signed and dated, changes, deletions, or additions are made only as a entry and refer back to the original entry rather than crossing it out. A new page in the field notebook is started when the previous page is full or when the previous page has been marked, dated, and signed so that no entries can be made. Pages are not removed from the bound notebook.

9.2. LABORATORY DATA

9.2.1. Laboratory Data Reduction

The computation of analytical results from the raw data generated is performed as prescribed in the various analytical methods. The step-by-step calculations are provided in the referenced analytical method. Data reduction procedures unique to the EG&G approved laboratories are specified in the laboratory specifications attachments in the OU-9 QAPP. Sample results will not be corrected for method blank results.

Laboratory data is stored separately for each project by the laboratory. Included in the file are calibration records, raw analytical data, processing of data, data validation, quality control samples results, data reports, and project-specific requirements. These records are kept for a minimum of 10 years. The EG&G subcontractor and EPA Region V will be notified of intent to dispose of Mound Plant data.

The laboratory limits access to laboratory data files and the laboratory's electronic database. Only laboratory personnel as designated in their position description are allowed to access the files and the database. The database will be accessed by individual password only. Each individual will be limited to areas in the database which relate directly to their positional responsibilities.

9.2.2. Laboratory Data Validation

9.2.2.1. Chemical and Radiological Data

Data validation procedures performed in the laboratory are described in the laboratory specifications attachments of the OU-9 QAPP.

In addition to the data review performed by the appropriate laboratory, the data will either be reviewed or validated per Table 9.1. Data validation will be performed by an organization external to the one that generated the data. The EG&G Mound subcontractor is responsible for coordinating the data review or data validation of laboratory analytical data.

Table 9.1 Data Review/Validation Table

Analysis/Method	Data Use	Type of Verification
VOC - SW8240	Field Measurement Verification	Data Review
TPH - E418.1	Field Measurement Verification	Data Review
Radionuclides	Determination of Need for Mixed Waste Treatment Pad	Data Review
Physical Testing	Specification Compliance	Data Review
VOC - SW8240	Closure Verification	Data Validation
TPH - E418.1	Closure Verification	Data Validation
TKN - E351.3	Treatment Monitoring	Data Review
Total Phosphorus - E365	Treatment Monitoring	Data Review
VOC - SW8240	Treatment Pad Closure	Data Validation
TPH - 418.1	Treatment Pad Closure	Data Validation

Data Generated for Field Measurement Verification and Treatment Monitoring

Data generated for verifying field measurements, for deciding whether a treatment pad for mixed waste is required, and for monitoring soil treatment have been identified for a review. The review will evaluate:

- Data package completeness
- Quality control check performance (blank spikes, matrix spikes, surrogates, etc.), and
- General contract compliance.

If during data review, deficiencies sufficient to impact the intended use of the data are identified, the data will either be rejected or submitted for complete data validation. A summary review report will be submitted to file with the data.

Data Generated for Soil Characterization (Physical Testing)

Physical testing data are used to verify soil meets construction specification. Physical testing data review will evaluate:

- Data package completeness.
- General contract compliance.

Data Generated for Closure of Excavated Pits and Treatment Pads

Data generated for closure have been identified for a complete data validation. The validation procedure includes a review of the following components:

- Completeness of data package.
- Sample hold times.
- Performance of calibration (initial and continuing) (criteria per Table 3.2).
- Laboratory control samples, MS/MSDs, replicates method blanks, surrogates, and other QC checks specified in Table 3.2. (criteria per Tables 3.2 and 3.3).
- Correct identification of analyte.
- 10 percent check on calculations performed (100 percent if error found).
- Contamination of field blanks.
- Evaluation of field duplicates against criteria in Table 3.2.

Appendix D provides a detailed summary of the guidelines for data validation of these results. The summary is based on EPA CLP validation procedures ("Laboratory Data Validation - Functional Guidelines for Evaluation of Organic Analyses, February 1, 1988," prepared by the EPA Data Review Work Group, latest revision).

Data Validation Qualifiers

The following qualifiers will be applied to validated data, in accordance with CLP Functional Guidelines and may also be applied to non-CLP analyses:

U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present).

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

Data Assessment

The data validation program also includes an overall assessment of data. An assessment is performed to evaluate the usability of the qualified data from data validation. As defined in the completeness equation on Table 3.4, valid data is defined as sample results determined usable. The QAM or his/her designee will perform an assessment of all data qualified from data validation. The assessor will have a working knowledge of the project data quality objectives and intended data use. The results of the assessment will be summarized and submitted to the project manager.

Results of data validation give an indication of potential error in numerical results if QC checks are outside acceptance criteria. The impact of the error on the data use is evaluated prior to using the data. All sample results in laboratory batches with quality control checks not meeting the required acceptance criteria (defined in Section 3 and in the USEPA functional guidelines) will be assessed for potential bias. The impact of the amount of bias will be evaluated against the cleanup criteria.

The decision tree used for assessing data usability will vary depending on the intended data use. However, every data assessment performed will summarize the assessment results and the basis used for rejecting any data beyond what data validators reject. Qualified data which indicate a bias that causes the sample result to be potentially near or above the action level, or leads to inconclusive results for other data uses, will be unusable for the particular data use.

9.2.3. Laboratory Data Reporting

9.2.3.1 Chemical and Radiological Data Reporting

Laboratory data reporting will be provided on electronic media (as ASCII files of a specified format) and in hard copy data reports. All data report packages (i.e., hard copy results and supporting data) received from the laboratory will be single copy, legible, paginated, reproducible, and unbound. Complete packages are shipped only with the electronic data deliverable. Only data report packages containing all results for a given

field batch will be shipped. Laboratory batches cannot be any greater in size than the identified field batch.

The data report packages are reviewed by another individual in the laboratory other than the preparer for the completeness requirements specified in this section. At least one identical copy of the data package must be kept in the project files at the laboratory.

Contents of Data Reports

Laboratory data reports will contain sufficient data to verify each aspect of the analysis, including sample preparation, instrument calibration, sample analysis, and calculation of the final result. All laboratory data report packages for each type of analysis will contain a case narrative that summarizes the following information on the given set of samples analyzed:

- Date of issue.
- The laboratory analysis performed.
- Any deviations from the stated analytical method.
- The laboratory batch number.
- The laboratory SOP number and revision date.
- Example calculation.
- The number of samples and the sample matrices.
- A reference to the quality control procedures performed for the specific methods used, including the reference to the acceptance criteria used.
- The contents of the laboratory report.
- The project name and number.
- The state of the sample received (e.g., whether preserved and packaged properly).
- Whether sample holding times were met and identification of those samples for which they were not met.
- Any observations that may have had an impact on the analyses.
- Any technical problems affecting the analysis and corrective actions taken.
- Laboratory quality control checks that did not meet the project criteria (as specified in the QAPP) and/or laboratory criteria (include any corrective actions taken and any known possible reasons for the results).

- The laboratory manager's signature approving the issuance of the data package.

A copy of the chain-of-custody form with all relinquished signatures will accompany each data package.

The following summarizes the contents of hard copy laboratory data report packages for each group of analyses. The laboratory-established quantitation limits, other than CLP analysis, will be reported in the packages.

- **Reports covering total petroleum hydrocarbons analyses** will at a minimum consist of the following:
  - Detailed table of contents.
  - A case narrative for each laboratory batch of samples analyzed.
  - A summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control checks.
  - A cross reference of laboratory sample identification numbers to the project sample identification numbers.
  - A description of all data qualifiers used in the laboratory report.
  - A record of sample extraction of all samples and laboratory quality control checks.
  - Instrument settings.
  - Applicable instrument run logs containing the analytical sequence with date and time.
  - Tabulated sample results.
  - Established retention time windows.
  - Tabulated results of matrix spikes, matrix spike duplicates, method blank, initial calibration, and continuing calibration checks.
  - Labeled and dated spectra of sample results, matrix spikes, MSDs, the method blank, and continuing calibration checks.
- **Reports covering analysis of total nitrogen, total phosphorus, and physical soil parameters** will contain, at a minimum, the following where applicable
  - Detailed table of contents.
  - A case narrative for each laboratory batch of samples analyzed.
  - A summary page stating the analysis dates for field samples and reported laboratory quality control checks (those listed on Table 3.2 for these analyses).
  - A cross reference of laboratory sample identification numbers to the project sample identification numbers.
  - A description of all data qualifiers used in the laboratory report.

- A record of sample preparation for all field samples and laboratory quality control samples.
- Instrument settings.
- Applicable instrument run logs containing the analytical sequence with date and time.
- Tabulated sample results.
- Raw data for each sample result and laboratory quality control sample results.
- Results of initial calibration and calibration checks (including date).
- Tabulated results of matrix spikes, MSDs, laboratory replicates, laboratory control samples, and the method blank.

- **Reports covering radiochemical analyses** will consist of the following elements:
  - Detailed table of contents.
  - A case narrative for each laboratory batch of samples analyzed.
  - A cross reference of laboratory sample identification numbers to the project sample identification numbers.
  - A summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control checks.
  - A description of all data qualifiers used in the laboratory report.
  - A record of sample preparation for all field samples and laboratory quality control.
  - Instrument calibration results (date, time, technician).
  - Minimum detectable activity for each sample result and QC result.
  - Results for standards, including instrument blanks and calibration standards.
  - Labeled and dated raw data for all sample results and laboratory quality control checks, including counting time and number of disintegrations per sample.
  - Calculated activity, per unit mass or liquid volume, with the following associated statistics.
  - Relative counting error at the 95% confidence level.
  - Lower detection limit.
  - Normalized deviation for method spikes and matrix spikes.

- **Reports covering volatile organic compounds** (method SW8240) will consist, at a minimum, of the following items where applicable:
  - Detailed table of contents.

- A case narrative for each laboratory batch of samples analyzed.
- A cross reference of laboratory sample identification numbers to the project sample identification numbers.
- A description of data qualifiers used in the laboratory report.
- A summary page stating the extraction and analysis dates for each field sample and reported laboratory quality control check (those listed on Table 3.2 for those analyses).
- Instrument settings.
- Applicable instrument run logs containing the analytical sequence with date and time.
- Tabulated sample results for all respective compounds listed on Table 6.1.
- Tabulated results of matrix spikes, matrix spike duplicates, method blank, initial calibration, continuing calibration checks, replicate samples, laboratory control sample, calibration check compounds, and system performance check compounds.
- Established retention time windows.
- Labeled and dated chromatograms and spectra of sample results and the laboratory quality control checks listed above.

Specifications to the above listed contents for all data packages include the following:

- Tabulated results will also include sample ID with corresponding laboratory ID, the analyte of interest with units and actual limit of quantitation, date of sampling, date of sample preparation/extraction/digestion, date of analysis, sample weight/volume, moisture content (where applicable), dilution factor, sample matrix, and instrument ID (including chromatographic column serial number, dimension, and packing/coating, where applicable).
- All laboratory QC results which are required to be reported will be tabulated similar to sample results, where applicable.
- Initial calibration results will include a summary of the standards analyzed, date and time analysis, instrument id, the mean/average calibration or response factor, standard deviation and acceptance criteria, and raw data (e.g., chromatogram, strip chart, etc.).
- Continuing calibration will include a summary of the standards analyzed, date and time of analysis, instrument ID, a comparison of the standards to the initial calibration, and a calculation of the percent difference from the initial calibration.
- Raw data in the form of instrument printouts, strip charts recordings, chromatograms, etc. will be labelled with the applicable sample ID, date, time of analysis, and instrument conditions.
- An example calculation of one of the sample results illustrating how the actual sample result was obtained will be supplied with each data package. All factors of the equations provided must be accounted for.

Electronic data deliverables (EDDs) are prepared for all radiological and chemical data. The EDD for results

will be delivered along with the data packages in the required format as described in Appendix C of the OU-9 QAPP. The EDD will not be considered complete until it can be successfully loaded in the EG&G subcontractor database management system.

Laboratory Data Qualifiers

The following qualifiers will be applied to the organic analysis results by the laboratory:

- U - Indicates compound was analyzed for but not detected. The associated sample quantitation limit will be the CRQL, corrected for dilution and for percent moisture.
- J - Indicates an estimated value. This flag is used under the following circumstances: 1) when estimating a concentration for tentatively identified compounds (TICs) assuming a 1:1 response, 2) when the qualitative data indicated the presence of a compound that meets the volatile, semivolatile, and pesticide/Aroclor identification criteria, and the result is less than the CRQL but greater than zero.
- N - Indicates presumptive evidence of a compound. This flag is used only for tentatively identified compounds, where identification is based on a mass spectral library search.
- B - Used when the analyte is found in the associated blank as well as in the sample. This flag must be used for a TIC as well as for a positively identified target compound.
- E - Identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
- D - Identifies all compounds identified in an analysis at a secondary dilution factor.
- A - Indicates that a TIC is a suspected aldol-condensation product.

The following qualifiers will be applied to the inorganic analysis results by the laboratory:

- B - Indicates that the reported value was obtained from a reading that was less than the CRDL but greater than or equal to the Instrument Detection Limit (IDL).
- U - Indicates that the analyte was analyzed for but not detected.
- E - Indicates the reported value is estimated because of the presence of interferences.
- M - Duplicate injection precision was not met.
- N - Spiked sample recovery not within control limits.
- * - Duplicate analysis not within control limits.

Approval by the EG&G subcontractor is required for any additional data qualifiers used by the laboratory, other than those defined above, prior to submitting hardcopy data packages.

Format of Data Reports

The data report package will be organized by the laboratory into the following sections and paginated. Each section and subsection will be separated by a colored divider sheet.

Section I
- Title and Table of Contents
- Certificate of Analysis
- Case Narrative
- Summary of Quality Control
- Summary of Sample Results
- Summary of Analysis and Preparation Dates
- Cross reference of Sample Ids to Laboratory IDs
- Example Calculation

Section II
- Analytical Results
- Raw Data (behind each result)

Section III
- Standards Data
- Initial and Continuing Calibration
- Retention Time Windows
- Instrument Calibration/Tuning
- Raw Data (behind each result)

Section IV
- Quality Control Results
- Raw Data (behind each result)
- Sample Preparation/Extraction/Digestion Logs
- Moisture Determination Results and Raw Data

Section V
- Instrument Run Log
- Chain-of-Custody
- Copy of Telephone Logs

10. PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be conducted as a systematic check to determine the quality of operation and to monitor the capability and performance of the total measurement system. A performance audit independently collects measurement data using performance evaluation samples. Performance audits are quantitative in nature. A system audit consists of a review of the total data production process and includes on-site reviews of a field and laboratory's operational systems and physical facilities for sampling, calibration, and measurement protocols. System audits are qualitative in nature.

Formal audits include pre-contract evaluation of subcontracted activity, internal audits of ongoing and completed activities and external audits of subcontracted activities. In addition, limited scope audits may be carried out at any time of procedure use by observation. Internal audits will be conducted by the EG&G subcontractor's QAO or designee.

The QAO is responsible for the audit process, concerns on the audit report, and coordinates with the corporate QAO who is responsible for auditor and lead auditor certification. Auditors shall have knowledge of QA program elements and project documents supplying the QA-related requirements for activities audited, including the QAPP, the FSP, and related SOPs. The QAO shall have corporate lead auditor certification. Certification shall be consistent with NQA-1 requirements for auditor/lead auditor certification and include auditor training. Technical Specialists may be audit team members to audit/peer review technical aspects of the work. They shall have the same training as any other audit team member. Audit format shall include audit opening and closeout meetings. The audit report shall be issued within 20 calendar days of the closeout meeting.

External audits may be performed by EPA Region V, the Region V Central Regional Laboratory, and/or the Region V Central District Office.

10.1. FIELD AUDITS

The EG&G subcontractor's QAO or the designated auditor will perform at least one internal field audit during Phase II and III of the removal action. This audit will be scheduled and executed as part of work on the project. Field sampling and associated activities will be audited at least once. The purpose of field performance audits is to ensure that the methods and protocols detailed in this QAPP and SOPs are being consistently adhered to in the field.

The field audit will be performed using an audit checklist of a format presented in Figure 10.1. The field audit will include a review of the following activities:

- Soil sampling procedures.
- Field measurement procedures.
- Field logbook documentation.
- Sample labeling, handling, and custody procedures.
- Completion of ER Program field forms.
- The number and type of quality control samples collected.
- Construction procedures.

These activities will be reviewed for their adherence to the procedures established in the Work Plan, SAP, Mound Plant ER Program SOPs, and the QAPP. Audit questions will be developed by the QAO. These checklists are used to ensure completeness of the review and to document the results of the audit.

As part of the field audit, field operation records will be reviewed to verify that field-related activities were performed in accordance with appropriate project procedures. Items reviewed will include, but are not limited to, field equipment calibration records, daily field logs, and chain-of-custody documentation. Upon audit completion, an audit report containing observations and any findings and associated corrective actions will be submitted to the ER Program EG&G installation coordinator, ER Program subcontractor project manager, and site manager. These reports will be delivered to EPA upon their request.

SAMPLE AUDIT CHECKLIST

FACILITY	AUDITOR(S)	DATE

ACTIVITY/REQUIREMENT	AUDIT QUESTIONS	ANSWER			AUDITOR COMMENTS
		Yes	No	N/A	

Figure 10.1 Sample Audit Checklist form

10.2. LABORATORY AUDITS

10.2.1. Laboratory System Audits

An audit of the analytical laboratories will be performed by the ER Program EG&G subcontractor QAO or designee prior to the implementation of the project. The system audit will consist of review of the laboratory quality assurance manual; the instrumentation and/or analytical system developed for the analyses of interest; sample preparation methodologies; laboratory sample handling, log-in, and custody procedures; data reduction and reporting procedures; data validation procedures; instrument calibration procedures; the quality control program developed for the methods; and other laboratory procedures that may impact the laboratory analyses to be performed for this investigation. Results of laboratory systems audits including the checklist and reports to the laboratory will be distributed to EG&G Mound and DOE, and US EPA upon their request. For this project, laboratories audited and currently approved for the OU-9 RI/FS Program by EG&G will be used and a system audit specific to this project will not be performed.

An on-site audit of the analytical laboratories may be performed as determined necessary (e.g., recurring nonconformances which impact data quality) during this project by the ER Program EG&G subcontractor QAO or designee. The audit will evaluate at a minimum the laboratories' performance on the following activities specific to the investigation:

- Implementation and follow-through of the laboratory quality control program established for this investigation as defined in the QAPP,
- Sample custody and handling procedures,
- Analytical methods followed as defined in the QAPP,
- Sample tracking.
- Data reduction.
- Data validation.
- Instrument calibration.
- Sample preparation.
- Documentation of data analysis/data reduction.

The EPA Region V Central Regional Laboratory may perform external system audits of the laboratories, as necessary, for this project. This audit may include an on-site visit to the laboratories.

10.2.2 Laboratory Performance Audits

The analytical laboratory will participate in one or more of the following, as pertinent:

- USEPA CLP round robin program (laboratories performing chemical analyses).
- USEPA RAD Intercompanies Program Studies (laboratories performing radiological analyses).
- U.S. DOE Environmental Measurements Laboratory Quality Assurance Program (laboratories performing radiological analyses).
- Or a comparable cross check program.

The results of the EPA cross-check program are evaluated by the EPA, and the results are published as part of the public record. The DOE Environmental Measurement Laboratory performance samples will be reviewed by the DOE or their subcontractor to ensure acceptable laboratory performance.

The laboratory quality assurance coordinator has responsibility for monitoring the internal quality assurance program. The quality assurance coordinator is responsible for scheduling, coordinating, and conducting internal performance audits and for reviewing data for performance samples received. The quality assurance officer supplies blind performance samples to the laboratory at least semiannually.

External performance audits of the laboratories may also be conducted by the EPA Region V Central Regional Laboratory as necessary. This audit may include an on-site visit to the laboratories.

10.2.3. Laboratory Monitoring

In addition to the formal auditing procedures above, laboratories conducting analyses on samples collected at the Mound Plant will be routinely monitored by the EG&G subcontractor. The following monitoring activities will be performed:

1) The topics of daily communication with the laboratory will be established prior to receipt of samples. The primary points of contact within the laboratory and the EG&G subcontracting firm will be identified. Daily communication during field sampling and routine communication with the laboratory contact during sample analysis will, at a minimum, include:

Sample receipt
Status of sample analysis
Nonconformances
Data reporting
Other anomalies in program

Results of the above will be submitted to the EG&G subcontractor by the laboratory as a laboratory monthly progress report.

2) The laboratory will supply the primary contact a controlled copy of SOPs, including all updates. SOPs will be reviewed by the EG&G subcontractor as they are updated to ensure laboratory procedures do not conflict with program requirements.

3) Project opening meetings with the laboratory will be conducted prior to field sampling by the EG&G subcontractor to discuss: 1) project requirements, 2) communications, 3) sample shipment, 4) implementation of the QAPP, 5) data reporting, and 6) documentation of nonconformances to the QAPP.

4) Hard copy data packages are reviewed by the EG&G subcontractor for completeness within one month of receipt.

11. PREVENTIVE MAINTENANCE

Proper preventive maintenance of field and laboratory equipment is a necessary element in achieving equipment reliability and minimizing equipment downtime.

11.1. FIELD EQUIPMENT

Field equipment will be properly calibrated, properly charged, and in good general working condition before the beginning of each working day. The required equipment checks and their frequency for each type of field equipment to be used are defined in Mound Plant ER Program SOPs 6.1, Health and Safety Monitoring of Combustible Gas Levels; 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector; 6.4, Total Alpha Surface Contamination Measurements; and 6.7, Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER (all included in Appendix A). Table 3.1 in Section 3 summarizes the checks to be performed during the FFTA investigation. Any nonoperational field equipment will be removed from service, tagged, segregated, and dispositioned. As required, equipment will be returned to the manufacturer or to instrument stores. Replacement will be obtained as needed. Repairs will only be made by trained staff. Field equipment will not be repaired in the field. Maintenance records will be maintained for each field instrument according to a unique number affixed to the instrument. These records will be reviewed prior to their use in the field to ensure that instrument maintenance and calibration are up-to-date.

All field instruments will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed to maintain its operating integrity during variable temperature ranges that are representative of ranges that will be encountered during cold-weather working conditions. At the end of each working day, all field equipment will be taken out of the field and placed in a cool, dry room for overnight storage.

All subcontractor equipment (e.g., drill rigs and water trucks) will arrive at the site in proper working condition each day. Before the start of work each day, the field supervisor or field health and safety officer will assess all equipment for fluid leaks. If a leak is detected, the equipment will be removed from service

for repair or replacement. If the equipment belongs to a subcontractor, the subcontractor representative shall be included in the assessment.

11.2. LABORATORY EQUIPMENT

The ability to generate valid analytical data requires that all analytical instrumentation be properly maintained. All analytical laboratories used for the project program will have a full service contract or an equivalent maintenance program on all major instruments. Specific preventive maintenance programs for each laboratory are presented in the laboratory specifications attachments in the OU-9.

12. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The procedures to assess precision, accuracy, and completeness are presented in Section 3. Equations are used to calculate data, and acceptance criteria are used to assess precision, accuracy, and completeness of data results (Subsections 3.1.1, 3.1.3, 3.2.2, and Tables 3.1 through 3.4). Accuracy, precision, and completeness are defined in subsections 3.1.1, 3.2.1, and 3.3, respectively.

The precision and accuracy requirements for analyses are given in Tables 3.2 and 3.3. All analytical data are reviewed relative to those criteria. The results of quality control checks outside the acceptance criteria will be assessed by the EG&G subcontractor for data usability. The acceptance criteria for field quality control checks do not take into account the interdependencies of the checks. Since many of the quality control checks are interrelated (e.g., both a method blank and a trip blank could have contaminants), each batch of analytical data will be assessed on a case-by-case basis. Field blank results associated with soil/sediment data will be used only to provide information on the potential for contamination to exist in the soil/sediment samples and will not be used for quantitative purposes.

The laboratory will review the results of laboratory quality control checks listed on Table 3.2. If the results are outside the acceptance criteria, then the identified corrective actions will be performed.

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. The analyst will verify that all quality control procedures are followed and that results of analysis of quality control samples are within acceptance criteria. If acceptance criteria limits are exceeded, appropriate corrective actions will be taken and out-of-control situations will be described in the analytical report case narrative.

13. CORRECTIVE ACTION PROTOCOLS

13.1. INTERNAL CORRECTIVE ACTIONS

Internal corrective actions may arise:

- As the result of audit activities.
- As the result of any staff member discovering a deficiency in a past activity.
- As deficiencies that are discovered and corrected at the time of occurrence.

Examples of corrective actions are given in Table 13.1. How the corrective action is reported and documented is determined by the time of discovery and whether the immediate corrective action is possible.

13.1.1. Corrective Actions Resulting from Audits

The audit team leader is responsible for the audit report. The project QAO and audit team shall sign a formal report of all audit proceedings. The programmatic impact of a negative finding, such as the lack of or failure to use an appropriate procedure, will be determined by the project QAO and audit team. A negative response will be issued as a formal corrective action request and transmitted to the site manager and project manager. A corrective action plan and schedule will be requested, and the project manager will be responsible for ensuring that action to correct the deficiency is developed and initiated, and any special expertise is made available. The project manager will also be responsible for implementing the corrective action and ensuring that no additional work, dependent on the activity, is performed until the deficiency is corrected. Corrective action may include reanalyzing the samples (if holding time permits), resampling, and evaluating and amending the sampling and analytical procedures.

The project manager will approve the corrective action and will be responsible for ensuring that the corrective action adequately addresses the deficiency. The project QAO or designee will ensure that corrective actions for deficiencies are implemented by:

- Evaluating all reported deficiencies.
- Controlling additional work on the related activity.
- Maintaining the log of CARs.
- Ensuring CARs are included in the site documentation files.

The QAO or lead auditor are responsible for verifying completion of corrective action. If the corrective action is incomplete, further action will be required. This activity will be documented at the completion of the verification of the corrective action. The corrective action shall be closed and the appropriate management notified.

13.1.2. Corrective Actions Resulting from a Past Activity

The discoverer notifies the operable unit manager or the field manager for any immediate actions. The site health and safety officer is to be immediately notified if any health and safety impacts are suspected. The discoverer of the situation contacts the QAM and site manager who originates a formal Corrective Action Report (Figure 13.1).

13.1.3. Corrective Actions Resulting from an Activity at the Time of Occurrence

The deficiency is fully documented in field notebooks. The field manager is to be notified to determine any additional impact or further actions.

13.2. LABORATORY CORRECTIVE ACTION

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. In this pursuit, the analyst will verify that all standard operating procedures and quality control procedures are followed and that the results of analysis of quality control samples are within acceptance criteria.

If his assessment reveals that any of the quality control acceptance criteria are not met, he or she must immediately assess the analytical system to correct the problem. The deficiency is reported to the appropriate supervisor, who will complete and sign a nonconformance memorandum form and notify the Quality Control Coordinator. Written laboratory nonconformances are reported to the Quality Assurance Director monthly.

Figure 13.1. Corrective Action Report

Page__of__

MOUND PLANT ER PROGRAM
CORRECTIVE ACTION REPORT

[1]Responsible Organization	[2]Date	[3]☐ QF No.___	[4]Work Order No. ____-____-
[5]Identified During	[6]Persons Contacted	[7]Manager	Notified/Date

[8]Requirement

[9]Finding/Condition Adverse to Quality

[10a]Significant Condition Adverse to Quality ☐ Yes ☐ No	[10b]Hardware Related ☐ Yes ☐ No Tags applied ☐ Yes ☐ No

[11]Issue Date

[12]Initiator Date	[13]Validation Date	[14]QA Manager Date

[15]Impact On In-Process or Completed Work

[16]Root Cause of the Adverse Condition

[17]Remedial Correction Action

Committed Completion Date:

[18]Corrective Action to Prevent Recurrence

Committed Completion Date:

[19]Response Prepared By Signature: Date:	[20]Project Manager Approval Signature: Date:
[21]Response Evaluation ☐ Accept ☐ Reject Comment _____	[22] QA Manager _____ Date_____ QA Officer _____ Date_____
[23]Verification of Correction Action ☐ Accept ☐ Reject Comment _____	[24] QA Manager _____ Date_____
[25]Closure QA Manager _____ Date _____	[26] QA Officer _____ Date _____

[27]
Tending Codes: _____

Table 13.1. Corrective Actions to Specific Field Activities

Problem	Corrective Action
Broken sample bottle	Notify laboratory to determine if enough sample volume, with correct preservation and bottle type, is available from other bottles collected for the location. If not, then resample the location. If a well and breakage occurs within 4 hours of collection resample well. If after 4 hours from collection, repurge and resample the well.
Incorrect parameters requested	Notify field manager and laboratory and correct.
Samples collected in wrong bottle bottle or incorrect preservation	Notify field manager and laboratory. Resample the location for the parameters which were sampled incorrectly.
Discrepancy in or incomplete chain-of-custody form	Document the discrepancy. Notify the field manager and laboratory.
Missing ER Program field form	Take available information from field log and transcribe to the form. Note on form the missing data and attach memo documenting the missing information.
Incorrect sample packing	Laboratory will notify the contact in the EG&G subcontractoring firm. Field manager will be notified.
Missing information or incorrect information in field log book.	Responsible field personnel will make correction on the current page of the logbook and will refer to the page with incorrect or missing information.
Incorrect format used in field logbook	Note in logbook at which point it was discovered. Begin using correct format.
Required quality control sample not collected in a given day	Notify field manager. Collect additional quality control sample. If a trip blank is not collected where required, assess impact on associated samples results.

Table 13.1. (continued)

Problem	Corrective Action
Misidentified sample location	Notify field manager. Contact laboratory and have them not analyze samples. Sample the correct location.
Field instruments and equipment not decontaminated according to the Mound ER Program SOPs	Remeasure parameter or perform the activity again with a properly decontaminated instrument or equipment.
No or incomplete decontamination between samples collected during drilling.	Responsible field personnel will note in logbook if discovered during the activity and will correct. The QAM will include nonconformance in the monthly quality assurance report. Evaluate sample data for usability.
No or incomplete decontamination drilling equipment between sample locations	Responsible field personnel will note in logbook if discovered during the activity and will correct. The QAM will include nonconformance in the monthly quality assurance report. Evaluate sample data for usability.
Chain-of-custody form not sent with samples	If chain-of-custody seals are not broken, notify field manager. Fax copy and send originals overnight to laboratory. Resample if chain-of-custody seals are broken prior to receipt by laboratory.
Measurement of Internal temperature of samples outside specified range	Notify field manager. Resample all associated samples as determined necessary.
Health and safety field screening measurement missed	Notify field manager and site safety coordinator.

The nature of the corrective action obviously depends on the nature of the problem. For example, if a continuing calibration verification is determined to be out of control, the corrective action may require recalibration of the analytical system and reanalysis of all samples since the last acceptable continuing, calibration standard. Specific corrective actions to exceeded acceptance criteria for laboratory quality control checks are summarized in Table 3.2.

The laboratory reports all sample variances (e.g., insufficient sample size, extract loss during concentration, sample matrix problems, solvent contamination) in a nonconformance report which contains the following information:

- Client name.
- Project name.
- Operational unit and task.
- Date of occurrence.
- Analysis method.
- Laboratory batch number.
- Affected client sample Ids.
- Nature of nonconformance.
- Criteria not met.
- Responsible analyst or technician.
- Corrective action taken.
- Signature of project manager.
- Signature of section/unit manager.
- Signature of QA coordinator.

14. QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance (QA) reports to management are made to allow managers to easily and effectively monitor data quality.

Reports to management include:

- Audit reports.
- Corrective Action Reports.
- Change notices to Plans, Reports, and Procedures.
- Notices of planned training and results of training activities.
- Limitations on the use of any data.
- Data quality assessment in terms of precision, accuracy, representation, completeness, compatibility, and method detection limits.

The above items are the responsibility of the generator of the report/document. The QAM will copy the QAO on all such reports. Those activities that are the responsibility of the QAM will be reported by the QAM. Management consists of those individuals responsible for taking action on the items reported.

Activities to be performed will be scheduled through the monthly progress report. This document may be used for more general notification of QA issues and schedules, particularly those involving the DOE; DAO, EG&G project management, and regulators and other parties to which the monthly report is distributed.

Reports will be made in a timely manner.

15. REFERENCES

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APPENDIX A

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE 1.1

GENERAL INSTRUCTIONS FOR FIELD PERSONNEL

1. PURPOSE

To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about procedures and equipment for a given operation. Refer to the FSP or WP for the type of samples, measurements, and tests to be collected or performed. The collection and documentation of data should be performed as described in specific SOPs. These general instructions are intended to supplement the information supplied in the FSP or WP and associated SOPs and clarify the role of field personnel at remedial investigations. These instructions will ensure that field personnel take the proper precautions to understand the site, the objective and the schedule for the field program, their authority, and their responsibilities described in the FSP or WP.

This SOP is supported by others that describe procedures and rationale for performing reconnaissance geophysical and soil gas surveys; soil and rock boring; sample logging; soil and sediment sample collection; installation and operation of vadose-zone instruments and samplers; groundwater monitoring well installation, development, and sampling; operation of sampling equipment; sample control and data documentation; performance of aquifer testing; collection, preservation, handling, packaging, and shipping of samples; decontamination procedures; health and safety monitoring; and radiological surveys.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of this SOP and SOPs 1.3-1.10 is required. In addition, a review of associated SOPs for each task is necessary. The associated SOPs are listed in Section 3.1 of each task SOP. Constant review of the SOPs will ensure that the work performed in the field is legally defensible, well documented, and cost-effective. The decontamination procedures are important for protecting the health and safety of workers, and to minimize the risk of cross-contamination among samples.

3.2. Preparation

3.2.1. Office

A. Personnel should review the FSP or WP and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This may include (but is not limited to) the documents listed below.

1. The scope of work or work plan described in the FSP or WP
2. Previous reports related to the site
3. Reports related to the area
4. Site maps
5. Area maps
6. Access agreements
7. The subcontractor's work plan
8. Data collection forms and equipment checklists
9. Associated SOPs

B. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors. With this in mind, field personnel should contact installation staff, members of the community (in coordination with installation staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained.

C. Obtain and test all equipment needed for the task. See checklist in Appendix 5.1.

D. Most sample analyses must be performed within a stringent time period. In addition, laboratories are vulnerable to heavy overloads. Contact the laboratory before sampling activities begin to ensure that the personnel are aware of specific requirements for analyses and can complete the work quickly and efficiently.

E. Delays at the freight office can be eliminated by contacting the carrier before arrival with a shipment. The carrier can supply information on regulations and specifications for shipping, the address of the nearest delivery office, and the time of the next freight pickup in the area.

3.2.2. Documentation

A. Obtain a logbook and ER Program data collection forms. All measurements, observations, and instrument readings should be entered on the forms according to the instructions supplied. All entries should be made in black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or NP for Not Performed. If any procedure was not performed as prescribed, give the reason for the change or omission in the comments field of the form. To change an entry to a form or field log book, draw a single line through it, add the correct information above it, and initial the change. Information that does not require data entry should be entered in the logbook. All logbooks are numbered, bound, and contain numbered pages for quality assurance/quality control purposes. Do not alter the logbook (e.g., tearing out pages) or data collection forms in any manner.

B. The information management codes and sample identification numbers used in data entry are assigned by the data administrator. The data administrator directly transmits the updated codes to the project personnel. This system is necessary to avoid duplication of site identifiers or inaccurate entries. Because the list of codes is continually being updated, SOPs cannot be revised each time a new list is produced.

C. Three days before leaving for any field trip, a previsit/pretravel report form must be submitted to DOE. The report contains information about dates of travel, mode of travel, hotel accommodations, and contact phone numbers. Arrangements for renting field vehicles should be made at this time.

3.2.3. Field

A. Check the condition and operation of all supplies and equipment at the site. Perform calibration checks specified in operators' manuals or appropriate SOPs.

B. Establish decontamination zones and barricades to public access.

3.3. Operation

A. The field personnel monitor and provide technical direction for the field work, log samples, take measurements, and sometimes pack and ship samples as required.

B. Under direction of the site manager, field personnel may designate sampling or hole locations, depth and completion zones, types of samples and depths of sample (or measured, if *in situ*), and approve and record procedures, materials, and all activities conducted in compliance with the FSP or WP.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a label affixed to the sample container--either a Soil Sample Identification Label or a Water Sample Identification Label. SOP 1.3, Sample Control and Documentation, contains copies of these forms and instructions for completing the forms.

C. Additional duties that the field personnel may perform are described below.

1. Keep a logbook to record information concerning equipment, personnel, site visitors, and activities (start and stop times, supplies used, footage drilled/installed, and site observations), as well as weather or site conditions affecting the activities. The field personnel should note all relevant instructions and information and document that proper QA/QC protocols have been followed. All information pertaining to a field activity should be entered in a bound book with consecutively numbered pages (see SOP 1.3, Sample Control and Documentation, for instructions on keeping the logbook). Subcontractors should sign/initial the daily log, thereby certifying that the account records agree with their estimates.

2. Telephone the site manager or office headquarters daily and provide a progress report.

3. Observe that the subcontractor complies with the FSP or WP and all applicable permits and licenses.

4. Complete all data collection forms according to applicable instructions as work progresses.

5. Observe whether the subcontractor follows the applicable health and safety requirements. If violations occur, the field personnel should stop work and immediately notify the site manager or site health and safety officer.

6. Monitor air, personnel, and equipment for contamination and record results on appropriate forms or in the logbook.

7. Supervise decontamination of equipment and personnel. Record procedures used for decontamination in the logbook. Collect decontamination solutions in containers for appropriate disposal as specified in the FSP or WP.

8. Notify the site manager of any modifications to the contract that may be appropriate. Work not defined in the FSP or WP should not be initiated without the approval of the site manager.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP. Restoration can include repair of damage to the land surface (tire ruts) or private property (fences), as well as restoration anticipated at the time the FSP or WP was prepared (for example, revegetation or borehole abandonment).

C. Mark sampling locations or survey points with wooden lathe stakes, wooden survey pegs, or metal fenceposts. Write the location ID on the marker or survey flagging so that it is readily visible. Mark groundwater monitoring wells on the guard pipe and inside the casing cap. Use a black marker for wooden stakes, flagging, and the casing cap. Mark the guard pipes with welds or stencils and paint.

D. Shipping samples is the last task in most field operations. SOPs 1.3-1.5 should be used as guides to sample handling and transport. SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples, is a summary of Department of Transportation regulations pertaining to the transport of hazardous substances most commonly sampled in the field. Use SOP 1.5 in conjunction with the appropriate Code of Federal Regulations and guidance supplied by the freight carrier to ensure that packages are documented and properly labeled.

3.4.2. Documentation

A. Record any restoration work in the logbook.

B. Record any uncompleted work in the logbook. This record may include sampling that could not be performed, damage that could not be repaired, or requirements for long-term monitoring (for example, the need to verify instrument readings at different times of the year).

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Review data collection forms for completeness.

E. Submit a travel expense report.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

None.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Overshoes

_____ Work gloves (2 pairs)

_____ Acid (10% HCL) bottle

_____ Clipboard case

_____ Strapping tape

_____ Pin hammer

_____ Tape measure (tenths)

_____ Protractor

_____ Hat

_____ First aid kit

_____ Sun screen

_____ Thermoluminescent dosimeter (TLD)

_____ Safety shoes/boots

_____ Ziplock bags

_____ Preprinted labels

_____ Distilled (organic-free) water

_____ Methanol (Nanograde)

_____ Freight forms

_____ Telephone directories

_____ Chain-of-custody forms

_____ Hard hat

_____ Pieces of wood (2 inches x 2 inches x 8 inches) to indicate core loss intervals

APPENDIX 5.1, continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stamped, addressed envelopes (large and regular sizes)

_____ Phone and gas credit cards

_____ Calculator

_____ Pens, pencils, and permanent markers

_____ Package cord

_____ Flagging

_____ Hand lens

_____ Tool box

_____ Rain suit

_____ Camera

_____ Ear plugs

_____ Stopwatch

_____ Cold-weather gear

_____ Alpha meter

_____ Safety glasses

_____ Kitchen screen (determine lithology)

_____ Ice chest

_____ Bound logbook

_____ Data collection forms

STANDARD OPERATING PROCEDURE 1.3

SAMPLE CONTROL AND DOCUMENTATION

1. PURPOSE

To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected and the destination of the collected samples. Collection and measurement of samples and the documentation of data will be performed as described in specific SOPs.

This SOP describes the methodology of sample control and documentation for all projects. Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, correspondence, sample labels or tags, chain-of-custody reports, photographs, and analytical records. Waterproof black ink must be used in recording all data in documents bearing serial numbers.

The logbooks are under the supervision of the quality control officer. There may be several logbooks; for example, there may be a separate logbook for field activities, one for samples, and one for instruments. The QA officer numbers the logbooks and assigns them to individuals designated for specific tasks of the project. All information pertinent to a field activity must be entered into a logbook. A record of uncompleted work is kept in a logbook. All project logbooks are turned over to the document control officer at the end of each work period and to a central file at the end of the field activity.

All logbooks are numbered and bound, and the pages are numbered. Waterproof black ink is used for recording all data. Logbook pages should never be removed, and no data should removed. To change an incorrect entry, the individual draws a line through the entry, writes the change above the entry, dates and initials the change. If anyone other than the person to whom the logbook is assigned makes an entry, that person dates and signs the entry. Blank (skipped) pages in the log-book should be marked so that no additional entries can be made on it.

Record all information pertinent to the sampling activity (for example, date, site, ID number, and location) in the logbook. Note the field conditions, weather conditions, and any unusual circumstances. Notes should be as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Language should be objective, factual, and free of personal feelings and inappropriate terminology.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

Field preparation requires organizing sample bottles, sample labels, and documentation in an orderly, systematic manner that promotes consistency and traceability of all data. Appropriate items should be completed before a sample is collected.

A. Record all pertinent information (for example, date, site, ID number, and location) in the logbook. Note field conditions, unusual circumstances, and weather conditions.

B. Fill out information on the sample identification label and attach the label to a sample bottle.

C. Complete initial information required on data collection forms.

3.3. Operation

3.3.1. Logbook

Enter all information pertinent to a field activity in a bound logbook with consecutively numbered pages. Enter information that does not require data entry into the logbook. If not included on a data collection form, entries in the logbook should include at least the information listed below.

- Date and time of entry
- Purpose of sampling
- Name and address of field contact
- Site identification
- Type of process producing waste (if known)
- Type of sample (soil, water, sediment, etc.)
- Sample identifier and size of sample taken
- Type of analysis requested
- Description of sampling point or location number
- Date and time for collection of sample
- Collector's sample identification number(s) and/or name
- References of the sampling site (like maps or photographs)
- Field observations and sampling locations
- Associated field measurements
- Method of sample collection, preservation techniques/reagents used, and any deviations or anomalies noted

- Transfer of a logbook to individuals designated for specific tasks of the project

- Any uncompleted work

For water samples, the TEGD suggests the following additional information.

- Presence of immiscible layers and detection method

- Collection method for immiscible layers

- Sample distribution and transporter

- Climatic conditions including air temp

- Internal temperature of field and shipping container

Because sampling situations vary widely, make notes as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Use language that is objective, factual, and free of personal feelings or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, he/she should date and sign the entry. Never remove logbook pages. If a mistake is made, draw a single line through the mistake, write the new information above the line, and date and initial the change.

3.3.2. Photographs

Photographs provide the most accurate record of the field worker's observations. They can be significant during future inspections, informal meetings, and hearings. A photograph must be documented to be a valid representation of an existing situation. For each photograph taken, record the items listed below in the logbook and on the back of each processed photograph.

- Date and time

- Signature of photographer

- Name and identification number of site

- Type of camera, lens, f-stop, shutter speed, and film used

- General direction faced and description of the subject

- Distance from photographer to object

- Location at the site

- Sequential number of photograph and the roll number

Any remarks about the contents of a photograph could jeopardize its value as legal evidence, so limit comments to the photograph's location. Photographs should be taken with a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings.

3.3.3. Sample Labels

Use soil and water sample identification labels to tag or label sample containers. Seal each sample immediately after it is collected and labeled with waterproof black ink. Label tags may be filled out before collection to minimize the handling of the sample containers. Appendix 5.1, Soil Sample and Water Sample Identification Labels, provides examples of the common sample labels to be used. Instructions for completing the labels are included in Appendix 1.3, Data Form Completion.

When appropriate, use an etching tool to mark sample containers in the field, rather than immediately applying a sample label or tag. This avoids possible label contamination problems and subsequent decontamination difficulties. In this case, write the data intended for the sample label in the logbook and transcribe them onto the label after the sample containers have been decontaminated.

Firmly attach the labels to the sample containers. The containers must be dry enough for gummed labels to be securely attached.

3.3.4. Sample Collection and Inventory

The number of persons involved in collecting and handling samples should be kept to a minimum. Use the guidelines established in this SOP and SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples. Complete data collection forms at the time the sample is collected and have the sample collector(s) sign or initial them. Include the date and time. On liquid containers, mark the liquid level with waterproof black ink. This requirement is not necessary for completely filled volatile organics analysis (VOA) septum vials. If the volume received by the laboratory is different than when collected, the sample container may have leaked, been tampered with, or spilled hazardous materials. Use the Custody Transfer Record/Lab Work Request form, Appendix 5.2, to inventory all samples collected in the field. Instructions for the form are in Appendix 5.3, Data Form Completion.

3.3.5. Chain of Custody

A. Objectives

The primary objective of the chain-of-custody procedure is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and introduction as evidence. A sample is in someone's custody when one of the criteria listed below has been satisfied.

1. The sample is in one's actual possession.

2. The sample is in one's view after being in one's physical possession.

3. The sample is in one's physical possession and is then locked up so that no one can tamper with it.

4. The sample is kept in a secured area that is restricted to authorized personnel.

B. Transfer of Custody and Shipment

When transferring the samples, the transferee should sign and record the date and time on the Custody Transfer Record/Lab Work Request form. Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody should fill in the appropriate section of the Custody Transfer Record/Lab Work Request form. To reduce the number of custody records, minimize the number of custodians in the chain of possession.

The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the Custody Transfer Record/Lab Work Request form. The chain-of-custody form is then placed in a sealed plastic bag and taped to the inside of the cooler lid, where it is immediately visible when the cooler is opened. Signed and dated chain-of-custody seals are also placed on the sample container lids to detect sample tampering.

In general, packaging of environmental samples will include the following: placement of sample containers in zip-lock plastic bags to reduce the chance of both breakage and release of sample if breakage does occur, and placement of the bagged sample containers in a cooler containing sufficient vermiculite to prevent breakage and to absorb any material that leaks. For water samples in 4L amber glass containers, the samples will be wrapped in "bubble wrap" to prevent breakage. Ice or blue ice is used to maintain sample temperatures at 4°C. If ice is used, it must be double-bagged in zip-lock bags. Experience has shown that fully 1/4 to 1/3 of the cooler volume must be ice, packaged around and over the sample containers, to maintain temperatures at 4°C.

Send all packages to the laboratory with the chain-of-custody record and other pertinent forms. Retain a copy of these forms at the originating office (either carbon or photocopy). Register mailed packages with a return receipt requested. For packages sent by common carrier, retain receipts as part of the permanent chain-of-custody documentation. Pack samples so that they do not break in shipment. Seal the cooler with chain-of-custody seals so that any tampering can be readily detected. SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples, describes these procedures in detail.

3.4. Postoperation

3.4.1. Field

A. Verify that all sample bottles have been correctly identified and labels have all necessary information (location, time, and date).

B. Cross-check filled sample bottles in possession against those recorded in the logbook. Maintain custody of filled sample bottles by keeping them in actual possession, within view, locked or sealed up to prevent tampering, or bringing them into a secure area.

C. Prepare samples for transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record data and any uncompleted work in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial and date all pages.

C. Document the chain of custody on the Custody Transfer Record/Lab Work Request form.

D. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

EPA. 1986. "RCRA Ground-water Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency document. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Soil Sample and Water Sample Identification Labels

5.2. Custody Transfer Record/Lab Work Request Form

5.3. Data Form Completion

APPENDIX 5.1

SOIL SAMPLE AND WATER SAMPLE IDENTIFICATION LABELS

SOIL SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

SAMPLE DEPTH INTERVAL FROM DATUM

BEGINNING DEPTH (FT FROM DATUM) _____

ENDING DEPTH (FT FROM DATUM) _____

ANALYSIS REQUESTED _____

COMMENTS _____

SSL-132

WATER SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

ANALYSIS REQUESTED _____

PRESERVATION METHOD _____

COMMENTS _____

WSL-133

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client _____
Work Order _____
Date Rec'd. _____ Date Due _____
RFW Contact _____
Client Contact/Phone _____

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected	Refrigerator#	#/Type Container	Containers/Volume	Preservative	ANALYSES REQUESTED →							

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

RFW 21-21-001/A-5/88

7-115

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NP for Not Performed, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form in the comments field. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

SOIL SAMPLE IDENTIFICATION LABEL

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

3. Lab Code. Three-character code identifying the company responsible for performing the analysis of water, soil, biota, and air samples.

4. Sampler. Name of person(s) collecting sample.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, and radiological samples are collected, and/or other measurements are taken.

6. Log Date. The date the information recorded on the label was obtained in the format DD-MMM-YY (01-JAN-88).

7. Log Time. The time the sample was collected (HH:MM).

8. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

9. Sample Depth Interval from Datum:

   a. Beginning Depth (Ft From Datum). Depth from the ground surface to the top of the sampling interval in the format of feet and tenths of feet.

   b. Ending Depth (Ft From Datum). Depth from the ground surface to the bottom of the sampling interval in the format of feet and tenths of feet.

10. Analysis Requested. Type of analysis requested.

11. Comments. Any additional information.

APPENDIX 5.3, Continued

WATER SAMPLE IDENTIFICATION LABEL FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

3. Lab Code. Three-character code identifying the laboratory responsible for performing the analysis.

4. Sampler. Name of person(s) collecting sample.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, and radiological samples are collected, and/or other measurements are taken.

6. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

7. Log Time. Time the sample was collected (HH:MM).

8. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

9. Analysis Requested. Type of analysis requested from the laboratory.

10. Preservation Method. Type of preservative used.

11. Comments. Any additional information.

CUSTODY TRANSFER/LAB WORK REQUEST FORM

1. Received By. Completed by lab.
2. Date. Completed by lab.
3. Assigned To. Completed by lab.
4. Client. Client name.
5. Client Contact. WESTON person who will be laboratory contact.
6. Phone. Phone number of WESTON contact.
7. RFW Contact. Laboratory contact.
8. Date Due. Date analysis is due from the laboratory.
9. Project Number. Project number under which work is billed.
10. Sample No. Completed by laboratory.
11. Client ID No. Three-part identifier consisting of facility code, location ID, and sample ID and separated by dashes (for example, KCP01-01-01 and PXT02-0002-0001). See the ER Program data administrator for conventions to identify field quality control samples.
12. Description. Any descriptive information about the sample.
13. Matrix. Matrix type for sample; see valid matrix codes on lower half of form.
14. Date Collected. Date the sample was collected in the format DD-MMM-YY (01-JAN-88).
15. Container/Preservative. Container size and type (500-ml glass).
16. Analysis Requested. The type of analysis requested for each sample. The column heading indicating the type.

    PCB=Polychorinated Biphenyl

    HE=High Explosive

    HSL=Hazardous Substance List

    EPTOX=Extraction Procedure Toxicity

    VOA=Volatile Organic Analysis

APPENDIX 5.3, Concluded

CUSTODY TRANSFER/LAB WORK REQUEST FORM

BNA=Base Neutral Acid

TCLD=Toxic Characterization Leach Procedure

PEST=Pesticides

MAJ=Major Cation/Anion

17. Matrix. Valid matrix codes.

18. Special Instructions. Any special instructions.

19. Items/Reason. The reason the custody is transferred for all or selected items of the shipment.

20. Relinquished By. Signature of person sending samples.

21. Received By. Person or (shipping company) who received samples.

22. Date. Date sample is sent.

23. Time. Time sample is sent.

STANDARD OPERATING PROCEDURE 1.4
SAMPLE CONTAINERS AND PRESERVATION

1. PURPOSE

To provide guidance in the selection of suitable containers for samples, container cleaning, required sample volumes, sample collection, holding times, and the recommended preservation techniques for water, wastes, sediments, sludges and soil samples.

2. GENERAL DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a given operation and establishes the number, types, and analyses of field samples (including field analyses). Refer to the FSP or WP for the procedures and equipment to be used in collecting samples. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

In choosing a sample container, the ideal material should be nonreactive with the sample and the particular analytical parameter to be tested. Glass or Teflon containers must be used with samples analyzed for organic compounds to prevent the introduction of extraneous organic compounds, such as those that might be leached from plastic containers. The rigid plastic screw caps for the bottles must be Teflon lined to prevent contamination.

Once a sample has been collected, steps must be taken to preserve the sample's chemical and physical integrity during transport and storage before analysis is conducted. The type of sample preservation required will vary according to the sample type and the parameter to be measured.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.3	Sample Control and Documentation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.8	Sampling for Volatile Organics

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Sample Container Preparation

Sample containers will vary according to the matrix and nature of the sample to be collected. Wide-mouth containers are generally used for soils and wastes; narrow-mouth containers are used for water. Calculations should be made to determine the number and type of containers required for the sampling effort, including extra bottles for contingencies.

Procurement of containers should be initiated as early as possible to avoid unavailability and shipping delays and to satisfy cleaning requirements. Obtain the required number of sample bottles included in the FSP or WP of a type consistent with recommendations in EPA-600/4-79-020 (EPA 1979). Sample containers can usually be obtained directly from the laboratory performing the analyses.

A. Container Type

1. Identify the containers required for analysis by matrix as shown in Appendixes 5.2 through 5.7 (for example, amber glass, narrow-mouth bottles for PCB analysis of water samples). Confirm the container requirements with the analytical laboratory and the FSP or WP.

2. Calculate the number of each type of container required by including duplicates and blanks with the number of investigative samples specified in the FSP or WP. Also include extra bottles for contingencies.

B. Container Cleaning

Containers certified as being precleaned to EPA specifications will be obtained from the manufacturer through the laboratory. If certified containers are not obtained, follow the procedures outlined below to wash containers and caps. The person washing containers must wear gloves.

1. Inorganic and general parameters

a. Wash containers, septa or liners, and closures in hot tap water with laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water.

c. Rinse three times with ASTM Type I deionized water (EPA 1979).

d. Oven dry containers, septa or liners, and closures.

e. Remove containers, septa or liners, and closures from oven.

f. Place liners in closures (Teflon side down) and place on containers. Containers should not be removed from the preparation room until sealed.

2. Trace metals

For certain parameters, a special cleaning procedure is needed to avoid adsorption or contamination resulting from interaction with container walls. These procedures are outlined below.

a. Wash containers, closures, and Teflon liners in hot tap water with laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water.

c. Rinse one time with 1:1 nitric acid.

d. Rinse three times with ASTM Type I deionized water (EPA 1979).

e. Air dry in a contaminant-free environment.

f. Place liners in closures and place closures on containers. Containers should not be removed from the preparation room until sealed.

3. Extractable Organics

a. Wash glass bottles, Teflon liners, and caps with hot tap water using laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water to remove detergent.

c. Rinse three times with ASTM Type I organic-free water (EPA 1979).

d. Oven dry bottles, liner, and caps to 105° - 125° for one hour.

e. Rinse with pesticide-grade hexane or pesticide-grade methylene chloride.

f. Oven dry bottles, liner, and caps to 105° - 125° for one hour.

g. Allow bottles, liners, and caps to cool to room temperature in an enclosed contaminant-free environment. Cap the containers after the glassware has been cooled.

h. Store in a contaminant-free area.

4. Volatile Organics Samples Containers

a. Wash glass vial, Teflon-based septa, Teflon liners, and caps in hot water using laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water.

c. Rinse three times with ASTM Type I organic-free water (EPA 1979).

d. Oven dry vial, caps, septa, and liner at 105° for one hour.

e. Allow vial, caps, septa, and liners to cool to room temperature in an enclosed contaminant-free environment.

f. Seal vials with septa (Teflon side down) and cap.

g. Label each vial with lot number and pack in the case.

h. Store in contaminant-free area.

5. Sterilization

   a. For microbiological analyses, sterilize the container and its stopper/cap by autoclaving at 121°C for 15 min or by dry heat at 180°C for 2 hrs.

   b. The sample bottles can be wrapped with aluminum foil before sterilization. Remove the protective wrapping after the sample is taken to facilitate cleaning the bottle before shipment to the analytical laboratory.

   c. An acceptable alternative for emergency or field use is the sterilization of containers by boiling in water for 15 min.

3.2.4. Sample Volume

The volume of sample collected should be sufficient to perform all the required analyses plus an additional amount to provide for any quality control needs, split samples, or repeat examination. The volumes listed in Appendixes 5.2 through 5.7 are intended as general guidelines. Specific volume requirements to be followed will be those specified in the appropriate Work Plan, and/or Field Sampling Plan. The laboratory receiving the sample should be consulted for specific volume requirements, and these should be specified in the FSP or WP.

NOTE: A sufficient number of containers must be available to ship the proper sample volume. For example, Department of Transportation (DOT) and International Air Transport Association (IATA) regulations limit the size of a sample container to 16 oz if the contents may include hazardous materials. In this case, two 500-mL or four 250-mL containers would be required to ship a one-liter fluid sample. See SOP 1.5, Guide to the Handling, Packaging, and Shipping of samples for additional information.

3.2.5. Sample Preservation

Sample containers may arrive at the site with the proper type and amount of preservatives in them. If onsite preservation of the samples is necessary, the proper reagents should be provided for the field crew in an easily usable form that can be added at the time of sampling. Preservation required for the specific analyses requested may be determined by using Appendixes 5.2 through 5.7. The preservation requirements specified in the Work Plan and/or Field Sampling Plan will take precedence over Appendixes 5.2 through 5.7. Materials commonly needed for sample preservation are listed below.

1. Small bottles of pelletized NaOH

2. Ascorbic acid crystals

3. Lead acetate paper and pH paper

4. Calibrated sampling scoops

5. Reagent-grade acids (HNO_3, HCl, and H_2SO_4) in Safe-Kote bottles

6. Calibrated dispenser bottles (0.5 to 2 mL) for acids.

3.2.6. Field

The appropriate number and type of precleaned containers, along with preservatives, equipment, and packaging containers, should be stored in a facility that can be locked or guarded. The storage facility should be located near the site and decontamination staging area, but should also be accessible to freight trucks that will be delivering new container shipments and transporting samples to the laboratory.

3.3. Operation

A. Soils/Wastes Sample Collection

NOTE: All individuals in the sampling area must wear gloves appropriate to their tasks. Only the persons collecting samples and filling sample containers must discard their gloves between sampling tasks (e.g. sample set).

1. While wearing protective gloves, fill the bottle with the sample. Wet soils should have enough headspace to allow for expansion. Soils collected for VOC analysis should be filled as full as possible with no headspace.

2. Take extreme care to avoid contamination of the bottles or caps. Remove the cap just before filling and replace it as soon as possible after filling. Avoid any personal contact with the inside of the bottle or cap.

3. Clean the exterior of the bottle with a wipe moistened with deionized water, followed by a wipe moistened with methanol. When appropriate, implement SOP 1.6, General Equipment Decontamination. Attach a completed sample label (according to SOP 1.3, Sample Control and Documentation) and cover with clear tape. The tape should extend at least 1/4 inch beyond the edges of the label. Wrap a strip of Parafilm around the junction of the bottle and cap.

4. Preservation of soil samples is usually accomplished by protecting the sample from UV light by using an amber bottle and keeping the sample cool.

5. If required, place the container in a cooler. Maintain the samples at a cool

temperature with frozen packaged ice (for example, Blue Ice) or ice cubes sealed in two plastic bags. Avoid freezing the sample by packing to prevent contact between the coolant and the sample container.

6. If samples are not delivered to the laboratory on a daily basis, check ice chests and insulated boxes every 24 hrs and replace thawed ice or Blue Ice packs as needed.

7. Avoid exposing the sample to extreme hot or cold temperatures and intense sunlight, even if no specific preservation is recommended.

8. EPA guidance recommends that a 4°C temperature be maintained in the sample container before and during shipment. A 40-mL VOA vial is filled with deionized, distilled water and used as a temperature blank for the cooler. The analytical laboratory will use this temperature blank to record the temperature at the time of sample receipt. The temperature should be 4°C ± 2°C or as specified in the QAPP. If the temperature is not within this range, the project manager, or designee, will be notified.

   The temperature should be checked again at the analytical laboratory. Record both temperatures in the special instructions section of the Custody Transfer Record/Lab Work Request form (see SOP 1.3., Sample Control and Documentation). If a continuous temperature record can be obtained during the shipment period, record the maximum temperature in the container on the custody transfer form.

B. Water Sample Collection

NOTE: All individuals in the sampling area must wear gloves appropriate to their tasks. Only the persons collecting samples and filling sample containers must discard their gloves between sampling tasks (e.g., sample set).

1. Before collecting samples for organics and CN, use the Hach Test Kit for residual chlorine and sulfides. If present, preserve samples according to instructions in Appendix 5.2, Recommendation for Sampling and Preservation of Water Samples According to Measurement (for example, $Na_2S_2O_3$ to organic samples).

2. Collect samples directly in the appropriate container, ensuring that the sampling flow rate, if applicable, does not exceed the flow rate used while purging. Collect samples in the order of their volatilization sensitivity (TEGD). When collecting VOAs, follow SOP 2.8, Sampling for Volatile Organics.

    1) Volatile organics

    2) Extractable organics

    3) Dissolved metals

    4) Total metals

    5) Cations

    6) Anions

    7) Radionuclides

3. Do not filter unless specified in the Sampling Plan.

4. Do not rinse the container.

5. Slowly fill each container almost full, except VOAs (see SOP 2.8, Sampling for Volatile Organics).

6. Add any prescribed preservative.

7. Cap the container, shake, and reopen it.

8. If using acid or base preservative, check the pH adjustment with pH paper.

9. If necessary, add more preservative.

10. Complete steps 3 and 5 through 8 from Section 3.3.A.

11. If an error was made in collection, discard the entire bottle and start with a new one.

C. Holding Time

In general, analyze samples as soon as possible after collection. Some parameters are required to be analyzed in the field (See Appendix 5.2). Allowable holding times are listed as guidelines. They represent the maximum times that samples are considered valid. The typical required holding times for each analyte (or analysis group) are presented in Appendix 5.2. However, the Work Plan and/or Field Sampling Plan will specify holding times on a project-specific basis and, if different, take precedence over the Appendix 5.2 limits. There are instructions in the FSP or WP for delivering the samples to the laboratory as soon as possible. (See SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples).

3.4. Postoperation

3.4.1. Field

A. Store unused, clean sample bottles in a clean environment for later use.

B. Clean acid dispensers and store them dry for the next field operation.

C. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

D. Restore the site to presampling conditions as specified in the FSP or WP.

E. Make sure all wells are labeled, sampling locations are properly staked, and the location ID is readily visible on the guard pipe or location stake.

F. Prepare samples for transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record any cleanup procedures and any uncompleted work (like site restoration or uncompleted sampling) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Korte, Nic, and Peter Kearl. 1985. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition." U.S. Department of Energy report GJ/TMC-08. Technical Measurements Center, Grand Junction Project Office, Grand Junction, Colorado.

EPA. 1979. "Handbook for Analytical Quality Control in Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-79-019. Washington, D.C.: U.S. Government Printing Office.

EPA. 1982. "Handbook for Sampling and Sample Preservation of Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-82-029. Washington, D.C.: U.S. Government Printing Office.

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EPA. 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency document OSWER-9950.1. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Recommendation for Sampling and Preservation of Water Samples According to Measurement

5.3. Sampling and Preservation Procedures for RCRA Groundwater Detection Monitoring

5.4. Analysis Plan for Soil/Sediment Samples

5.5. Sample Containers for Waste

5.6. Containers for Aqueous Waste Samples

5.7. Analysis Plan for Soil/Sediment/Waste Samples

APPENDIX 5.1
EQUIPMENT AND SUPPLIES CHECKLIST

_____ Narrow-mouth amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Amber glass vials with Teflon septa (40-mL)

_____ Blue Ice or equivalent

_____ 250-mL sterile bottle

_____ Cardboard boxes

_____ Insulated coolers

_____ Ballpoint pen (permanent black ink)

_____ Felt-tip marker pen (permanent black ink)

_____ Heavy-duty poly bags and ties

_____ Strapping tape

_____ Wide-mouth polyethylene bottles (0.5, 1, and 2 liters)

_____ Plastic trashcan liners

_____ 1-11 pH indicator paper

_____ Canvas bags

_____ Hach field test kit for sulfides

_____ Hach field test kit for chlorine

_____ Parafilm

_____ Ascorbic acid crystals

_____ Disposable surgical gloves (latex, PVC, other suitable plastic, or rubber)

_____ NaOH pellets

_____ Disposable wipes

_____ Crystalline $Na_2S_2O_3$

_____ Methanol and deionized water in Teflon wash bottles

APPENDIX 5.1, Continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Padding for packaging of samples

_____ Concentrated HNO_3, H_2SO_4, and HCl

_____ New or cleaned polyethylene narrow-mouth bottles (1.0 liter, 500 mL, 125 mL, and 60 mL)

APPENDIX 5.2
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Physical Properties				
Color	50	P,G	Cool 4°C	48 Hrs.
Conductance	100	P,G	Cool 4°C	28 Days
Hardness	100	P,G	HNO_3 to pH<2	6 Mos.
Odor	200	G only	Cool 4°C	24 Hrs.
pH	25	P,G	None Required	Analyze Immediately
Residue				
Filterable	1000	P,G	Cool 4°C	7 Days
Nonfilterable	1000	P,G	Cool 4°C	7 Days
Total	100	P,G	Cool 4°C	7 Days
Volatile	100	P,G	Cool 4°C	7 Days
Settleable Matter	1000	P,G	Cool 4°C	48 Hrs.
Temperature	1000	P,G	None Required	Analyze Immediately
Turbidity	100	P,G	Cool 4°C	48 Hrs.
Metals				
Dissolved	1000	P,G	Filter onsite HNO_3 to pH<2	6 Mos.[6] 6 Mos.
Total	1000	P,G	HNO_3 to pH<2	6 Mos.
Chromium^{+6}	200	P,G	Cool 4°C	24 Hrs.

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Mercury				
Dissolved	100	P,G	Filter HNO_3 to pH<2	28 Days from date of collection
Total	100	P,G	HNO_3 to pH<2	28 Days
Inorganics, Nonmetallics				
Acidity	100	P,G	Cool 4°C	14 Days
Alkalinity	200	P,G	Cool 4°C	14 Days
Bromide	100	P,G	None Required	28 Days
Cations	1,000	P	HNO_3 to pH<2	28 Days
Chloride	50	P,G	None Required	28 Days
Chlorine	200	P,G	None Required	Analyze Immediately
Cyanides	1500	P,G	NaOH to pH>12 Cool 4°C	14 Days from date of collection
Fluoride	500	P,G	Cool 4°C	28 Days
Iodide	100	P,G	Cool 4°C	24 Hrs.
Nitrogen				
Ammonia	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Kjeldahl, Total	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Nitrate Plus Nitrite	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Nitrate[9]	100	P,G	Cool 4°C	48 Hrs.
Nitrite	150	P,G	Cool 4°C	48 Hrs.

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Dissolved Oxygen				
Probe	300	G bottle and top	None Required	Analyze Immediately
Winkler	300	G bottle and top and store in dark	Fix onsite	8 Hours
Phosphorus				
Orthophosphate, Dissolved	50	P,G	Filter onsite Cool 4°C	48 Hrs.
Hydrolyzable	50	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Total, Dissolved	50	P,G	Filter on site Cool 4°C H_2SO_4 to pH<2	24 Hrs.
Total	500	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Silicia	50	P only	Cool 4°C	28 Days
Sulfate	50	P,G	Cool 4°C	28 Days
Sulfide	50	P,G	Cool 4°C add 2 m liter zinc acetate plus NaOH to pH >9	7 Days
Sulfite	50	P,G	None Required	Analyze Immediately
Organics				
BOD	1000	P,G	Cool 4°C	48 Hrs.
COD	50	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days
Oil & Grease	1000	P,G	Cool 4°C H_2SO_4 to pH<2	28 Days

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Total Organic Carbon	250	Amber G, Teflon-lined cap; no headspace	Cool 4°C H_2SO_4 to pH<2	28 Days
Phenolics	500	G only	Cool 4°C H_2SO_4 to pH<2	28 Days
Cyanide	1000	P,G	Cool 4°C 40% NaOH to pH>12, 0.6 g Ascorbic Acid[7]	14 Days from date of collection
Coliform, Fecal and Total	250	P,G	Cool 4°C Sterile	6 Hrs.
Oil and Grease	1000	G	Cool 4°C H_2SO_4 to pH<2	28 Days
Phenols	1000	G, Teflon-lined Cap	Cool 4°C	7 Days until extraction; 40 Days after extraction
Total Organic Halogen and Purgeable aromatics	80	G, Teflon-lined vial septum	Cool 4°C 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Purgeable aromatics	80	G, Teflon-lined septum	Cool 4°C 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Acetonitrile and Acrylonitrile	80	G, Teflon-lined cap	Cool 4°C	14 Days
Acrolein and acrylonitrile	1000	G, Teflon-lined septum	Cool 4°C 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Semivolatile Organic Compounds	2000	Amber G, Teflon-lined cap	Cool 4°C	7 Days until extraction; 40 days after extraction
Phenols	1000	G, Teflon-lined cap	Cool 4°C 0.008% $Na_2S_2O_3$[6]	7 days until extraction; 40 days after extraction

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Benzindines	1000	G, Teflon-lined cap	Cool 4°C 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Phthalate esters	1000	G, Teflon-lined cap	Cool 4°C 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Nitrosamines	1000	G, Teflon-lined cap	Cool 4°C store in dark 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Nitroaromatics and isophorone	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Polynuclear aromatic hydrocarbons	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Haloethers	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Chlorinated hydrocarbons	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
TCDD	1000	G, Teflon-lined cap	Cool 4°C	7 days until extraction; 40 days after extraction
Explosives	1000	Amber G, Teflon-lined cap	Cool 4°C	7 days until extraction; 30 days after extraction

APPENDIX 5.2, Continued
RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Pesticides Tests				
Pesticides/PCBs	2000	Amber G, Teflon-lined cap	Cool 4°C	7 days from date of collection until extraction; 40 days after extraction
Radiological Tests				
Alpha, beta and radium	1000	P,G	HNO_3 to pH<2	6 mos.
Tritium	250	G	None	None
Gamma Spectrometry	1000	P	HNO_3 to pH<2	None
Isotopic Plutonium	1000	P	HNO_3 to pH<2	None
Isotopic Thorium	1000	P	HNO_3 to pH<2	None
Isotopic Uranium	500	P	HNO_3 to pH<2	6 mos.
Sr-90	1000	P	HNO_3 to pH<2	6 mos.
Radium-226	1000	P	HNO_3 to pH<2	None
Americium-241	1000	P	HNO_3 to pH<2	None

[1]More specific instructions for preservation and sampling are found with each procedure described in this manual. A general discussion about sampling water and industrial wastewater may be found as ASTM, Part 31, p. 72-82 (1976) Method D-3370.
[2]Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
[3]Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automated sample makes it impossible to preserve each aliquot, then samples may be preserved by keeping cool at 4°C until compositing and sample splitting is completed.
[4]Shipment of preserved and unpreserved samples must comply with SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples.
[5]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permitted, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time and has received a variance from the regional administrator. Some samples may not be stable for a shorter time, if knowledge exists to show it is necessary to maintain sample stability.
[6]Should only be used in the presence of residual chlorine.
[7]Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
[8]Samples should be filtered immediately onsite before adding preservative for dissolved metals.
[9]For samples from nonchlorinated drinking water supplies, concentrated H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed within 14 days.

APPENDIX 5.3

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

Parameter	Recommended Container[b]	Preservative[d]	Maximum Holding Time	Minimum Volume Required for Analysis
		Indicators of Groundwater Contamination[c]		
pH	T,P,G	Field determined	None	25 mL
Specific conductance	T,P,G	Field determine	None	100 mL
TOC	G, amber, T-lined cap[e]	Cool 4°C	28 days HCl to pH<2	4 x 15 mL
TOX	G, amber, T-lined septa or caps	Cool 4°C, add 1.1M sodium sulfite	7 days	4 x 15 mL
		Groundwater Quality Characteristics		
Chloride	T, P, G	Cool 4°C	28 days	50 mL
Iron Manganese Sodium	T, P	Field acidified to pH <2 with HNO_3	6 months	200 mL
Phenols	G	Cool 4°C/H_2SO_4 to pH <2		28 days 500 mL
Sulfate	T, P, G	Cool 4°C	28 days	50 mL
		EPA Interim Drinking Water Characteristics		
Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	T, P G, Amber	Total Metals Field acidified to pH <2 with HNO_3 Dissolved Metals 1. Field filtration (0.45 micron) 2. Acidify to pH <2 with HNO_3	6 months 28 days 6 months	1000 mL 1000 mL

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

Parameter	Recommended Container[b]	Preservative	Maximum Holding Time	Minimum Volume Required for Analysis
Fluoride	T, P	Cool 4°C	28 days	300 mL
Nitrate/ Nitrite	T, P, G	Cool 4°C/ H_2SO_4 to pH <2	14 days	1000 mL
Endrin Lindane Methoxychlor Toxaphene 2,4 D 2,4,5 TP Silvex	T, G	Cool 4°C	7 days	2000 mL
Radium Gross Alpha Gross Beta	P, G	Field acidified to pH <2 with HNO_3	6 months	1 gallon
Coliform bacteria	PP, G (sterilized)	Cool 4°C	6 hours	200 mL
		Other Groundwater Characteristics of Interest		
Cyanide	P, G	Cool 4°C, NaOH to pH >12. 0.6 g ascorbic acid[f,g]	14 days from date of collection	500 mL
Oil and Grease	G only	Cool 4°C H_2SO_4 to pH <2	28 days	100 mL
Semivolatile, nonvolatile organics	T, G	Cool 4°C	7 days from date of collection until extraction; 40 days to analysis	60 mL
Volatiles	G, T-lined	Cool 4°C Cool 4°C and HCl to pH<2	7 days 14 days	60 mL

[a]References:

Test Methods for Evaluation Solid Waste - Physical/Chemical Methods, SW-846 (2nd edition, 1982).
Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
Standard Methods for the Examination of Water and Wastewater, 16th edition (1985).

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

[b]Container Types:

P = Plastic (polyethylene)
G = Glass
T = Fluorocarbon resins (PTFE, Teflon, FEP and PFA)
PP = Polypropylene

[c]Based on the requirements for detection monitoring (265.93), the owner/operator must collect a sufficient volume of groundwater to allow for the analysis of four separate replicates.

[d]Shipping containers (cooling chest with ice or ice pack) should be certified as to the 4#C temperature at the time of sample placement into these containers. Preservation of samples requires that the temperature of collected samples be adjusted to 4#C and maintained at 4#C upon placement of sample and during shipment. Field personnel will check the temperature in the container at the time of shipping and ice the samples to maintain a cool temperature during shipment. Maximum-minimum thermometers can be placed into the shipping chest to record temperature history. Chain-of-custody forms will include the temperature in the container at the time of shipment and delivery at the laboratory in addition to in-transit (maximum) temperature, if available.

[e]Do not allow any headspace in the container.

[f]Use ascorbic acid only in the presence of oxidizing agents.

[g]Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

APPENDIX 5.4

ANALYSIS PLAN FOR SOIL/SEDIMENT SAMPLES

Analyte*	Sample Container	Sample Volume (g)	Preservations	Holding Time(days)
Volatile Organics	40-mL vial (2) w/Teflon-lined silicon rubber septum	5	Cool 4°C	14 from date of of collection
Semivolatile Organic Compounds	Amber G, Teflon-lined cap	100	Cool 4°C	14/40[2]
Pesticide/PCB	Amber G, Teflon-lined cap	100	Cool 4°C	14/40[2]
Total Organic Carbon	Amber G, Teflon-lined cap	50	Cool 4°C	28 days
Soil pH	P	50	Cool 4°C	48 hrs
Explosives	Amber G, Teflon-lined cap	100	Cool 4°C	7/30[5]
TAL Inorganic[1]	P	100	Cool 4°C	180 Mercury = 28 days from date of collection
Non-TAL Metals	P, G, 1 L	200	Cool 4°C	180
Reactivity	Amber G	—	Cool 4°C	N/A
Chloride	P	100	Cool 4°C	28 days
Fluoride	P	50	Cool 4°C	28 days
Sulfate	P	100	Cool 4°C	28 days
Nitrate-Nitrite	P	100	Cool 4°C	28 days
Cyanide	P	100	Cool 4°C	14 days
Hexavalent Chromium	G, 1 L	100	Cool 4°C	1
Radiological				
Tritium	G	250	N/A	None
Gamma Spectrometry	P	750	N/A	None
Isotopic Plutonium	P	750	N/A	None
Isotopic Thorium	P	750	N/A	None
Isotopic Uranium	P	750	N/A	None
Sr-90	P	750	N/A	None

APPENDIX 5.4, Continued

ANALYSIS PLAN FOR SOIL/SEDIMENT SAMPLES

Analyte*	Sample Container	Sample Volume (g)	Preservations	Holding Time(days)
Geotechnical				
Cation Exchange Capacity	P	100	Cool 4°C	N/A
Grain Size Distribution	P	50 lbs[6]	N/A	N/A
Specific Gravity	P	50 lbs[6]	N/A	N/A
Hydraulic Conductivity	P	50 lbs[6]	N/A	N/A
Relative Density	P	50 lbs[6]	N/A	N/A
Maximum Density	P	50 lbs[6]	N/A	N/A
Moisture Content	P	500	Cool 4°C Airtight	7 days
Organic Content	P	500	Cool 4°C	7 days
Clay Mineralogy	P	100	N/A	N/A

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[1]Includes lithium, molybdenum, bismuth, and tin, which are non-TAL metals, but are analyzed using the same methods.
[2]Extract within 7 days from date of collection; analysis within 40 days of extraction.
[3]Soil/sediments will be leached with Laboratory Reagent Water (20 g soil to 50 mL water) and water extract analyzed using procedure in "Methods for Chemical Analysis of Water and Wastes," 1983; EPA 600/4-79-020.
[4]Soil/sediment will be leached with Laboratory Reagent Water (5 g soil and 100 mL of water) by shaking for 2 hours, and the water extract filtered and subsequently analyzed. This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 16th Edition.
[5]Extract within 7 days from date of collection; analysis within 30 days of extraction.
[6]Shelby tubes of sufficient volume may be used to collect samples for these analysis.
*The FSP or WP will define the actual suite of parameters to be analyzed for specific samples. The QAPP will define the actual methodology for analyses.

APPENDIX 5.5

SAMPLE CONTAINERS FOR WASTE

Waste Type	Recommended Container	Closure	Analysis
Photosensitive wastes 1000 or 2000 m liter	Amber HDPE or amber glass caps with Teflon liners for glass bottles	LPE caps for HDPE bottles; Bakelite	Waste characterization per 40 CFR-Part 261
Pesticide hydrocarbon chlorinated hydrocarbons petroleum distillates	Wide-mouth borosilicate glass bottles 1000 or 2000 mL	Bakelite caps with Teflon liner	Waste characterization per 40 CFR-Part 261
Oil wastes	HDPE bottles wide mouth 1000 or 2000 mL	LPE caps	Waste characterization per 40 CFR-Part 261
Strong alkali or hydrofluoric acid	HDPE bottle, wide mouth 1000 mL	LPE caps	Waste characterization per 40 CFR-Part 261
Aqueous wastes–characterization of organics	Borosilicate glass bottles 1000 or 2000 mL	Caps with Teflon liner	Waste characterization per 40 CFR-Part 261
Solids (sludge, soils, and granular)	8-oz, wide-mouth glass bottle	Bakelite caps with Teflon liners	Waste characterization per 40 CFR-Part 261

APPENDIX 5.6

CONTAINERS FOR AQUEOUS WASTE SAMPLES

Analyte*	Sample Container	Sample Volume	Preservation[7]	Holding Time(days)
TCL Volatile	40 mL vial (2)	40 mL	HCl pH<2 with HCl	14 from date of collection
TCL Semivolatile	Amber G, 1L	1 L	Cool 4°C	7/40[5]
TCL Pesticide/PCB	Amber G, 1L	1 L	Cool 4°C	7/40[5]
TAL Inorganic[2]	P,G, 1L	1 L	pH<2,w/HNO_3[6]	180 (Mercury = 28 days from date of collection)
Non-TAL Metals	P,G, 1L	1 L	pH<2,w/HNO_3[6]	180
Cyanide	P,G, 1L	0.5 L	pH>12,w/NaOH	14 from date of collection
pH[3]	P,G	N/A	None	Field Meas.
Sp. Conductivity[3]	P,G	N/A	None	Field Meas.
Temperature[3]	P,G	N/A	None	Field Meas.
Diss. Oxygen[3]	G	N/A	None	Field Meas.
TDS	P,G 1L	0.1 L	Cool 4°C	7
TSS	P,G 1L	0.1 L	Cool 4°C	7
Total Phosphate	P,G, 1L	1 L	Cool 4°C, pH<2[6]	28
Chloride, Sulfate	P,G, 1L	1 L	Cool 4°C	28
Carbonate/Bicarbonate[4]	P,G, 1L	1 L	Cool 4°C	14
Nitrate	P,G, 1L	1 L	Cool 4°C	2
Hexavalent Chromium	P,G, 1L	1 L	Cool 4°C	2

[2]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals, but are analyzed using the same methods.
[3]Field Measurements are collected at time of sampling.
[4]These are reported as carbonate and biocarbonate alkalinity.
[5]Seven days from date of collection to extraction; analysis within 40 days of extraction.
[6]All samples with the exception of those for total metals will be filtered within 4 hours of sample collection and preservatives added to the filtrate as specified.
[7]All samples will be kept at 4°C after arrival at the laboratory.
*The FSP or WP will define the actual suite of parameters to be analyzed for specific samples.

APPENDIX 5.7

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES*

Analyte*	Sample Container	Sample Volume(g)	Preservations	Holding Time(days)
TCL Volatile	40 mL vial (2)	5	Cool 4°C	14 from date of collection
TCL Semivolatile	Amber G, 1 L	10-30	Cool 4°C	7/40[3]
TCL Pesticide/PCB	Amber G, 1 L	10-30	Cool 4°C	7/40[3]
TAL Inorganic[2]	P,G, 1 L	200	Cool 4°C	180
Non-TAL Metals	P,G, 1L	200	Cool 4°C	180 (Mercury = 28 days from date of collection)
TCLP	Amber G	100	Cool 4°C	14 days
Chloride	G, 1 L[4]	20	Cool 4°C	28
Sulfate	G, 1 L[4]	20	Cool 4°C	28
Nitrate	G, 1 L[4]	20	Cool 4°C	28
Cyanide	G, 1 L	200	Cool 4°C	12
Hexavalent Chromium	G, 1 L[5]	200	Cool 4°C	1

[2]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals.
[3]Extract within 7 days from date of collection; analysis within 40 days of extraction.
[4]Soil/sediments will be leached with laboratory reagent water (20 g soil to 50 m liter water) and water extract analyzed using referenced procedure. Procedure reference: Methods for Chemical Analysis of Water and Wastes, 1983; EPA 600/4-79-020.
[5]Soil/sediment will be leached with laboratory reagent water (5 g soil and 100 m liter of water) by shaking for 2 hours. The water extract is filtered and subsequently analyzed. This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 15th Edition.
*The FSP or WP Sampling Plans will define the actual suite of parameters to be analyzed for specific samples.

APPENDIX 5.7, Continued

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES

Method References

Ref. 1. Method 9010 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 2. Method 8240 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 3. Method 8270 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 4. Method 8080 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 5. Method 6010 or 7000 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 6. Method 9010 or 9030 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 7. Method 1310 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

STANDARD OPERATING PROCEDURE 1.5

GUIDE TO THE HANDLING, PACKAGING, AND SHIPPING OF SAMPLES

1. PURPOSE

To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information concerning the scope and details of a specific operation. Refer to the FSP or WP for the type of samples to be collected and the destination for the samples. This SOP describes the procedures used by the ER Program technical assistance subcontractor when handling, packaging, and shipping samples. Other procedures or requirements used by installation subcontractors must conform to this SOP. The transportation of samples must protect the integrity of the sample and prevent any detrimental effects from the potentially hazardous nature of the samples.

Samples collected at a site are classified as environmental or hazardous material samples. In general, environmental samples are collected from streams, farm ponds, small lakes, wells, and offsite soils that are not expected to be contaminated with hazardous materials. Samples of onsite soils or water and materials collected from drums, bulk storage tanks, obviously contaminated ponds, impoundments, lagoons, pools, and leachates from hazardous waste sites are considered samples of hazardous materials. A distinction must be made between the two types of samples for two reasons.

1. The appropriate Department of Transportation (DOT) or International Air Transport Association (IATA) procedures for the transportation of samples must be determined. If there is any doubt, a sample should be considered hazardous and shipped accordingly.

2. The health and safety of laboratory personnel receiving samples must be protected. Special precautions are used at laboratories when samples that are not environmental are received.

Hazardous materials defined by the transportation regulations contained in 49 CFR (Subchapter C, Part 171) or the current edition of IATA regulations for dangerous goods (Sections 3 and 4) should be shipped only by the method of transportation specified in these regulations. Overnight shipments by air (Federal Express, for example) are governed by the IATA regulations. Transportation of hazardous materials exclusively by surface route is governed by the requirements of 49 CFR. This operating practice ensures compliance with the appropriate regulations and at times requires the implementation of packaging instructions that are more conservative and stringent than those required by regulation. Employees should be aware that regulatory bodies with jurisdiction have the authority to levy substantial fines and penalties to violators. Failure on the part of any employee to follow the requirements of these procedures is cause for disciplinary action, including discharge.

This SOP provides general guidance for packaging, marking, labeling, and shipping samples of environmental and hazardous materials and should not be misconstrued as the equivalent of or replacement for the DOT or IATA regulations. When shipping any potentially hazardous samples, the DOT regulations (49 CFR 171-178) and IATA regulations must be followed. This SOP should be used in conjunction with DOT and IATA regulations and advice from the freight carrier to ensure that all regulations governing transportation are being followed.

Any questions about the instructions for shipping environmental samples or hazardous materials in this SOP should be directed to the subcontractor's health and safety officer, who provides technical assistance to the ER Program.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, SOPs 1.1-1.10 must be reviewed. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.
B. Coordinate schedules/actions with the installation staff.
C. Obtain appropriate permission for property access.
D. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.
E. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.3.2. Documentation

A. Obtain a logbook from the QA officer.
B. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).
C. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.3. Operation

Procedures for shipping samples under DOT and IATA regulations are provided in Appendixes 5.1 through 5.4. The following step-by-step procedure will ensure that all applicable requirements for classifying, packing, marking, labeling, and documenting samples can be met.

A. Determine the correct technical name or composition of substances that might be in the samples. Check to see if the substance is forbidden on aircraft. Section 1 of the IATA Regulations for Dangerous Goods contains a list of the substances that cannot be transported by air.

B. All samples must be transported by cargo aircraft or land transport. See Appendixes 5.1 through 5.4 for the appropriate DOT and IATA requirements.

C. Consult the DOT or IATA references to select the appropriate shipping container and packing material.

D. Prepare the consignment according to relevant requirements.

E. Ensure that all appropriate markings are printed on the packages and labels are attached.

F. Make any appropriate advance arrangements with the carrier and obtain current information about regulations and specifications that might affect the shipment.

G. Prepare the cargo airbill, complete, and sign the appropriate declarations for transporting dangerous goods.

H. Deliver the shipment to the local office of the freight carrier or arrange for a pickup at the site. Do not seal the container until the freight carrier is satisfied that the internal packaging meets all applicable regulations.

I. Ensure that all chain-of-custody procedures are observed. The copy of the bill of lading form will be retained as evidence of the chain-of-custody transfer.

3.4. Postoperation

3.4.1. Field

A. When transferring the samples, have the transferee sign and record the date and time on the Custody Transfer Record/Lab Work Request form (see SOP 1.3, Sample Control and Documentation). Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody should fill in the appropriate section of the Custody Transfer Record/Lab Work Request form. Minimize the time of possession.

B. The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes completing, dating, and signing the appropriate portion of the Custody Transfer Record/Lab Work Request form. When samples of hazardous materials are shipped to a laboratory, provide advance notice.

C. Verify that all sample bottles have been correctly identified and labels include necessary information (for example, location, time, and date).

3.4.2 Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. As in any other activity that may be used to support litigation, regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever samples for evidence are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate, written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and the introduction as evidence.

A sample is in someone's custody under any of the conditions listed below.

- It is in one's actual possession.

- It is in one's view (after being in one's physical possession).

- It is one's physical possession and then locked up so that no one can tamper with it.

- It is kept in a secured area that is restricted to only authorized personnel.

C. Send all packages to the laboratory with the Custody Transfer Record/Lab Work Request form and other pertinent forms. Retain a copy of these forms at the originating office (either carbon or photocopy). Register mailed packages with a return receipt requested. For packages sent by common carrier, retain receipts as part of the permanent chain-of-custody documentation. Pack samples to eliminate the possibility of breakage during shipment. Seal or lock the package so that any tampering can be readily detected.

D. Additional guidelines for chain of custody, a sample of the form, and instructions for completing the Custody Transfer Record/Lab Work Request form are included in SOP 1.3, Sample Control and Documentation.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

International Air Transport Association. 1993. Dangerous Goods Regulations. January 1993. Montreal, Quebec, Canada.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transportation, Parts 100-199. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1 Environmental Samples

5.2 Samples of Hazardous and Radioactive Materials

5.3 Transportation of Unknown Hazardous Materials by 49 CFR

5.4 Transportation of Unknown Hazardous Materials by IATA

APPENDIX 5.1
ENVIRONMENTAL SAMPLES

A. Environmental Samples

Environmental samples which are expected to contain only small quantities of contaminants may be shipped as excepted quantities under IATA. Excepted quantity limitations are defined in Section 2.7 of the IATA Regulations for Dangerous Goods. The following procedure for shipping environmental samples is based on the samples meeting the IATA restrictions.

B. Packaging

Before any samples are placed in their final shipping containers, the exterior of the sample containers should be wiped clean with a damp cloth. Environmental samples must then be packaged according to the following procedures.

1. Place sample container, properly labeled and with a chain-of-custody seal on a sealed lid, into a polyethylene bag and seal the bag.

2. Place sample in a fiberboard container approved by the Department of Transportation (DOT) or picnic cooler.

3. Pack container with enough noncombustible, absorbent cushioning material to minimize the possibility of breakage and absorb any materials that may have leaked from the sample jars. Vermiculite is recommended.

4. If there are multiple samples, be sure there is sufficient cushioning material between the sample containers (each in its individual polyethylene bag) to prevent breakage from dropping or severe shock.

5. Sealed bags of ice are packed with the samples to obtain 4°C.

6. Tape a sealed plastic bag containing the completed chain-of-custody form to the inside of the shipping container lid.

7. Seal outside container with duct tape or strapping tape.

8. On each side of the shipping container, place a signed chain-of-custody seal at the junction between the shipping container and lid.

C. Marking/Labeling

Sample containers must have a completed sample identification tag (see SOP 1.3, Sample Control and Documentation), and the outside container must be marked Environmental Sample. The appropriate side of the container must be marked This End Up, and arrow labels should be used accordingly. Affix a "Excepted Quantities" Label for samples shipped by air on the outside container (fiberboard box or cooler). No DOT placards or labeling are required. Assure that all sample containers are labeled identically to labels on the shipping container.

D. Shipping Papers

No DOT or International Air Transport Association (IATA) shipping papers are required for environmental samples.

E. Transportation

There are no DOT or IATA restrictions on the mode of transportation for environmental samples. An overnight carrier is required.

F. Additional Guidelines for Water Samples

Additional guidelines for the shipment of water samples is given in the TEGD. These include the following activities.

1. When the samples are placed in the shipping cooler, record the internal temperature of the cooler on the chain-of-custody form.

2. Make sure that signed and dated chain-of-custody seals are present on the cap of each individual sample container and on the lid of the shipping cooler.

3. The internal temperature of the shipping container will be measured using a laboratory grade thermometer upon opening the cooler at the contracted laboratory.

APPENDIX 5.2
SAMPLES OF HAZARDOUS AND RADIOACTIVE MATERIALS

A. Samples of Hazardous Material

Samples that are not environmental samples or samples known or expected to contain hazardous substances must be considered samples of hazardous material and transported according to the following requirements.

If the hazardous material in the sample is known or can be accurately identified, it is packaged, marked, labeled, and shipped according to the specific instructions for that material described in the Department of Transportation Hazardous Materials Table (49 CFR 72.101) or the latest edition of the International Air Transport Association Dangerous Goods Regulations.

B. Samples of Radioactive Materials

Samples containing greater than 70 KBq/Kg (2000 ρCi/g) of any radionuclide are considered radioactive materials by DOT (49 CFR 173.403y) and IATA, Section 6. If the material is transported by air, then the IATA rules must be followed. Otherwise the DOT regulations must be followed.

If shipping samples by ground, then Table V.1 summarizes the shipping categories and concentration limits for several radionuclides commonly encountered during investigations. The labeling and packaging requirements for these categories are given in 49 CFR 172 parts D and E.

If shipping radioactive samples by air, then the directions below may be followed. A flow chart, figure 1, describes the process of selecting and shipping containers.

1) Decide whether the samples are radioactive. If the activity is less than 2000 ρCi/g, then no special radiological handling is required. If the activity is greater than 2000 ρCi/g, then check 6.0.3 forbidden radioactive materials. If the samples are not forbidden, continue preparing the samples of shipping. If the samples are forbidden call the project Regional Safety Officer (RSO).

2) Determine whether the sample can be shipped as a excepted quantity. Note: In the radiological section, an excepted quantity is equivalent to limited quantity

If only one radionuclide is known to be present, then compare the sample activity to a modified A_2 value. The A_2 value for a specific isotope can be found in Table 6.1.B, in the IATA regulations. The A_2 value is then modified by a factor before comparing the value to the sample activity for classification as an excepted quantity. The factor for soil samples is 10^{-3} and for water sample is 10^{-4}. For example, given a soil sample containing Plutonium - 237 with an activity of 1 Ci, an A_2 value of 500, and a modification factor of 10^{-3}, the sample could not be shipped as an excepted quantity.

$$1 \text{ Ci} < (10^{-3})(500 \text{ Ci})$$

$$1 \text{ Ci} < 0.5$$

not true, Sample can't be shipped as exempt

If the sample activity was equal or less than the modified A_2 value, the sample would be shipped and labeled as an excepted quantity, section 6.2.1. Shipment as excepted quantity requires the inside container to be labeled radioactive and the shipping paper to be marked as indicated in section 6.7.3.a.

If more than one radionuclide is known to be present in the sample, then the activity of each nuclide is divided by a modified A_2 value and summed. If the sum is less than one, then the sample can be shipped as an excepted quantity. The formula for determining whether the mixture is an excepted quantity is, where B(i) is the nuclide activity in the sample, F is the

$$\Sigma \frac{B(i)}{F(A_2)\ (i)}$$

modification factor(10^{-4} for water or 10^{-3} for soil), and A_2 is the value obtained from Table 6.1.B. For example, given a soil sample known to contain Barium-133 with an activity of 0.05 Ci and iron-55 with an activity of 0.2 Ci, the calculation to determine whether it is an excepted quantity

$$1 > \frac{0.05}{(10^{-3})(80)} + \frac{0.2}{(10^{-3})(1000)}$$

$$1 > \frac{0.05}{0.08} + \frac{0.2}{1}$$

$$1 > 0.625 + 0.2$$

$$1 > 0.825$$

true, therefore ship as an excepted quantity. See section 6.2.1.

Note: The activity used to determine whether a sample is shipped as an excepted quantity is based on activity per shipping unit. In other words, if five samples are shipped in a cooler, then the total activity of the five samples is compared to the modified A_2 value.

3) Determine whether the sample be shipped in a Type A package. The same comparison process described for evaluating whether a sample is an excepted quantity is followed except the modification factor is not used. If the material meets the requirements for a Type A package, see section 6.2.3. Marking and labeling as per 6.3 and 6.4.

For example, given a water sample containing only Iron-55 with an activity of 10 Ci. The activity is compared to the A_2 value of 1000 Ci.

$$B(i) < A_2(i)$$

$10 < 1000$ Since 10 is less than 1000, the Type A package is acceptable.

If multiple radionuclides are present, then the formula:

$$\sum \frac{B(i)}{A_2(i)} < 1$$

is used to determine whether a Type A package is appropriate. The sum must be less than 1 to use a Type A package. For example, if a soil sample contains Mercury -197 with an activity of 10 Ci and A_2 value of 200 Ci and Iodine -123 with an activity of 90 Ci and an A_2 value of 100 Ci, then

$$\sum \frac{B(i)}{A_2(i)} < 1$$

$$\frac{10}{200} + \frac{90}{100} < 1$$

$0.05 + .90 < 1$

$0.95 < 1$ True, Type A package is acceptable.

If shipping samples in a Type A package, inform the project RSO and check whether the laboratory is permitted to receive samples with the screened level of activity. If samples cannot be shipped in Type A package, call the project RSO. Samples with activities to great to ship as Type A, require very special handling and are not discussed in the SOP.

TABLE V.1
RADIOACTIVE SAMPLE SHIPMENT REQUIREMENTS

Radionuclide	49 CFR Reference	Concentration	Total Quantity	DOT Class
Tritium in water				
	49 CFR 173.403(y)	<2 μCi/L	NA	Environmental
	49 CFR 173.423	2 μCi/L to 1×10^5 μCi/L	<1,000 Ci/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n)	1×10^5 μCi/L to 5×10^6 μCi/L	<1,000 Ci/ package	UN2912 (LSA)
Plutonium-238 in soil or other solids				
	49 CFR 173.403(y)	0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.423	0.002 μCi/g to 0.1 μCi/g	<30 μCi/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n) 49 CFR 173.435	0.002 μCi/g to 0.1 μCi/g	30 μCi to 3,000 μCi/ package	UN2912 (LSA)
Thorium-232 soil or other solids				
	49 CFR 173.403(y)	<0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.435	0.002 μCi/g to 300 μCi/g	Unlimited	UN2910 (Limited quantity)
Thorium-230 in soil or other solids				
	49 CFR 173.403(y)	<0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.423	0.002 μCi/g to 0.1 μCi/g	<30 μCi/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n) 49 CFR 173.435	0.002 μCi/g to 0.1 μCi/g	30 μCi to 3,000 μCi/ package	UN2912 (LSA)

[a]The package refers to the shipment cooler (not the sample jars).
DOT - U.S. Department of Transportation
NA - not applicable
LSA - low-specific activity

APPENDIX 5.3
TRANSPORTATION OF UNKNOWN HAZARDOUS MATERIALS BY 49 CFR

A. Transportation of Unknown Hazardous Materials by 49 CFR

1. For samples of hazardous substances of unknown content that will be shipped by surface carrier under 49 CFR Transportation Regulations, the appropriate transportation category is selected through a process of elimination using the Department of Transportation (DOT) Hazardous Materials Classification system. While it is probable that most unknown samples of hazardous material shipped by field personnel will not contain radioactive materials or Poison A materials, it is essential for the following gradient hierarchy to be considered.

2. If radiation survey instruments demonstrate (or reasonable probability exists) that the unknown hazardous sample is radioactive, the appropriate DOT shipping regulations for radioactive material must be followed. Contact the subcontractor's health and safety officer for ER Program technical assistance for specific details.

3. If radioactive material is eliminated, the sample must then be considered to contain Poison A materials. DOT defines Poison A as an extremely dangerous, poisonous gas or a gas or liquid of the nature that a very small amount of gas (or vapor of the liquid) will be dangerous to life. Most Poison A materials are gases and would not be found in glass or drum-like containers. All samples taken from closed containers do not have to be shipped as Poison As. Based upon information available, judgment must be made as to whether a sample from a closed container is a Poison A. For specific instructions on the proper procedures for shipping Poison A, contact the subcontractor's health and safety officer for ER Program technical assistance.

4. If Poison A is eliminated as a shipment category, the next two classifications are flammable or nonflammable gases. Because an open container is not expected to contain a significant amount of gas, flammable liquid would be the next applicable category. After the categories of radioactive material, Poison A flammable gas, and nonflammable gas have been eliminated, the sample can be classified as a flammable liquid and shipped accordingly.

5. These procedures would also suffice for shipping any other samples classified below Poison A in the DOT classification table.

6. These procedures would also suffice for shipping any other samples classified below flammable liquids in the DOT classification table.

B. Shipment of Flammable Liquid by 49 CFR

The following instructions apply to the shipment of a flammable liquid by rail car, truck, or other common carrier.

1. Collect the sample in a glass or polyethylene container with a metallic, Teflon-lined screw cap. The container may be no larger than 16 fluid oz. To prevent leakage, fill the container no more than 90% full. Mark the fluid level on the outside of the sample container. If an air space in the sample container would affect sample integrity (for example, the case of a volatile organics analysis vial), place that container within a second container to meet the 90% requirement. Before any samples are placed in the final shipping container, the exterior should be wiped clean with a detergent solution.

2. Complete the sample identification tag (see SOP 1.3, Sample Control and Documentation) and attach it securely to the sample container. The sample identification tag should contain information needed to trace the sample to its point of origin and sample taker, as well as any quality assurance/quality control information.

3. Seal the container and place it in a 2-mL-thick (or thicker) polyethylene bag with one sample in each bag. Position the identification tag so that it can be read through the bag. Seal the bag.

4. Place the sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to secure the lid onto the can.

5. Place one or more metal cans into a strong outside container (like a picnic cooler or a DOT-approved fiberboard box). Surround cans with noncombustible, absorbent cushioning material for stability during transport. Total sample volume in the picnic cooler or fiberboard box should not exceed 10 gallons. A separate air bill and shipping declaration must be processed for each container or combination of containers so that the total sample volume on any air bill will not exceed 10 gallons.

C. Shipment by Land

The following instructions apply for shipment of samples of hazardous material by car or truck (not by common carrier).

1. The above instructions for flammable liquids will apply.
2. Additionally, sample containers must be firmly secured so that they will not bounce against the sides of the vehicle during transit or in an accident.
3. Limit shipments to 1000 lbs or less. Under 1000 lbs, there are no placarding requirements under 49 CFR 172.504 (c) (1).

D. Chain of Custody

Include the Custody Transfer Record/Lab Work Request form (properly executed) in the outside container. It is also recommended to use chain-of-custody tape over each can lid.

E. Marking and Labeling Samples Classified as Flammable Liquid

1. Use abbreviations only where specified.
2. Place the information listed below on each paint can.

   - Laboratory name and address
   - Flammable Liquid, N.O.S. UN 1993. The designation N.O.S. means not otherwise specified. Use an approved DOT label.

3. Information placed on cans should also be placed on at least one side of the outside shipping containers. If labelling is placed on more than one side, it must be attached to all visible sides.

F. Shipping Papers for Samples Classified as Flammable Liquid

Shipping papers must be provided for the shipment of all samples (including those transported by rental, government, company, or personal cars).

G. Bill of Lading/Certification Statement

Complete the bill of lading and sign the certification statement. If the carrier does not provide it, use a standard industry form. Provide the information listed below in the order listed. One form may be used for more than one outside container.

- Flammable Liquid, N.O.S. UN 1993
- Limited Quantity (or Ltd. Qty.)
- Net weight or net volume (weight or volume may be abbreviated) just before or after the UN or ID number.
- Further description (like Laboratory Samples) is allowed if it does not contradict required information.

H. Transportation

1. Transport samples of unknown hazardous material that are classified as flammable liquid by rented or common carrier truck or railroad, as appropriate.

2. Do not transport by any air transport system.

APPENDIX 5.4
TRANSPORTATION OF UNKNOWN HAZARDOUS MATERIAL BY IATA

A. Transportation of Unknown Hazardous Material by International Air Transport Association (IATA)

For samples containing unknown material that will be shipped by air carrier, the most appropriate classification in the IATA regulations is the classification of other regulated substances. In order to use this designation, the categories shown below must be eliminated.

- Radioactive Materials
- Poison A Materials
- Flammable Gases
- Nonflammable Gases

Use of Appendix 5.4 is inappropriate, when the shipper suspects only specific regulated contaminants are present in the samples based on site knowledge or field measurements. If sufficient information is available, to suspect only certain contaminants are present at concentration greater than permitted by excepted quantities, then the samples must be shipped under the appropriate IATA classification, Section 3, as determined by the contaminants. If site contaminants are unknown and both site history and field instruments, preclude classifying the samples within one of the specific IATA classifications, then the samples can be shipped as Class 9 as described below

B. Shipment of Other Regulated Substances

The instructions below will apply for the shipment of other regulated substances by cargo-carrying aircraft, rail car, or other common carrier.

1. Collect the sample in a glass or polyethylene container with a nonmetallic, Teflon-lined screw cap. The container may be no larger than 16 fluid oz. To prevent leakage, fill the container no more than 90% full. If an air space in the sample container would affect sample integrity (for example, the case of a volatile organics analysis vial), place that container within a second container to meet the 90% requirement. Before any samples are placed in the final shipping container, the exterior should be wiped clean with detergent solution.

2. Complete the sample identification tag (see SOP 1.3, Sample Control and Documentation) and attach it securely to the sample container. The sample identification tag should contain information needed to trace the sample to its point of origin and sample taker, as well as any quality assurance/quality control information.

3. Seal the container and place it in a 2-mL-thick (or thicker) polyethylene bag with one sample in each bag. Position the identification tag so that it can be read through the bag. Seal the bag.

4. Place the sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to secure the lid onto the can.

5. Place one or more metal cans into a strong outside container (like a picnic cooler or a DOT-approved fiberboard box). Surround cans with noncombustible, absorbent cushioning material for stability during transport. Total sample volume in the picnic cooler or fiberboard box should not exceed 40 liters.

C. Chain of Custody

Include the Custody Transfer Record/Lab Work Request form (properly executed) in the outside container. It is also recommended to use chain-of-custody tape over each can lid.

D. Marking and Labeling Samples Classified as Other Regulated Substances

1. Use abbreviations only where specified.

2. Place the information listed below on each paint can.

   - Laboratory name and address
   - Other regulated substances, UN8027. Hazardous Class # 9

3. Information placed on cans should also be placed on at least one side of the outside shipping containers. If labelling is placed on more than one side, it must be attached to all visible sides.

4. Cargo Aircraft Only must be printed on all outside shipping containers.

5. Print Laboratory Samples and This End Up or This Side Up clearly on top of the outside shipping container. Outside containers also must contain the statement" Inside Packages to Comply with Prescribed Specifications." Put upward pointing arrows on all four sides of the container.

E. Shipping Papers for Samples Classified as Other Regulated Substances

Shipping papers must be provided for the shipment of all samples (including those transported by rental, government, company, or personal cars).

F. Bill of Lading/Certification Statement

Complete the bill of lading and sign the certification statement. If the carrier does not provide it, use a standard industry form. Provide the information listed below in the order listed. One form may be used for more than one outside container.

- Other Regulated substances, UN8027
- Class or Division # 9

- Net weight or net volume (weight or volume may be abbreviated) just before or after the UN or ID number.
- Further description (like Laboratory Samples) is allowed if it does not contradict required information.

G. Transportation

1. Transport samples of unknown hazardous material that are classified as other regulated substances by rented or common carrier truck, railroad, express overnight package services, or other appropriate means.

2. Do not transport by any passenger-carrying air transport system. Ship by air carriers that transport only cargo (for example, Federal Express).

STANDARD OPERATING PROCEDURE 1.6

GENERAL EQUIPMENT DECONTAMINATION

1. PURPOSE

To describe methods for the decontamination of field equipment potentially contaminated during sample collection.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a given operation. The FSP or WP also contains specifications for the use of decontamination agents, areas where decontamination will be performed, and quality assurance procedures to verify the effectiveness of the decontamination procedures. Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for the safety of all field personnel.

Decontamination is mainly achieved by rinsing with liquids that include soap or detergent solutions, tap water, deionized water, and methanol. Equipment is allowed to air dry after being cleaned or wiped dry with chemical-free cloths or paper towels. It can then be reused immediately. Steam cleaning should be used whenever visible contamination exists or for large machinery/vehicles.

It is the primary responsibility of the site manager to assure that proper decontamination procedures are followed and that all waste materials produced are properly stored or disposed of. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that contaminants are not negligently introduced into the environment.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
6.4	Total Alpha Surface Contamination Measurements

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1.

E. Notify the analytical laboratory of the decontamination blank sample and the approximate arrival date.

F. Contact the carrier that will transport the sample to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

A. Assemble containers and equipment for decontamination.

B. Decontaminate all equipment before use.

3.3. Operation

The extent of known contamination determines the extent to which equipment must be decontaminated. If the extent of contamination cannot be readily determined, clean the equipment on the assumption that it is highly contaminated until enough data are available to allow an accurate assessment of the level of contamination.

Adequate supplies of rinsing liquids and all materials should be available. Perform decontamination in the same level of protective clothing as sampling activities unless a different level of protection is specified in the FSP or Health and Safety Plan.

The procedure for full field decontamination follows. Any deviations from this procedure for a specific project are included in the FSP or WP.

Decontamination Steps

1. The purpose of the initial step is to remove gross contamination. Remove any solid particles from the equipment or material by brushing and then

rinsing with available tap water. For drilling equipment, steam cleaning is necessary.

2. Wash equipment with a nonphosphate soap or detergent solution, such as Alconox®.

3. Rinse with tap water by submerging or spraying.

4. For organic contaminants, rinse with methanol then hexane. Methanol must be of a laboratory-reagent grade and hexane a "pesticide" grade.

5. Rinse thoroughly with distilled water.

6. Air dry equipment or rinse with nanograde methanol to expedite drying.

7. If radiation screening is required by the FSP or WP, screen the equipment with a radiation detector according to SOP 6.4, Total Alpha Surface Contamination Measurements; or SOP 6.12, Radon-222 Flux Measurements Using Charcoal Canisters. If activity above the limits for unrestricted use is detected, repeat steps 1-6.

8. Samples of drippings from the last rinse in step 5 may be collected and analyzed to verify the effectiveness of the decontamination procedure. This type of sample is called a decontamination blank. The results of these analyses are not usually available for at least one week after they arrive in the laboratory, so it is important to do a thorough decontamination from the start of the sampling activity to minimize the potential for a positive hit in the decontamination drippings.

3.4. Postoperation

3.4.1. Field

A. Decontaminate as much sampling equipment as possible and properly dispose of expendable items that cannot be decontaminated. Proper disposal may involve onsite drumming of liquids and solids in approved containers for subsequent disposal. Expensive items like machinery may require a more advanced decontamination analysis.

B. Prepare the decontamination blank sample and transport it according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

C. Store containers of solutions produced during decontamination in a secure area.

D. Dispose of any soiled materials as designated in the FSP or WP.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of contamination attained.

3.4.3. Office

A. Deliver original logbooks to the site manager for technical review. He/she will review and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that the sample arrives safely and instructions for analyses are clearly understood.

D. After receiving the results of the laboratory analyses, arrange for the disposal of wastes generated during the investigation.

4. SOURCE

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Decontamination solutions preselected by the laboratory

_____ Cleaning liquids: soap or detergent solutions, tap water, deionized water, and methanol

_____ Chemical-free paper towels

_____ Cleaning brushes

_____ Cleaning containers: plastic buckets and galvanized steel pans

_____ Waste storage containers: drums and plastic bags

STANDARD OPERATING PROCEDURE 1.8

PERSONNEL DECONTAMINATION--LEVEL D PROTECTION

1. PURPOSE

To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading to higher levels of protection.

Level D protective clothing is primarily a work uniform. This level of protection is worn when work functions preclude splashes, immersion, inhalation, or exposure to materials above the action limits specified in the FSP or WP.

Although Level D protection is worn under these conditions, workers may be wearing disposable coveralls and gloves, safety boots/shoes, a hard hat, and safety glasses. Therefore, the site Health and Safety Plan must address the proper disposition of disposable clothing and decontamination measures that should be implemented. The disposition of disposable items must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; documentation procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.9	Personnel Decontamination--Level C Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The FSP or WP Health and Safety Plan will specify the procedures and equipment required for the decontamination and disposal of Level D protective clothing. All onsite personnel will be informed about the proper disposal of protective clothing and any decontamination solutions used.

C. Appendix 5.1 lists the items suggested for Level D decontamination. This list provides general guidelines and can be modified in order to meet site-specific work activities or features.

D. Obtain necessary clothing, protective gear, and equipment. Read the Health and Safety Plan and ensure that necessary decontamination materials are available.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

Before initiating field activities, designate an area for decontamination activities. Although Level D areas should be minimally contaminated, always use caution to prevent the potential spread of any unknown contaminants.

3.3. Operation

The following decontamination procedures are recommended for Level D protection. These measures represent suggested guidelines and may be modified to meet site-specific conditions.

A. Remove any disposable coveralls, rubber gloves, and boot covers and place in a plastic trash sack.

B. If dusty conditions have been encountered, use water-dampened paper towels to remove the dust from hard hats and safety glasses/goggles. Place used paper towels in a trash sack.

C. If necessary, decontaminate safety boots with water and a steel brush. Do not wear muddy or dusty boots out of the exclusion zone.

D. All workers should wash hands and face before leaving the site.

E. All workers should change clothing and shower as soon as possible after the day's work activities.

3.4. Postoperation

3.4.1. Field

Collect all trash sacks containing disposable clothing. Dispose of trash sacks according to the requirements of the site Health and Safety Plan. The site manager or field team leader is responsible for the safe disposal of any items.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

Return all unused items to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG) and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides." Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Plastic trash sacks
30-gallon size: (no. of boxes) _____
20-gallon size: (no. of boxes) _____

_____ Plastic wash tub: (number) _____

_____ Paper towels: (no. of rolls)_____

_____ Liquid hand soap

_____ Wet wipe towelettes

_____ Water container
(size) 1 gallon_____ 5 gallon_____

_____ Brushes (scrub or wire)

_____ Alpha scintillation detector

STANDARD OPERATING PROCEDURE 1.9

PERSONNEL DECONTAMINATION--LEVEL C PROTECTION

1. PURPOSE

To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information regarding the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading or downgrading to other levels of protection.

Protective clothing and equipment must be worn by personnel when known or suspected hazardous substances are involved. The necessary equipment and procedures for decontaminating personnel in Level C protection are addressed in this SOP. The procedures include maximum and minimum decontamination measures.

The establishment of decontamination lines is site specific; these lines depend upon the types of contamination and the work performed. When the decontamination line is no longer required, contaminated wash and rinse solutions and articles must be contained and disposed of appropriately. Disposal must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.8	Personnel Decontamination--Level D Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The selection of the appropriate level of personnel decontamination is site specific and is given in the site Health and Safety Plan. Coordinate any changes with the site health and safety coordinator. Considerations for selection include work activity, known or suspected contaminants, previous experience at the site, and health and safety requirements.

C. The site Health and Safety Plan should include details of the procedures for the ultimate disposal of protective clothing and waste water. The packaging and disposal procedures must be approved by the installation authorities responsible for waste disposal. Inform all onsite personnel about the proper disposal of protective clothing and decontamination solutions.

D. Appendix 5.1 includes recommendations for equipment and supplies used in maximum decontamination measures. Appendix 5.2 includes recommendations for equipment and supplies used in minimum decontamination measures. These appendixes contain general equipment guidelines. The selection of equipment must be site specific to incorporate unusual work activities or site features. Detailed information is in the FSP or WP.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

A. Before field activities begin, establish site work zones to prevent the accidental spread of hazardous substances. The establishment of work zones is site specific and coordinated with the site health and safety coordinator at the time the Health and Safety Plan is prepared. Considerations for establishing work zones should include wind direction, weather conditions, emergency situations, changes in site activities, and access.

B. Appendix 5.3 shows an example of a maximum decontamination layout for Level C protection. Appendix 5.4 shows an example of the minimum decontamination layout for Level C protection.

NOTE: The layouts may be modified according to site-specific conditions.

3.3. Operation

3.3.1. Maximum Decontamination Measures

The maximum decontamination measures for Level C are described in Appendix 5.5. These measures are guidelines and may be modified according to site-specific conditions.

3.3.2. Modification of Maximum Decontamination Measures

Depending upon site-specific conditions and circumstances, modifications to the maximum decontamination measures may be permissible. Two example situations in which the maximum decontamination measures may be modified are described below.

A. Situation 1--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and safety boots are not contaminated.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, 4 through 8, 10, 11, and 14 through 17.

B. Situation 2--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and safety boots are not contaminated. The individual needs a new canister or mask and will return to the exclusion zone.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1 and 4 through 9.

3.3.3. Minimum Decontamination Measures

The minimum decontamination measures for Level C are described in Appendix 5.6. These measures are guidelines and may be modified according to site-specific conditions.

3.4. Postoperation

3.4.1. Field

After the completion of field activities, all contaminated wash and rinse waters, decontamination solutions, and contaminated articles must be properly disposed of. The disposal methods must follow installation requirements. The site manager or field team leader is responsible for the safe disposal of contaminated materials. Planning for the proper disposal should be included during office preparation before field activities begin.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

Return all unused or properly decontaminated equipment will be returned to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides." Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency document, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies for Maximum Decontamination Measures for Level C

5.2. Equipment and Supplies for Minimum Decontamination Measure for Level C

5.3. Maximum Decontamination Layout for Level C Protection

5.4. Minimum Decontamination Layout for Level C Protection

5.5. Maximum Measures for Level C Decontamination

5.6. Minimum Measures for Level C Decontamination

APPENDIX 5.1

EQUIPMENT AND SUPPLIES FOR MAXIMUM DECONTAMINATION MEASURES FOR LEVEL C

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 4:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 5:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools

Station 6:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 7:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 8:
a. Containers (20-30 Gallons)
or
High-pressure spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 9:
a. Air Tanks or Face Masks and Cartridge, Depending on Level
b. Tape
c. Boot Covers
d. Gloves

Station 10:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools
d. Boot Jack

Station 11:
a. Rack
b. Drop Cloths
c. Bench or Stools

Station 12:
a. Table

Station 13:
a. Basin or Bucket
b. Decon Solution
c. Small Table

Station 14:
a. Water
b. Basin or Bucket
c. Small Table

Station 15:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 16:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 17:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 18:
a. Water
b. Soap
c. Small Table
d. Basin or Bucket
e. Field Showers
f. Towels

Station 19:
a. Dressing Trailer in Inclement Weather
b. Tables
c. Chairs
d. Lockers
e. Cloths

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.2

EQUIPMENT AND SUPPLIES FOR MINIMUM DECONTAMINATION MEASURES FOR LEVEL C

Station 1:
- a: Various Size Containers
- b. Plastic Liners
- c. Plastic Drop Cloths

Station 2:
- a. Containers (20-30 Gallons)
- b. Decon Solution
- c. Rinse Water
- d. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

Station 4:
- a. Air Tanks or Masks and Cartridges, Depending Upon
- b. Tape
- c. Boot Covers
- d. Gloves

Station 5:
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

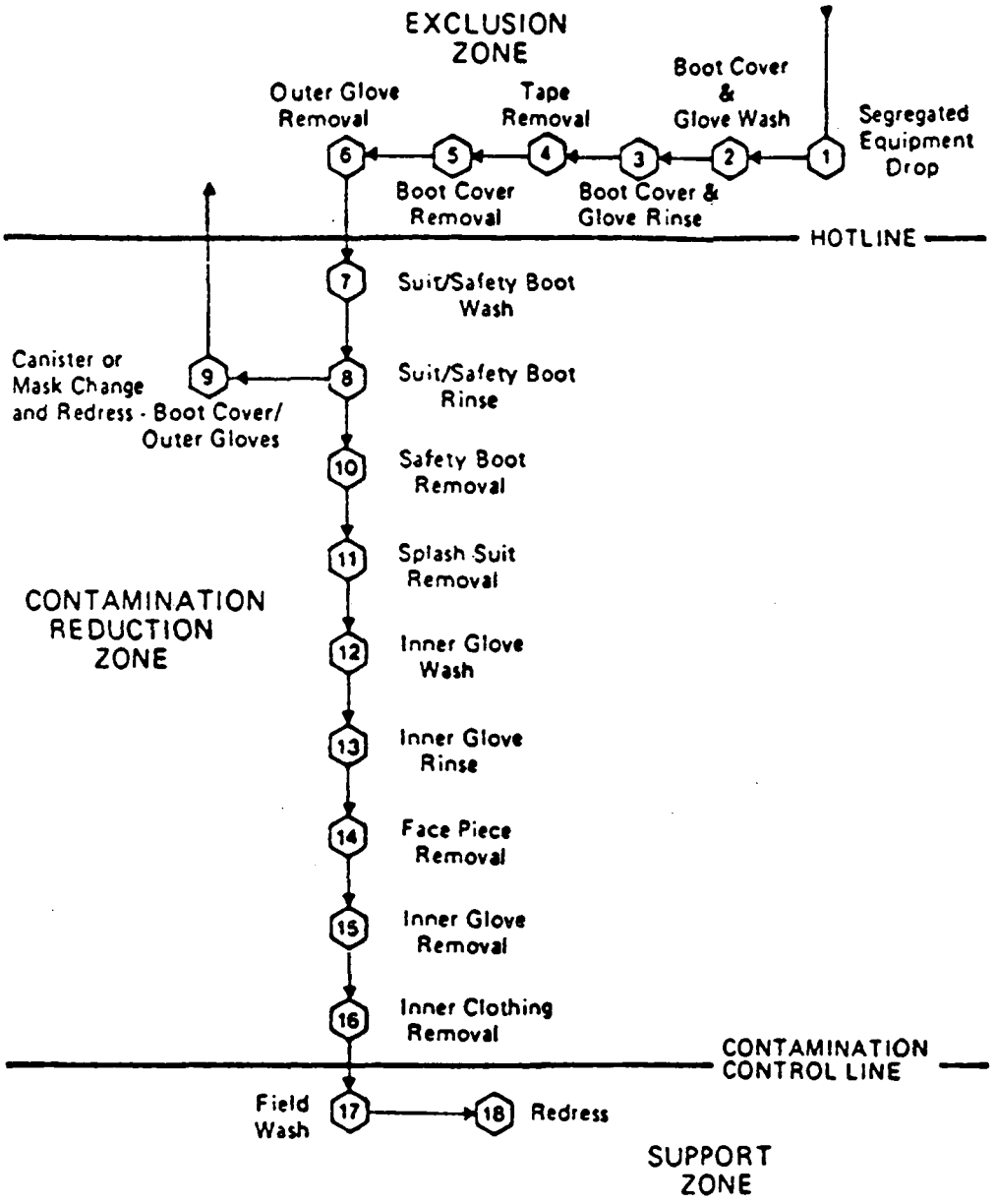
Station 6:
- a. Plastic Sheets
- b. Basin or Bucket
- c. Soap and Towels
- d. Bench or Stools

Station 7:
- a. Water
- b. Soap
- c. Tables
- d. Wash Basin or Bucket

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.3

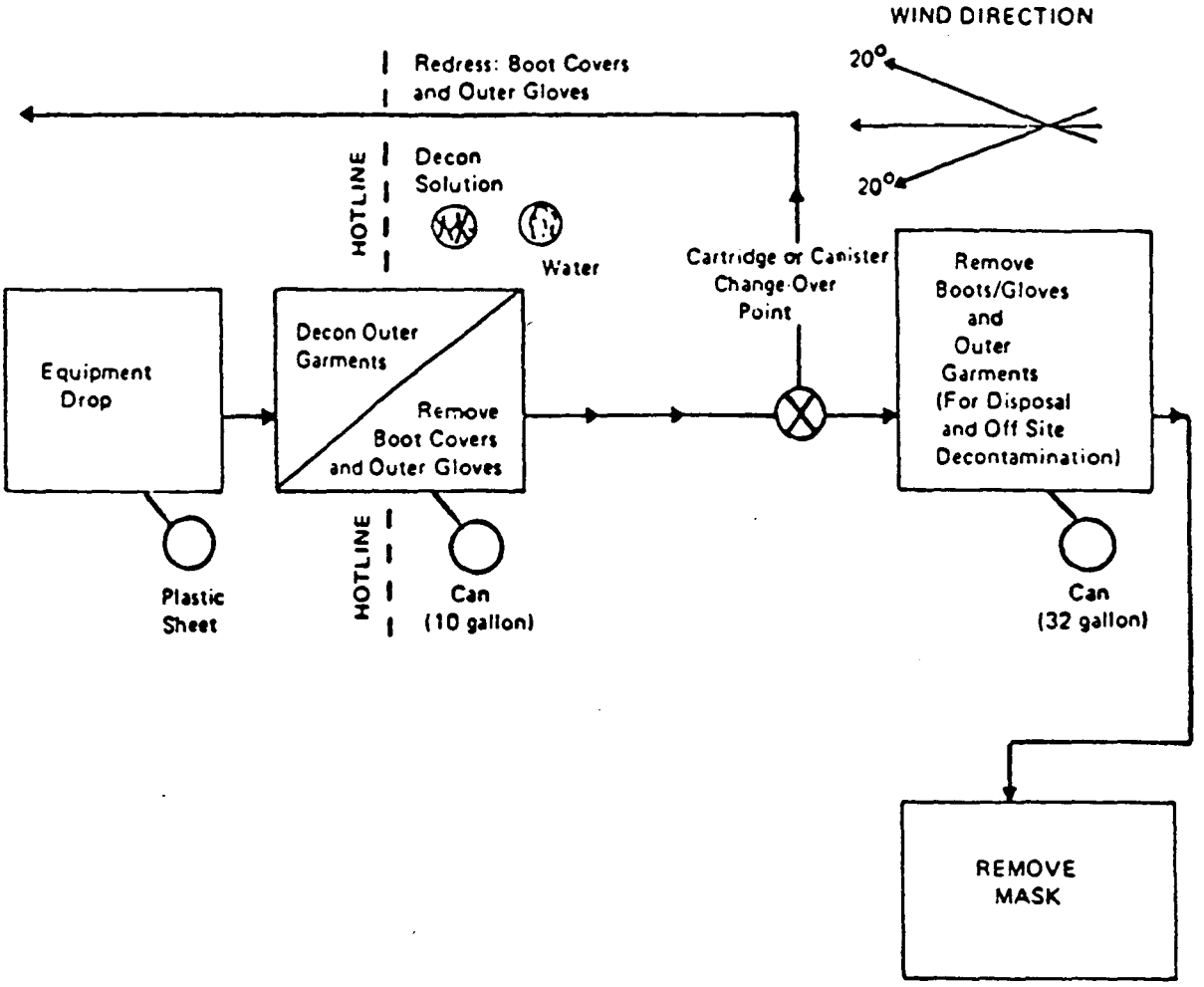
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



SOURCES: NIOSH, OSHA, USCG and EPA, October 1985
U.S. EPA, November 1985

APPENDIX 5.4

MINIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



SOURCES: NIOSH, OSHA, USCG and EPA, October 1985
U.S. EPA, November 1985

APPENDIX 5.5

MAXIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Segregated Equipment Drop	1. Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2. Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3. Rinse off decon solution from station 2 using copious amounts of water.
Station 4:	Tape Removal	4. Remove tape around boots and gloves and deposit in container with plastic liner.
Station 5:	Boot Cover Removal	5. Remove boot covers and deposit in containers with plastic liner.
Station 6:	Outer Glove Removal	6. Remove outer gloves and deposit in container with plastic liner.
Station 7:	Suit and Boot Wash	7. Wash splash suit, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution.
Station 8:	Suit and Boot and Glove Rinse	8. Rinse off decon solution using water. Repeat as many times as necessary.
Station 9:	Canister or Mask Change	9. If worker leaves exclusion zone to change canister (or mask), this is the last step in the decontamination procedure. The worker's canister is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.

APPENDIX 5.5, Continued

MAXIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 10:	Safety Boot Removal	10. Remove safety boots and deposit in container with plastic liner.
Station 11:	Splash Suit Removal	11. With assistance of helper, remove splash suit. Deposit in container with plastic liner.
Station 12:	Inner Glove Rinse	12. Wash inner gloves with decon solution.
Station 13:	Inner Glove Wash	13. Rinse inner gloves with water.
Station 14:	Face Piece Removal	14. Remove face piece. Deposit in container with plastic liner. Avoid touching face with fingers.
Station 15:	Inner Glove Removal	15. Remove inner gloves and deposit in lined container.
Station 16:	Inner Clothing Removal	16. Remove clothing soaked with perspiration and place in lined container. Do not wear inner clothing away from the site, because there is a possibility that small amounts of contaminants might have been transferred in removing the outer clothing. When applicable, begin a gross alpha contamination survey.
Station 17:	Field Wash	17. Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 18:	Redress	18. Put on clean clothes.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.6

MINIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves, and splash suit with decon solution or detergent water. Rinse off using water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. The worker's canister is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 5:	Boots, Gloves, and Outer Garment Removal	5. Boots, chemical-resistant splash suit, and inner gloves are removed and deposited in separate containers lined with plastic.
Station 6:	Face Piece Removal	6. Face piece is removed. Avoid touching face with fingers. Face piece deposited on plastic sheet.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

STANDARD OPERATING PROCEDURE 1.15

GUIDE TO MANAGEMENT OF INVESTIGATION-DERIVED MATERIAL

1. PURPOSE

The purpose of this standard operating procedure (SOP) is to provide general guidance and specific procedures for the management of investigation-derived material (IDM) at the U.S. Department of Energy's (DOE) Mound Plant in Ohio. This SOP describes the procedures used by the Environmental Restoration (ER) Program technical assistance contractors for the sampling of IDM, and provides guidance on the sampling and disposition of IDM. A discussion on material segregation and drum reuse is also included. Other procedures or requirements used by installation subcontractors must conform to this SOP. The disposal of hazardous, radioactive, or mixed IDM is covered under separate policies and procedures.

2. DISCUSSION

In general, IDM is material derived from environmental site investigation activities such as soil boring procedures, well construction and installation, aquifer testing, water quality sampling of wells, and decontamination of sampling and drilling equipment (rinsate). These materials are potentially subject to various regulations governing storage and disposal. Mound Plant is a CERCLA Site, therefore, applicable or relevant and appropriate requirements (ARARs) must be followed. Also, the response is required to comply with the substantive requirements for permits, but is not required to obtain permits. Figure 1 is a decision tree illustrating the management of IDM.

2.1. Sampling and Staging

The IDM is sampled for analytical testing and placed in labeled drums. Drums containing solid IDM, such as soil, are staged at the original sampling site, if possible, or moved to the Central Staging Area. All drums containing liquid IDM, such as purge water, are moved to the Central Staging Area. The containerized IDM is held until results of the analytical testing are used to classify the IDM and determine what actions are to be followed.

2.2. Classification Criteria

IDM can be classified as hazardous, radioactive, mixed, solid, or clean, depending on its characteristics. Each class is managed differently. Solid IDM that is not classified as hazardous, radioactive, or mixed by the CERCLA, RCRA, and DOE criteria described below is handled as solid waste in accordance with State of Ohio Environmental Protection Agency (OEPA) regulations.

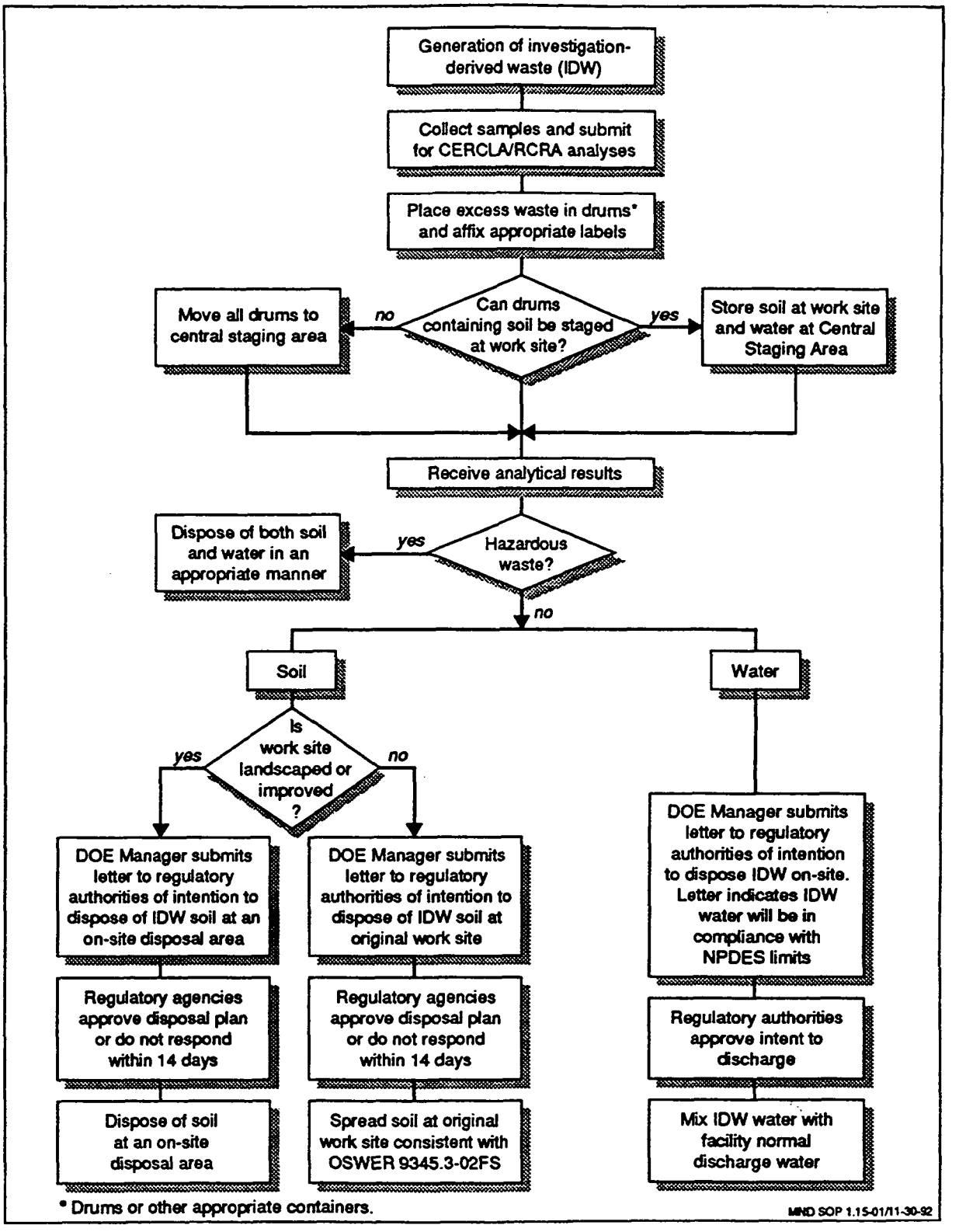
Hazardous IDM is material exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity as specified in 40 CFR 261, Subpart C, or mixtures of IDM and hazardous wastes specifically listed in 40 CFR 261, Subpart D.

Radioactive IDM is material containing concentrations of plutonium-238 and thorium-232 greater than 25 picoCuries per gram (pCi/g) and 5 pCi/g, respectively.

Mixed IDM is material that meets the definition of both hazardous and radioactive IDM.

Solid IDM is material that cannot be classified as hazardous, radioactive, or mixed, yet exhibits concentrations of identified potential chemical contaminants above background levels.

Clean IDM is material which contains identified potential chemical contaminants at concentrations less than background levels.



Management of investigation-derived waste.

2.3. Actions

Liquid IDM (purge water) that is nonhazardous will be added to Mound Plant normal discharge water and discharged through NPDES Outfall 001.

IDM classified as clean may be moved to Mound Plant's IDM Area, yet to be approved and constructed. IDM classified as solid waste will be disposed of at an OEPA approved landfill (off site).

IDM classified as hazardous, radioactive, or mixed will be disposed of or treated as dictated by federal and state regulations. There are currently (February 1993) only limited alternatives for mixed waste, so it would be held until alternatives could be evaluated as directed by CERCLA.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, SOPs 1.1 through 1.10 must be reviewed. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies, decontamination procedures, and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.5	Guide to the Handling, Packaging and Shipping of Samples
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the Work Plan or Sampling and Analysis Plan, and SOPs listed in subsection 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Determine that a sufficient number of drums and labeling materials are available for the IDM.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Obtain a sufficient number of the appropriate ER Program data collection forms. Consult Mound Plant OU-9 Quality Assurance Project Plan (QAPP) Table of Contents (DOE 1992).

C. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms and drum labels.

3.3. Operation

The following step-by-step procedure will ensure that all agreed-to practices are followed in the management of the IDM.

3.3.1. Drum Labeling

Drums will be marked with waterproof labels with the following information:

- date material was placed in the drum;
- source location ID (release site/well number (for decon water));
- medium (soil, water, or personal protective equipment);
- statement to the effect: "Investigation-derived material from CERCLA RI/FS; for more information contact subcontractor manager (name, phone number), EG&G Operable Unit Manager (name, phone number), or Monte Williams (x 4543)";
- FIDLER screening value;
- head space analysis value, if applicable; and
- sample numbers

3.3.2. Soil

A. Samples of soil cuttings will be collected at the work site, analyzed for radioactivity, and transmitted to the laboratory for CERCLA- and RCRA-type analyses.

B. Remaining soil that is not sampled will be placed in labeled, open-top (removable lid), metal drums and held at either the original sampling site, if possible, or moved to the Central Staging Area, currently the Waste Oil Drumfield.

C. Drum groups within the staging area will be placed on wooden pallets and covered with tarps to prevent weathering of the drums and protect label integrity.

D. A sign posted within the staging area will identify the drums as "Investigation-Derived Material" and will include the same information described in Section 3.3.1.

E. After receiving analytical results from the laboratory, the IDM will be classified as solid, hazardous, radioactive, or mixed in accordance with OEPA regulations and RCRA, CERCLA, and DOE criteria.

F. If the soil is determined to be solid, hazardous, or radioactive, it will be disposed of or treated at an appropriate disposal or treatment facility. Mixed waste will be held for further evaluation of alternatives.

G. Solid waste, other than soils, generated by the technical assistance contractor and subcontractor(s) (e.g., wipes, protective clothing that is not LSA, visqueen, garbage) will be segregated and placed in a dumpster for off-site disposal.

H. Bulk (large pieces) of asphalt or demolition material generated by breaking through pavement will be segregated and disposed of separately in an approved on-site area.

3.3.3. Water

A. Samples of water produced at the work site will be collected, analyzed for radioactivity, and transmitted to the laboratory for CERCLA analyses.

B. The remaining water that is not sampled will be placed in labeled, closed-top (non-removable lid), polyethylene drums and held at the Central Staging Area, currently the Waste Oil Drumfield.

C. Drum groups will be placed on wooden pallets and covered with tarps to prevent weathering of the drums and protect label integrity.

D. A sign posted within each staging area will identify the drums as "Investigation-Derived Material" and will include the same information described in Section 3.3.1.

E. After receiving analytical results from the laboratory, the IDM will be classified as nonhazardous, hazardous, radioactive, or mixed in accordance with OEPA regulations and RCRA, CERCLA, and DOE criteria.

F. If the water is nonhazardous, the remedial project manager at DAO will submit a letter to the OEPA water quality branch indicating that the IDM water will be added to normal Mound Plant discharge and will be in compliance with NPDES limits. Analytical results will be included in the submission. A copy of this letter will be submitted to U.S. EPA by DAO. Upon approval from OEPA, the water will then be discharged through Mound Plant NPDES Outfall 001 and directed off site to the Great Miami River. DAO will simultaneously notify U.S. EPA of the intent to discharge.

G. If the water is determined to be hazardous or radioactive, it will be disposed of or treated at an appropriate disposal or treatment facility. Mixed waste will be held for further evaluation of alternatives.

H. Liquid waste generated by the technical assistance contractor and subcontractor(s) (e.g., motor oil, additives, detergent solutions) will be segregated and disposed of or recycled separately at an appropriate facility.

3.3.4. Central Staging Area

A. The Central Staging Area is currently the Waste Oil Drumfield. It will be used for:

- purge water from wells;
- soil that cannot be stored at the work site because it hinders Mound Plant operations; and
- soil from areas off the site (e.g., the Miami-Erie Canal).

B. The Waste Oil Drumfield will be used immediately with the knowledge that it is a potential release site and remedial activities are in progress. Surface and subsurface samples obtained from the Waste Oil Drumfield will be analyzed for radioactivity and submitted to the laboratory for CERCLA analyses.

C. After results of surface and subsurface sampling and analysis are available, assuming that no remediation is required, the Waste Oil Drumfield will become a semi-permanent staging area for CERCLA wastes. It will be fenced and locked, with ER Program (EG&G and its contractors) to retain control of the area. It is presumed that at the conclusion of the ER Program, the area may need to be sampled again to verify that it was not contaminated by spills.

3.3.5. Waste Segregation

A. Waste Segregation will occur at a Central Staging Area. Drums presumed to contain radioactive soil (e.g., from Miami-Erie Canal) will be labeled as such and will be kept in a separate zone away from those presumed to contain hazardous waste. This is to prevent the accidental creation of mixed waste.

B. When information is available indicating the nature of the contents, containers may be stored separately from other noncompatible materials which may interact with the waste in a hazardous manner.

3.3.6. Drum Database

A database will be created and maintained to track the drums and their contents for the duration of time that they contain IDM. The database will contain information described in Section 3.3.1 and include a timeline documenting waste management procedures.

3.3.7. Drum Reuse

A. Empty drums used to move solid, nonhazardous IDM to an off-site landfill will be rinsed of visible solid residue. Rinsate from these drums will be handled in the same manner as the purge water as described in section 3.3.3. Empty drums used for nonhazardous liquid IDM that has been disposed of into NPDES Outfall 001 are not expected to contain solid residue and will not be rinsed. When these procedures are completed, empty drums may then be reused for subsequent IDM generated by the ER Program (it is assumed that drums will be reused only within the ER Program).

B. Drums that previously held low-specific activity (LSA) waste and have been emptied into LSA containers will be marked and retained only for radioactive soil that is unlikely to be hazardous.

C. It is assumed that drums containing IDM that is determined to be hazardous will be used to transport the waste off site.

3.4. Post Operation

3.4.1. Documentation

Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

3.4.2. Office

Deliver original forms and logbooks to the site manager for technical review. The site manager will review and sign the forms, and transmit them to the document control officer (copies to the files) for eventual delivery to the DOE.

4. REFERENCES

DOE. 1992. "Remedial Investigation/Feasibility Study, Operable Unit 9, Site-Wide Quality Assurance Project Plan, Draft Final, Mound Plant Environmental Restoration Program, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico, December 1992.

EPA. 1991. "Guide to Management of Investigation-Derived Wastes." U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Publication: 9345.3-02FS, May 1991.

STANDARD OPERATING PROCEDURE 6.1

HEALTH AND SAFETY MONITORING OF COMBUSTIBLE GAS LEVELS

1. PURPOSE

To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure. Combustible gas indicators (or explosimeters) are used to determine the potential for the combustion or explosion of unknown atmospheres. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or lower flammability limit (LFL) by measuring the change in electrical resistance in a Wheatstone bridge circuit.

CGIs provide readouts in units of percent LEL, in parts per million (ppm) combustible gases by volume, or both. The types of combustible gases to be encountered are often unknown. In those instances, the more explosive the calibration gas (the lower the LEL), the more sensitive the indication of explosivity, and a greater margin of safety results. The operator should be familiar with the LEL concentrations for specific gases to effectively use instruments that provide data only in ppm combustible gas (by volume).

Although instruments can be purchased that are factory-calibrated for gases like butane, pentane, natural gas, or petroleum vapors, methane calibration is the most common. The LEL of methane is 5% by volume in air; therefore, an air mixture containing 5% methane will be read as 100% LEL and is explosive. When combustible gases other than methane are sampled, the relative response of the detector must be considered. Recalibration to other gases may be possible (see the manufacturer's recommendations), and National Bureau of Standards (NBS) traceable calibration gases should be used. The relative sensitivity of the detector and the differences in LEL for different gases will produce varying meter responses. Correlation equations that will convert the percent LEL (based on methane) indicated by the instrument to a percent LEL for another combustible gas can usually be found in the CGI operating manual. Many units have alarm systems that can be adjusted for various LELs, and several incorporate oxygen analyzers.

2.1. Definitions

A. Lower Explosive Limit (LEL)

The LEL (also LFL, lower flammability limit) is defined as the lowest concentration of gas or vapor in air by volume that can be ignited and cause an explosion or flame propagation.

B. Upper Explosive Limit (UEL)

The UEL (also UFL, upper flammability limit) is the concentration of gas in air above which there is insufficient oxygen available to support combustion and an explosion is unlikely. A flame, however, may burn at the gas/air interface. Should additional air enter the mixture, a very explosive atmosphere may develop.

2.2. Instrument Limitations

A. Of the many instruments commercially available for detecting combustible or explosive gas, some are not certified safe for operation in the atmospheres they can detect. It is important to use only those instruments that are certified safe for use in atmospheres greater than 25% of the LEL. The instrument manufacturer's operating manual should be consulted to determine safety certification in specific atmospheres.

B. Combustible gas measurement instruments do not indicate if a given atmosphere contains hazardous or toxic compounds.

C. The CGI cannot be used in atmospheres containing silanes, silicones, silicates, or other compounds containing silicon because these substances seriously impair the instrument response.

D. If the detector has a platinum filament, its sensitivity may be reduced by exposure to gases like leaded gasoline vapors (tetraethyl lead), sulfur compounds (mercaptans and hydrogen sulfide), and sulfide compounds. An inhibitor filament that will nullify the effect of leaded gasoline vapors is available on some commercial units (Mine Safety Appliances Company, Model 260 Portable Combustible Gas and Oxygen Alarm). The instrument manufacturer's operating manual should be consulted to determine the instrument's ability to function in leaded gasoline atmospheres.

E. An oxygen detector should be used in conjunction with a CGI. Select a unit with this feature and follow the operating manual when the oxygen detector is calibrated and used. This is especially important when atmospheres are monitored within enclosed spaces or where oxygen deficient atmospheres (<19.5%) may exist.

F. Unusually high concentrations of sulfur dioxide, fluorine, chlorine, bromine, iodine, and oxides of nitrogen cause measurement interference.

G. Combustible gas indicator instruments must be calibrated frequently. Using an NBS traceable calibration gas, consult the manufacturer's operating manual for calibration frequency. Also, frequent calibration

will be necessary if several known organic species are present. Maximum accuracy requires a recalibration for each gas.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Perform a minimal check of the CGI in the office to ensure that it is functioning properly. Obtain the CGI, its operating manual, and a supply of NBS traceable gas. Methane is the factory calibration gas, but other gases may be used for specific requirements. Perform the equipment checks described below.

1. Make sure the instrument is clean and serviceable, especially sample lines and detector surfaces.

2. Check the battery charge level. If in doubt, charge the battery as described in the operating manual. Some units have charge level meters, while others have only low charge alarms.

3. Turn the unit to the on position and allow the instrument sufficient warmup time.

4. Verify that the sample pump is operable when the analyzer is on. The pump can usually be heard when operating.

5. With the intake assembly in combustible gas-free ambient air, zero the meter by rotating the zero control until the meter reads 0% LEL. For instruments with an additional oxygen meter, adjust the dial to 21% oxygen in nonhazardous locations.

6. Calibrate the unit against a known concentration of a calibration gas like hexane by rotating the calibration control (span or gain) until the meter reads the same concentration as the known standard.

7. Some instruments, like the Gas Tech Model 1314, require internal calibrating with a small screwdriver. Consult the operating manual before calibration. With this model, it is also necessary to maintain the proper flow rate during calibration. Connect a flow meter between the CGI and the calibration gas cylinder to monitor the flow rate.

8. The Gas Tech Model 1314 and others are equipped with three meters that read in percent O_2, percent LEL, and ppm. A correctly calibrated instrument for determining percent LEL is critical for monitoring many work environments. The percent oxygen is usually factory calibrated and should not be adjusted in the field. The ppm dial is often not used in the field unless a Photoionization Detector (PID) or Flame Ionization Detector (FID) is not available, as these instruments are considered to be more accurate.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Instrument Check

Before using the CGI in the field, follow the procedures in Section 3.2.1.D. Additional adjustments may be made. If necessary, adjust the alarm setting to the appropriate combustibility limit. The action level or the point at which activities are halted and personnel removed from the immediate vicinity is usually less than 25% of the LEL for the gases that are present.

B. Record necessary calibration data in the logbook and include the information listed below.

1. Date and time of arrival at the site

2. Site identification

3. Instrument, model number, and serial number

4. Date/time calibrated

5. Calibration gas used

6. Calibration location

7. Operator's signature

3.3. Operation

3.3.1. Field Measurements

A. Calibrate the CGI daily before use in the field. The calibration procedure for the Gas Tech Model 1314 is outlined in Appendix 5.4. Also, consult the manufacturer's manual.

B. Complete the Combustible Gas Indicator Monitoring Data form (Appendix 5.2) as described in Appendix 5.3, Data Form Completion.

C. Position the intake assembly close to the area in question to get an accurate reading. For readings taken downhole during drilling, there will be a slight delay between positioning the intake tubing downhole and registering accurate meter readings because of the time required for the sample to travel the length of the tube.

D. In general, combustible gas indicator instruments respond in the manner described below.

1. The meter indicates 0.5 LEL (50%). This means that 50% of the concentration of combustible gas needed to reach an unstable combustible situation is present. If the LEL of the gas is 5% in air, then the instrument indicates the presence of a 2.5% mixture.

2. The meter needle stays above 1.0 LEL (100%). This means that the concentration of combustible gas is greater than the LEL and less than the UEL. Therefore, the concentration is immediately combustible and explosive.

3. The meter needle rises above the 1.0 (100%) mark and then returns to zero. This response indicates that the ambient atmosphere has a combustible gas concentration greater than the UEL.

E. Personnel should evacuate the area if any of the events listed below occur.

1. Sounding of the alarm

2. Readings that reach the action levels designated in the Health and Safety Plan

3. Malfunctioning of the CGI

4. Condition encountered or suspected that indicates oxygen enrichment or depletion of the atmosphere (specially designed units are available for operation in those atmospheres)

F. Some important factors to keep in mind during use are listed below.

1. Slow, sweeping motions of intake or cell assembly will help ensure that problem atmospheres are not bypassed. Cover an area from floor (ground) to ceiling, the breathing zone, and areas where maximum concentrations may be expected (for example, downhole during drilling).

2. Operation of the unit in temperatures outside the recommended operating range may compromise the accuracy of readings or damage the instrument. Check the operating manual for the temperature limitations of a particular model.

3. Many combustible gas indicators are not designed for use in oxygen-enriched or depleted atmospheres. If this condition is encountered or suspected, personnel should evacuate the area. Specially designed units are available for operation in those atmospheres.

4. Use an oxygen detector in conjunction with a CGI. Select a unit and follow the operating manual for calibration and use of the oxygen detector.

5. Calibrate the equipment regularly and charge the battery after each field use. See the operating manual for details.

6. The operator should fully understand the operating principles and procedures for the specific CGI in use.

3.4 Postoperation

3.4.1 Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the CGI with a damp disposable towel to remove any visible dirt. Return the CGI to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

EPA. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition," U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Combustible Gas Indicator Monitoring Data Form

5.3. Data Form Completion

5.4. Calibration Procedure for Gas Tech Model 1314

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ CGI

_____ Battery charger for CGI

_____ Oxygen sensor

_____ Battery charger for oxygen sensor

_____ Spare gas detector filaments

_____ Spare batteries for CGI

_____ Jeweler's screwdrivers for internal adjustment

_____ Calibration kit

A) Spare gas cylinder (NBS traceable calibration gas)
B) Valve attachment
C) Flexible tubing (tygon)
D) Cylinder to encapsulate sensor probe

_____ Probe extensions

APPENDIX 5.2

COMBUSTIBLE GAS INDICATOR MONITORING DATA FORM

COMBUSTIBLE GAS INDICATOR (CGI) MONITORING DATA

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

CGI MANUFACTURER _____ CGI MODEL NO _____

SERIAL NO _____ CALIBRATION DATE/TIME _____

ACCEPTANCE CODE _____ BATTERY CONDITION _____

CALIBRATION GAS (%LEL):
TYPE _____ CONCENTRATION _____ % LEL CYLINDER SERIAL NO _____

CALIBRATION GAS (PPM):
TYPE _____ CONCENTRATION _____ PPM CYLINDER SERIAL NO _____

COMMENTS _____

LOCATION ID OR DESCRIPTION	COORDINATES (FT)		MONITORING TIME (HH:MM)	LOCATION TYPE	% LOWER EXPLOSIVE LIMIT	PPM	% OXYGEN
	NORTH	EAST					

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES: BH – BOREHOLE SL – SURFACE LOCATION TP – TEST PIT WL – WELL

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

CGI–101 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

COMBUSTIBLE GAS INDICATOR MONITORING DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained, in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. CGI Manufacturer. The company that manufactured the CGI.

6. CGI Model No. The model number of the CGI.

7. CGI Serial No. The serial number of the CGI.

8. CGI Calibration Date/Time. The date and time when the CGI was last calibrated.

9. Acceptance Code. One-character code assigned by the site manager.

10. Battery Condition. The battery charge reading at the beginning of the measurement.

11. Calibration Gas (% LEL). This information consists of three data fields: the chemical name of the calibration gas (type), concentration of the calibration gas (% LEL), and the serial number of the gas cylinder.

12. Calibration Gas (ppm). This information consists of three data fields: the chemical name of the calibration gas (type), concentration of the calibration gas (ppm), and the serial number of the gas cylinder.

13. Comments. Any additional information.

14. Location ID or Description. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

15. Coordinates (Ft). The location of the measurement of the survey grid in units of feet. The two coordinate fields are in the format north, east.

16. Monitoring Time (HH:MM). The time when a field measurement was taken in the format hours:minutes using a 24-hr clock. Example: 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m. (See conversion table below.)

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

17. Location Type. Code describing the location of the CGI reading. The location type codes are: BH--borehole, TP--test pit, SL--surface location, and WL--well.

18. Percent Lower Explosive Limit. The reading obtained with the meter set to the LEL Scale.

19. PPM. The reading with the meter set to the PPM scale.

20. Percent Oxygen. Record the percent oxygen reading in this data field.

GASTECH MODEL 1314 CALIBRATION

CALIBRATION PROCEDURE

1. PPM RANGE
   - 1.01 Turn on instrument, allow to warm up and adjust zero in normal way.
   - 1.02 Add a few drops of water to glass wool packing inside humidifier. Glass wool should be moist but not dripping.
   - 1.03 Couple flowmeter to Cilpiok fitting, and humidifier to flowmeter inlet, as shown.
   - 1.04 Couple Cilpiok fitting to instrument inlet.
   - 1.05 Readjust zero as required after instrument stabilizes.
   - 1.06 Note flowmeter reading.
   - 1.07 Connect calibration valve to ppm–range cylinder. Open valve slightly to produce a small flow.
   - 1.08 Couple valve outlet to humidifier inlet.
   - 1.09 Adjust valve to give same flow on flowmeter as observed in 1.06.
   - 1.10 Watch meter as gas enters instrument. Observe highest reading.
   - 1.11 Compare reading with marked gas concentration on cylinder.
   - 1.12 If not correct, adjust calibration as shown in Section V of Instruction Manual.
   - 1.13 Turn off valve and disconnect calibration components.
2. LEL Range

   Use same procedure as above, but in LEL range. However, omit humidifier as it is not necessary in LEL range. Use LEL range cylinder.

GMC-130 (1/88)

STANDARD OPERATING PROCEDURE 6.2

HEALTH AND SAFETY MONITORING OF ORGANIC VAPORS WITH A PHOTOIONIZATION DETECTOR

1. PURPOSE

To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of the given operation and the applicability of this procedure to the work activities.

The PID is useful as a general survey instrument at hazardous waste sites. A PID is capable of detecting and measuring real-time concentrations of many organic and inorganic vapors in the air. A PID is similar to a flame ionization detector (FID) in application. The PID has somewhat broader capabilities because it can detect certain inorganic vapors. Conversely, the PID is unable to respond to certain low molecular weight hydrocarbons (like methane and ethane) that are readily detected by FID instruments. Appendix 5.1 describes the application comparisons between an FID organic vapor analyzer and a PID.

A PID will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionizing source in the detector, which is an ultraviolet (UV) lamp. Several probes are available for the PID, each having a different source and a different ionization potential. For this reason, the selection of the appropriate probe is essential in obtaining useful field results. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases. Therefore, it indicates an integrated response to the mixture.

2.1. PID Instrument Limitations

A. The PID is a nonspecific total vapor detector. It cannot be used to identify unknown substances; it can only quantify them.

B. The PID must be calibrated to a specific compound.

C. The PID does not respond to certain low molecular weight hydrocarbons like methane and ethane.

D. Certain toxic gases and vapors like carbon tetrachloride and hydrogen cyanide have high ionization potentials and cannot be detected with a PID.

E. Certain models of PID instruments are not intrinsically safe. Refer to the manufacturer's operating manual for use in potentially flammable or

combustible atmospheres. A PID should be used in conjunction with a combustible gas indicator (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels).

F. Electrical power lines or power transformers close to the PID instrument may cause measurement errors. Under this circumstance, refer to the operating manual for proper procedures.

G. High winds and high humidity will affect measurement readings. Certain models of PID instruments become unusable under foggy conditions. An indication of this is the needle dropping below 0.

H. The lamp window must be periodically cleaned to ensure ionization of the air contaminants.

I. One PID instrument, the HNu, measures concentrations from about 1 to 2000 ppm, although the response is not linear over this entire range. For example, the response to benzene is linear from about 0 to 600 ppm. This means the HNu reads a true concentration of benzene only between 0 and 600. Greater concentrations are read at a lower level than the true value. Consult the manufacturer's operating manual to determine the instrument's response to various chemicals.

2.2. Regulatory Limitations

A. Transport of calibration gas cylinders by passenger and cargo aircraft follow the U.S. Code of Federal Regulations, 49 CFR Parts 100-177. Benzene is a typical calibration gas included with a PID. Benzene is classified as a nonflammable gas, UN 1556, and the proper shipping name is compressed gas. It must be shipped in cargo aircraft only.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.1	Health and Safety Monitoring of Combustible Gas Levels

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.2. Perform the procedures described below.

1. Start-Up Procedure

   a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug interface. Do not use excessive force.

   b. Turn the function switch to the battery check position. The needle on the meter should be within or above the green battery arc on the scale; if not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

   c. Turn the function switch to any range setting. Look into the end of the probe to see if the lamp is on. If it is on, it will emit a purple glow. Do not stare into the probe any longer than 3 sec. Long-term exposure to UV light will damage the eyes. Also, listen for the hum of the fan motor.

   d. To zero the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed because this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted (if necessary). Wait 15 to 20 sec to ensure that the zero reading is stable. If necessary, readjust the zero.

2. Operational Check

   a. Follow the start-up procedure.

   b. With the instrument set on the 0 to 20 range, hold a solvent-based marker pen near the probe tip. If the meter deflects upscale, the instrument is working.

3. Calibration Procedure

   a. Follow the start-up procedure and the operational check.

   b. Set the function switch to the range setting for the concentration of the calibration gas.

c. Remove the detector from the outer casing by loosening the screw on the bottom of the casing.

d. Attach a regulator to a disposable cylinder of calibration gas. Connect the regulator to the probe of the PID with a piece of clean tygon tubing. Open the valve on the regulator.

e. After 15 sec, adjust the internal calibration screw until the meter reading equals the concentration of the calibration gas used. Consult the operating manual for the location of this screw.

f. If the PID does not start up, check out or calibrate properly and notify the equipment manager immediately. Under no circumstances should work requiring monitoring with a PID be performed without a properly functioning instrument.

g. Replace the detector in the outer casing.

h. Contact the carrier that will transport equipment and hazardous materials to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the calibration data on the Photoionization Detector Field Data form (Appendix 5.3). See Appendix 5.4 (Data Form Completion) for instructions.

3.2.3. Field

A. Follow the start-up procedure, operational check, and calibration check described in Section 3.2.1.D.

B. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0 to 20 ppm range; adjust the range if necessary.

C. With the exception of the probe's inlet and exhaust, wrap the PID in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside the instrument in the event of precipitation.

3.3. Operation

3.3.1 Measuring organic vapor levels using the PID

A. As with any field instrument, accurate results depend on the operator's knowledge of the operator's manual. Follow the instructions in the operating manual explicitly in order to obtain accurate results.

B. Position the intake assembly close to the monitoring area because the low sampling rate allows for only very localized readings. Do not immerse the intake assembly in fluid under any circumstances.

C. While taking care not to permit the PID to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site Health and Safety Plan. Conduct the PID survey at a slow to moderate rate of speed and slowly sweep the intake assembly (the probe) from side to side.

D. During drilling activities, perform PID monitoring at every 5-ft interval downhole, at the headspace, and in the breathing zone. In addition, monitoring may be performed in the breathing zone during actual drilling when elevated organic vapor levels are encountered. When the activity being monitored does not involve drilling (like surface sampling), readings may only be recorded in the breathing zone. Refer to the site Health and Safety Plan for specific monitoring instructions.

E. Be prepared to evacuate the area if the preset alarm sounds. Operators using supplied air systems may not need to evacuate the work area, but they should frequently observe the levels indicated by the instrument.

F. Static voltage sources like power lines, radio transmissions, or transformers may interfere with measurements. See the operator's manual for a discussion of necessary considerations.

3.4. Postoperation

3.4.1. Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the PID with a damp disposable towel to remove any visible dirt. Return the PID to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment and charge the batteries. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

HNU Systems, Inc. 1986. "Instruction Manual for the Trace Gas Analyzer Model PI 101." Newton, Massachusetts.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transporatation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Characterization of Hazardous Waste Sites--A Methods Manual: Volume II, Available Sampling Methods, Second Edition" U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Comparison of the FID and PID

5.2. Equipment and Supplies Checklist

5.3. Photoionization Detector Field Data Form

5.4. Data Form Completion

APPENDIX 5.1

COMPARISON OF THE FID AND PID

	FID	PID
Response	Responds to many organic gases and vapors, especially low molecular weight hydrocarbons.	Responds to many organic and some inorganic gases and vapors, especially heavy hydrocarbons.
Application	In survey mode, detects total concentrations of gases and vapors. In GC mode, identifies and measures specific compounds.	In survey mode, detects total concentrations of gases and vapors. Some identification of compounds possible if GC column and standards are used.
Limitations	Does not respond to inorganic gases and vapors with a higher ionization potential than the flame detector. No temperature control.	Does not respond to methane or inorganic aliphatic chlorinated solvents. Does not respond properly in presence of water vapor (high humidity). Does not detect a compound if probe (lamp) has a lower energy than compound's ionization potential.
Calibration gas	Methane and others	Benzene (1,3-butadiene) and others
Ease of operation	Requires experience to interpret correctly, especially in GC mode.	Fairly easy to use and interpret. More difficult in the GC mode.
Detection limits	0.1 ppm (methane)	0.1 ppm (benzene), depends on lamp voltage.
Response time	2-3 sec (survey mode)	3 sec for 90% of total concentration

APPENDIX 5.1, Continued

	FID	PID
Maintenance	Periodically clean and inspect particle filters, valve rings, and burner chamber. Check calibration and pumping system for leaks. Recharge battery after each use.	Clean UV lamp frequently. Check calibration regularly. Recharge battery after each use.
Useful range	0-1000 ppm	0-2000 ppm
Service life	8 hrs; 3 hrs with strip chart recorder	10 hrs; 5 hrs with strip chart recorder

APPENDIX 5.2

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Photoionization detector (PID)

_____ Operating manual

_____ Probes: 9.5eV_____, 10.2eV_____, and 11.7eV_____

_____ Battery charger for PID

_____ Spare batteries

_____ Jeweler's screwdriver for adjustments

_____ Tygon tubing

_____ NBS traceable calibration gas (type)_____

_____ "T" valve for calibration

_____ Intake assembly extension

_____ Strap for carrying PID

_____ Teflon tubing for downhole measurements

_____ Plastic bags for protecting the PID from moisture and dirt

APPENDIX 5.3

PHOTOIONIZATION DETECTOR FIELD DATA FORM

PHOTOIONIZATION DETECTOR FIELD DATA

FACILITY CODE _____ **LOG DATE** _____

LOCATION ID _____ LOCATION TYPE _____

LOGGER CODE _____ FIELD REP _____

PHOTOIONZATION DETECTOR INSTRUMENT: MODEL _____

MANUFACTURER _____ DATE/TIME CALIBRATED _____

SERIAL NO _____ **ACCEPTANCE CODE** _____

CALIBRATION GASES:	
TYPE/CYLINDER ID NO	CONCENTRATION (PPM)/SPAN
1	1
2	2

COMMENTS _____

TIME (HH:MM)	SAMPLE ID	OBSERVED READING (ppm)					DRILLING DEPTH (FT)	COMMENTS
		DH	HS	BZ	D	OT		

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

LOCATION TYPES:
BH – BOREHOLE
SS – SOIL SAMPLE
SL – SURFACE LOCATION
SB – SAMPLE BOTTLE
TP – TEST PIT
WL – WELL
OT – OTHER

OBSERVED READING: D – DURING DRILLING (BZ)
DH – DOWNHOLE BZ – BREATHING ZONE
HS – HEADSPACE OT – OTHER

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
PHD–040 (1/88)

FORM COMPLETED BY/DATE

TECHNICAL REVIEWER/DATE

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PHOTOIONIZATION DETECTOR FIELD DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where the program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

4. Location Type. Two-character code identifying where the sample was taken. There is one location type for each location ID. Location types include those listed below.

   BH--Borehole

   TP--Test Pit

   SL--Surface Location

   WL--Well

   SB--Sample Bottle

   SS--Soil Sample

   OT--Other (explain)

5. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information on the form.

6. Field Rep. The name of the field representative.

7. PID Model. Model of photoionization detector (PID) instrument.

8. PID Manufacturer. Manufacturer's name on the PID instrument used.

9. Date/Time Calibrated. Last day and time when the PID instrument was calibrated. Calibration should be performed daily.

10. Serial No. Serial No. of PID instrument.

11. Acceptance Code. One-character code assigned by the site manager.

12. Calibration Gases

    a) Type/Cylinder ID No. Name of the calibration gas and the identification number of the cylinder.

    b) Concentration (ppm)/span. Concentration of calibration gas in parts per million (ppm) and the span setting for calibration.

13. Comments. Any additional information.

14. Time (HH:MM). The time when a field measurement was taken in the 24-hr clock format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

15. Sample ID. When samples are being taken during a PID monitoring, the identification number or code assigned to a particular sample (like 01) is correlated with the observed readings and appropriate drilling depth (if drilling is being performed). This is useful in selecting samples for analyses and in the correlation of laboratory data with PID measurements.

16. Observed Reading (ppm). PID reading at the respective location ID in the units indicated on the meter. When the calibration gas and the gas being measured for the environment are the same, the meter reads in parts per million (ppm) during drilling. Readings may be taken downhole, at the headspace, and in the breathing zone, and data should be recorded in the appropriately marked column.

17. Drilling Depth (Ft). PID monitoring is performed every 5 ft during drilling. The depth of the drilling is listed in feet and can be given as the most recent interval (like 5-10) or as the ending depth (like 10).

18. Comments. Any additional information, including the type of gas being measured if this determination can be made (for example, by labels on drums).

STANDARD OPERATING PROCEDURE 6.3

HEALTH AND SAFETY MONITORING OF ORGANIC VAPORS WITH A FLAME IONIZATION DETECTOR

1. PURPOSE

To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable flame ionization detector (FID).

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of the given operation and the applicability of this procedure to the work activities.

An FID is useful as a general screening tool to detect the presence of most organic vapors. It can be used to detect pockets of gaseous hydrocarbons in depressions or confined spaces, to screen drums or other containers for the presence of trapped vapors, or to screen an area for the presence of elevated levels of vapor-phase organics.

The FID is similar to a photoionization detector (PID) in application, but cannot detect certain inorganic vapors that are detected by the PID. However, the PID is unable to respond to certain low molecular weight hydrocarbons (like methane and ethane) that are readily detected by FID instruments. Appendix 5.1 describes the application comparisons between an FID organic vapor analyzer and a PID.

The FID will respond to most organic vapors as they form positively charged ions when burned in a hydrogen flame. The magnitude of the response is a function of the detector sensitivity and the ionization properties of the particular compound, as well as its concentration. As a result, the response must be compared with the response generated by a known concentration of a standard gas. The sample concentration is then reported as the parts-per-million (ppm) equivalent of the standard gas. Most units are calibrated with methane; however, almost any gaseous hydrocarbon that produces a response can be used. Many models also have built-in calibration circuits to ensure that the electronic response remains constant in all ranges.

2.1. FID Instrument Limitations

A. The FID does not respond to nongaseous organic compounds like some pesticides, polynuclear aromatic hydrocarbons (PNAs), and polychlorinated biphenyls (PCBs).

B. Most portable FIDs rely on the sample gas to supply the combustion air to the detector flame, so they are designed to operate in ambient atmospheres with oxygen concentrations of approximately 21%. This design precludes the sampling of process vents, poorly ventilated or sealed containers, or any sample gas hydrocarbon concentration sufficient to reduce the available oxygen or saturate the detector. Optional equipment is available that supplies oxygen from a compressed gas bottle or introduces sample gas through a dilution system with a known dilution factor.

C. Concentrations beyond the greatest scale factor of the instrument or in excess of 30% of the lower explosive limit (LEL) of the sample component require system modification. If system modifications are required, consult the manufacturer's operating manual.

D. Certain FID instruments have negligible response to carbon monoxide (CO) and carbon dioxide (CO_2). Their structure precludes the production of appreciable ions in the detector flame so other organic materials may be analyzed in the presence of CO and CO_2.

E. As with the PID, the FID responds differently to different compounds. Appendix 5.2 contains a list of the relative sensitivities of one FID model to some common organic compounds. Because the instrument is factory calibrated to methane, all relative responses are given in percentages with methane at 100. Therefore, the identity of the chemical of interest must be ascertained before its concentration can be determined. In addition, the unit requires a trained individual to maintain and operate the unit.

F. In general, the FID is more sensitive to hydrocarbons than to any other chemical class. Compounds containing oxygen, such as alcohols, ethers, aldehydes, carbolic acid and esters, give a lower response than that observed for hydrocarbons. This is particularly noticeable with compounds having a high ratio of oxygen to carbon, such as the lower members of each series which have one, two or three carbons. With compounds containing higher numbers of carbons, the effect is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

Nitrogen-containing compounds (e.g., amines, amides, and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, $CHCl_3$ gives a much higher response than CCl_4. As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simple hydrocarbons.

2.2. Regulatory Limitations

A. International Air Transport Association (IATA) Dangerous Goods Regulations (2.9.2, Jan 1992) prohibit carrying compressed hydrogen gas on passenger aircraft. When the FID instrument is transported on a passenger aircraft, the hydrogen gas contained in the instrument must be emptied before loading.

B. Transport of an FID or extra cylinders of hydrogen gas or calibration gas by cargo aircraft must comply with the regulations stipulated in 49 CFR, Parts 100-177.

C. Appendix 5.6 describes the procedure for transporting an FID with a hydrogen tank. Consult the shipper for any recent changes in this procedure.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection,

preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Contact the carrier that will transport samples to obtain information on regulations and specifications.

E. Assemble the equipment and supplies listed in Appendix 5.3. Perform the functional checks described below. The purpose of these checks is to verify that an instrument will function properly (for example, the batteries are serviceable and the instrument can be zeroed and calibrated) in the field. If problems develop, obtain a replacement unit and perform the same functional checks.

1. Turn the instrument on and allow adequate warmup time.

2. Check the battery charge level indicator. If it is not fully charged, recharge the battery as described in the manual.

3. Turn on the pump and check for leaks by covering the sample inlet and observing the rotameter. The indicator ball should drop to zero.

4. With the pump operating, open the hydrogen gas storage tank valve and the supply regulator to allow fuel gas to flow into the detector chamber.

5. Depress the igniter switch, observe the indicator needle for positive response, and listen for a pop. if the flame fails to light, depress the igniter switch again. Once the detector flame is lit, the unit is ready for use. Before lighting the detector flame, always be sure that the carrier gas flow (usually sample gas) is started.

6. If the instrument has internal calibration capability, perform the instrument calibration according to the procedures described in the operating manual.l

7. If the instrument has an alarm mode, set the alarm at the desired concentration.

3.2.2. Documentation

A. Obtain a logbook from the logbook coordinator.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the calibration data on the Photoionization Detector Field Data form (Appendix 5.3). See Appendix 5.4 (Data Form Completion) for instructions.

3.2.3. Field

Before using the FID in the field, perform the following instrument checks to ensure that the equipment was not damaged during transport:

A. Follow the instrument checkout procedures described in Section 3.2.1.E.

B. If calibration to a specific hydrocarbon species is desired, complete this procedure according to the manufacturer's operating instructions.

C. Calibrate the FID daily before each use in the field.

3.3. Operation

3.3.1. Field Measurements of Organic Vapors

As with any field instrument, accurate results depend on the operator's knowledge of the operator's manual. The instructions in the manual should be followed explicitly in order to obtain accurate results.

A. Hold the sample probe in the area in question. The low sample rate allows for only very localized readings.

B. A slow sweeping motion should help prevent the bypassing of problem areas. Make sure the batteries are recharged within the time frame specified in the operator's manual. The usual length of the operating time between charges is 8 to 12 hours.

C. During drilling activities, perform FID monitoring at 5-ft intervals downhole, at the headspace, and in the breathing zone. In addition, where elevated organic vapor levels are encountered, monitoring may be performed in the breathing zone during actual drilling. When the activity does not require drilling (like surface sampling), readings may only be recorded in the breathing zone. Consult the Health and Safety Plan for the specific monitoring instructions.

D. In many areas in and adjacent to Mound Plant, organic vapors in subsurface are suspected to be from methane gas. All positive readings on OVA will be followed by installation of charcoal filters. Readings, both with and without the filter, will be recorded in logbooks. All organic vapors except methane will be absorbed by the filter.

After collecting the readings, STOP WORK and notify project manager of the measurements. The project manager will provide further instructions. Site geologic conditions may require use of double casings as described in SOP 4.1.1.

E. Some units have alarms that signal the operator if the detector flame goes out. If the alarm sounds, evacuate the work area, relight the flame in a known safe area, and reenter the site.

F. Monitor fuel and combustion air supply gauges regularly to ensure sufficient gas supplies.

G. High background readings after prolonged use may indicate that the sample probe or in-line filters (in front of detector) need to be cleaned. Use pipe cleaners to clean the probe and clean air blown backwards through the probe to clean the filters. Do not use organic solvents because the detector may be saturated by the solvent.

H. Perform the routine maintenance described in the operating manual. Because the unit contains pressurized gas supplies, also perform leak-check procedures regularly. Leaking hydrogen gas is explosive.

I. Concentrations beyond the maximum full-scale capability of the instrument or in excess of 30% LEL of the sample component require system modification. Similar modification may be necessary for sampling in oxygen-deficient atmospheres. This usually entails increasing the combustion air to the detector by sample dilution or by an independent air supply. A dilution system is the apparatus required to supply a filtered, controlled air supply for analyzers that use the sample gas stream as the source of combustion air. A dilution system can dilute a gas stream by ratios up to 100:1 through the selection of various critical orifices.

3.4. Postoperation

3.4.1. Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the FID with a damp disposable towel to remove any visible dirt. Return the FID to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. If necessary, make sure all survey or sampling locations are properly staked and that the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Charge the instrument batteries.

D. If necessary, replenish supplies of the NBS traceable calibration gas.

4. SOURCES

Foxboro Analytical (A Division of The Foxboro Company). 1985. "Instruction and Service Manual, Century Systems Portable Organic Vapor Analyzer, Model OVA-128." New Haven, Connecticut.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transportation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition," U.S. Environmental Protection Agency document EPA-600/4-84-076, December 1984. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada,.

5. APPENDIXES

5.1. Comparison of the FID and PID

5.2. Relative Sensitivities of the FID to Some Common Organic Compounds

5.3. Equipment and Supplies Checklist

5.4. Flame Ionization Detector Field Data Form

5.5. Data Form Completion

5.6. Shipment of OVA-128 and Hydrogen Tank

APPENDIX 5.1

COMPARISON OF THE FID AND PID

	FID	PID
Response	Responds to many organic gases and vapors, especially low molecular weight hydrocarbons	Responds to many organic and some inorganic gases and vapors, especially heavy hydrocarbons.
Application	In survey mode, detects total concentrations of gases and vapors. In GC mode, identifies and measures specific compounds.	In survey mode, detects total concentrations of gases and vapors. Some identification of compounds possible if GC column and standards are used.
Limitations	Does not respond to gases and vapors with a higher ionization potential than the flame detector. No temperature control.	Does not respond to methane or aliphatic chlorinated solvents. Does not respond properly in the presence of water vapor or high humidity. Does not detect a compound if the probe (lamp) has a lower energy than the compound's ionization potential.
Calibration gas	Methane and others	Benzene (1,3- butadiene) and others
Ease of operation	Requires experience to interpret correctly, especially in GC mode.	Fairly easy to use and interpret. More difficult in the GC mode.
Detection limits	0.1 ppm (methane)	0.1 ppm (benzene), depends on lamp voltage.
Response time	2-3 sec (survey mode)	3 sec for 90% of total concentration
Maintenance	Periodically clean and inspect particle filters, valve rings, and burner chamber. Check calibration and pumping system for leaks. Recharge battery after each use.	Clean UV lamp frequently. Check calibration regularly. Recharge battery after each use.
Useful range	0-1000 ppm	0-2000 ppm
Service life	8 hrs; 3 hrs with strip chart recorder	10 hrs; 5 hrs with strip chart recorder

APPENDIX 5.2

RELATIVE SENSITIVITIES OF THE FID TO SOME COMMON ORGANIC COMPOUNDS

Compound	Relative Response
Methane	100
Ethane	90
Propane	64
n-Butane	61
n-Pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Acetone	100
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
Methanol	15
Ethanol	25
Isopropyl alcohol	65
Carbon tetrachloride	10
Chloroform	70
Trichloroethylene	72
Vinyl chloride	35

Source: Foxboro Analytical, 1985.

APPENDIX 5.3

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Flame ionization detector (FID)

_____ Probe extension

_____ Operating manual

_____ Battery charger

_____ Spare batteries

_____ Jeweler's screwdriver for adjustments and calibration

_____ Refueling hose for hydrogen cylinder

_____ NBS traceable calibration gas

APPENDIX 5.4

FLAME IONIZATION DETECTOR FIELD DATA FORM

FLAME IONIZATION DETECTOR FIELD DATA

FACILITY CODE _____ LOG DATE _____

LOCATION ID _____ LOCATION TYPE _____

LOGGER CODE _____ FIELD REP _____

FLAME IONIZATION DETECTOR INSTRUMENT :

MANUFACTURER _____ MODEL _____

SERIAL NO _____

DATE/TIME CALIBRATED _____ ACCEPTANCE CODE _____

CALIBRATION GASES :	
TYPE/CYLINDER ID NO	CONCENTRATION (PPM)
1	1
2	2

COMMENTS _____

TIME (HH:MM)	SAMPLE ID	OBSERVED READING (ppm)					DRILLING DEPTH (FT)	COMMENTS
		DH	HS	BZ	D	OT		

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES:		OBSERVED READING:	
BH – BOREHOLE	SB – SAMPLE BOTTLE	DH – DOWNHOLE	BZ – BREATHING ZONE
TP – TEST PIT	SL – SURFACE LOCATION	HS – HEADSPACE	D – DURING DRILLING (BZ)
SS – SOIL SAMPLE	WL – WELL		OT – OTHER
	OT – OTHER (EXPLAIN)		

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
FID–042 (1/93)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.5

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

FLAME IONIZATION DETECTOR FIELD DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

4. Location Type. Two-character code identifying where the samples were taken. There is one location type for each location ID. Location types include those listed below.

   BH–Borehole

   TP–Test Pit

   SL–Surface Location

   WL–Well

   SB–Sample Bottle

   SS–Soil Sample

   OT–Other (explain)

5. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

6. Field Rep. The name of the field representative.

7. Manufacturer. Manufacturer's name on flame ionization detector (FID) instrument used.

8. Model. Model of FID instrument.

9. Serial No. Serial No. of FID instrument.

10. Date/Time Calibrated. The day and time when the FID instrument was calibrated. Calibration should be performed daily.

11. Acceptance Code. One- character code assigned by the site manager.

12. Calibration Gases

    a. Type/Cylinder ID No. The identification of the calibration gas and the lot number on the cylinder.

    b. Concentration (ppm). The concentration of the calibration gas in parts per million (ppm).

13. Comments. Any additional information.

14. Time (HH:MM). Time when a field measurement was taken in the 24-hr clock format of hours:minutes (for example, 0837 for 8:37 a.m. and 1912 for 7:12 p.m.)

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	0100
12:00 Noon	1200
1:00 p.m.	1300
2:00 p.m.	1400
3:00 p.m.	1500
4:00 p.m.	1600
5:00 p.m.	1700
6:00 p.m.	1800
7:00 p.m.	1900
8:00 p.m.	2000
9:00 p.m.	2100
10:00 p.m.	2200
11:00 p.m.	2300
12:00 Midnight	2400

15. Sample ID. When samples are being taken while FID monitoring is being performed, the identification number or code assigned to a particular sample like 01 is correlated with the observed readings and appropriate drilling depth if drilling is being performed. This is useful in selecting samples for analyses and in the correlation of laboratory data with FID measurements.

16. Observed Reading (ppm). FID reading at the respective location ID in the units indicated on the meter. When the calibration gas and the gas being measured for the environment are the same, the meter reads in parts per million. Measurements can be made in the breathing zone, downhole, at the headspace, or other specified locations.

17. Drilling Depth (Ft). FID monitoring is performed every 5 ft during any type of drilling. The depth of the drilling is listed in feet and can be given as the most recent interval (like 5-10) or as the ending depth (like 10).

18. Comments. Any additional information, such as type of gas being measured, if this determination can be made (for example, by labels on drums).

APPENDIX 5.6

SHIPMENT OF OVA-128 AND HYDROGEN TANK

An organic vapor analyzer (OVA) is typically shipped with a charged cylinder and a supplementary hydrogen tank to a hazardous waste site as part of the safety monitoring requirements for site characterization. The OVA and the hydrogen tank must be shipped so as to protect their integrity and to protect against potential damage or injury that may be caused from leakage/breakage of the equipment. Regulations addressing the packaging, labeling, and shipping of an OVA and a hydrogen tank are described in 49 CFR Parts 171-178.
The packaging and labeling requirements for shipment of the OVA and the hydrogen tank are summarized in the following paragraphs.

A. Organic Vapor Analyzer

The OVA must be placed in its own case or in a box to minimize damage during handling and transportation. The following labels must be placed on the container before shipping.

1. A Flammable Gas label (red and white label)
2. A Danger label (orange and black label)
3. A label no smaller than 1 inch along each dimension with Hydrogen clearly written on it
4. A label stating Inside Packages Comply with Prescribed Specifications

Personnel engaged in shipping OVAs must note that a U.S. DOT exemption is applicable to the shipment of the OVA and must be attached to the shipping papers. In addition, personnel should note that it is preferable to transport all hazardous materials on cargo aircraft (for example, Emory or Federal Express).

B. Hydrogen Tank

The hydrogen tank must be secured with a safety cap. Because the tank needs to be shipped in a vertical position (safety cap on the up end), personnel may package the tank in a box for stability and further security. It should be noted that the hydrogen tank may be shipped without a box as long as the tank can remain in an upright position. If the hydrogen tank is packaged in a box, the shipper must ensure that the box has been securely taped. The following labels must be placed on the tank or container before shipping. Personnel involved in shipping hydrogen tanks must note that hydrogen tanks cannot be shipped by passenger aircraft or rail.

1. A Flammable Gas label (red and white label)
2. A Danger label (orange and black label)
3. A label no smaller than 1 inch with UN1049 clearly written on it
4. A label no smaller than 1 inch with Hydrogen clearly written on it
5. Labels with This End Up on the container or tank point pointing toward the safety cap
6. A Cargo Aircraft Only label
7. A label stating Inside Packages Comply with Prescribed Specifications

STANDARD OPERATING PROCEDURE x.x

INSTRUCTIONS FOR HORIBA OCMA-220 INFRARED SPECTROMETER

1. PURPOSE

To provide field personnel with instructions regarding calibration and measurement of total petroleum hydrocarbons using the Horiba Infrared Spectrometer.

2. DISCUSSION

The Horiba Infrared Spectrometer is used to measure total petroleum hydrocarbon concentrations in soil and water. The spectrometer will be used to screen samples in the field to evaluate the extent of hydrocarbon contamination. A percentage of field measurements will be confirmed by laboratory analysis as described in the QAPP.

3. PROCEDURES

3.1. Associated Procedures

There are no associated procedures.

3.2. Preparation

3.2.1. Required Equipment and Reagents

A. Horiba OCMA-220 Infrared Spectrometer

B. Solvent Syringe (20 mL, 1 mL)

C. Balance

D. Solvent Reclamation System

E. Heavy Oil, Calibration material

F. Flon-S-316

3.2.2. Documentation

A. Obtain a logbook and ER Program data collection forms. All measurements, observations, and instrument readings should be entered on the forms or logbooks as appropriate. All entries should be made in black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or NP for Not Performed. If any procedure was not performed as prescribed, give the reason for the change or omission in the comments field of the form or in the logbook. To change an entry to a form or field log book, draw a single line through it, add the correct information above it, and initial the change. Information that does not require data entry should be entered in the logbook. All logbooks are numbered, bound, and contain numbered pages for quality assurance/quality control purposes. Do not alter the logbook (e.g., tearing out pages) or data collection forms in any manner.

B. The information management codes and sample identification numbers used in data entry are assigned by the data administrator.

3.2.3. Field

A. Check the condition and operation of all supplies and equipment at the site. Perform calibration checks specified in operators' manuals or appropriate SOPs.

3.3. Operation

3.3.1. Calibration

Preparation:

Allow 60 minutes for warming up after power is turned on. Press range to select measuring range (50 ppm) and set EX. TIME to appropriate position. Place a 100 or 200 mL glass beaker with about 10 mL water in it underneath sample discharge pipe.

Zero Calibration:

A-1 Turn EXTRACTOR to CLOSE. Pour 15 mL of tap water and 15 mL of solvent into inlet.
A-2 Press EXTRACT. Extraction will stop automatically at the time preset on EX. TIME. Check to see good separation of water and solvent at monitor window.
A-3 Turn DISCHARGE to CLOSE and EXTRACTOR to OPEN. Wait one minute. Close EXTRACTOR.
A-4 Open DISCHARGE to drain IR cell only.
A-5 Repeat A-3 and A-4 for a total of three times. (Do not open discharge, A4, on the third aliquot.)
A-6 At third aliquot, press MEASURE and adjust ZERO to read display at zero.
A-7 Press MEASURE again and turn DISCHARGE to OPEN.
THIS COMPLETES THE ZERO CALIBRATION.

Span Calibration Using Check:

The span check has been preset at the factory to 40 ppm. It may be readjusted with the span potentiometer to 33 to reading mg per liter.
B-1 Follow steps A-1 through A-6.
B-2 Press and hold the CHECK button. Adjust display to read 40 ppm.
B-3 Press and hold the CHECK button again; change to 200 ppm range and confirm reading of 160 ppm.
B-4 Follow step A-7.
THIS COMPLETES SPAN CHECK.

Measurement of Sample , (Water)

C-1 Turn EXTRACTOR to CLOSE. Pour 15 mL of sample water and 15 mL of solvent into inlet.
C-2 Follow A-2 through A-5.
C-3 Press MEASURE and read data on display.
C-4 Follow A-7.

CAUTION: Avoid skin contact or breathing of solvent and vapors. Always zero analyzer with clean solvent after use to keep the IR cell clean.

3.3.2. Sample Analysis

1. Weigh 10 grams* of soil (± 0.1 gram).
2. To a 40 mL volatile organic analysis vial, add the soil and 1 or more grams of anhydrous sodium sulfate to dry the sample. Mix the soil and the Na_2SO_4 well. Add 1 or more grams of silica gel (60-200 mesh Davidson Grade 950 or equivalent). Stir or shake to mix. Add 30 mL* of solvent**. Stir or shake to mix.
3. Perform the extraction of hydrocarbons into the solvent using the model GE-50 50 Watt Ultrasonic Disruptor. Sonicate for about 1 minute*. Put the VOA bottle in a water bath to cool and settle, for approximately 2 minutes*.
4. Carefully pour the extract through a solvent rinsed and dried Whatman No. 40, 11 cm, filter paper into the OCMA-220. Confirm that a minimum of 15 mL of extract is available for measurement. Add tap water or a measured amount of solvent, if necessary, to fill the extract chamber to the full line. If solvent is added, mix using the OCMA-220 extractor for several seconds. Measure three aliquots from the extract. Disregard the first two and read the third as the final concentration.
5. If necessary, drain and dilute the extract to display the results between 0 and 50, note the dilution ratio.
6. Calculate total recoverable petroleum hydrocarbons in milligrams per kilogram using the following formula:

$$TPH = (C \times D \times V)/Kg.$$

Where: C = concentration in milligrams per liter from the OCMA-220.
D = dilution ratio = (volume of solvent for extraction + volume of solvent for dilution if needed)/volume of solvent for extraction.
V = volume of extract in liters.
kg = soil sample mass in kilograms.

Example: $\frac{10.0 \text{ mg/L} \times 0.030 \text{ L}}{0.010 \text{ KG}} = 30$ mg per kilogram

* These values may be varied, depending on the sample, to obtain optimum usage of solvent, analysis time, and analyzer resolution.

** FLON S-316 solvent is recommended. Perchloro-ethylene may be used in a well-ventilated area. Freon-113 is being phased out by 1995. The OCMA-220 will operate with any of these solvents, however, an optical alignment is required to change from one solvent type to another.

3.4. Quality Assurance

3.4.1. Perform a continuing calibration check, after each calibration and after every 10 samples. If the instrument measurements differs from the expected value by more than 10 percent, then re-calibrate the instrument.

3.4.2 Perform a method blank check, after each calibration and continuing calibration check to verify no cross contamination has occurred. If the instrument for the blank is greater than x ppm, then analyze a second blank. If the second blank also indicates contamination, investigate the source of the problem, correct the problem and re-calibrate the instrument.

4. SOURCES

Horiba OCMA-220 Instrument Operating Procedure

APPENDIX B

STATEMENTS OF WORK FOR SELECTED LABORATORY ANALYSES

SOW-001 Tritium Cryogenic Soil Preparation

SOW-002 Soil Preparation for Common Organic, Inorganic, and Selected Radiological Analyses

Statement of Work for Tritium Cryogenic Soil Preparation

1.0 Scope and Application

This procedure is used to determine amount of tritium present in soil or soil-like sample matrices.

2.0 Summary of the Method

Tritiated water is removed from the solid matrix through vacuum distillation and the distillate (water) is collected in a cryogenic trap. The distillate can then be mixed with a scintillation cocktail fluor and counted.

3.0 Interferences

Trace quantities of organic material present in the sample may co-distill with the tritiated water causing a quenching effect in the scintillant. The quenching can bias the reported result low. This interference can be eliminated by oxidizing trace organic with hydrogen peroxide, and then neutralizing the excess peroxide with manganese dioxide.

4.0 Apparatus and Materials

4.1 Distillation glassware

4.2 Vacuum pump

4.3 Trap

4.4 Dewar Flask

4.5 Heating Mantel

4.6 Electronic Balance (accurate to $\pm$ 0.1 g)

4.7 Plastic scintillation vial

5.0 Reagents/Supplies

5.1 "Dead" water *(used for method blank)*

5.2 30% Hydrogen Peroxide

5.3 Manganese Dioxide

5.4 Liquid Nitrogen

6.0 Sample Collection/Preservation/Holding

See FFTA QAPP, Revision 0, Table 4.7.

7.0 Procedure

7.1 Perform a % moisture determination on the soil per CLP SOW Document No. OLM01.

7.2 A representative soil aliquot must be taken as described in SOW-003. Weigh the aliquot of soil and add the soil to the distillation apparatus. Use 50 g of wet soil or if the soil is dry (not dried) use 100 g. (The amount of soil may also be determined based on the % moisture.)

7.3 Connect up the distillation apparatus to the vacuum and the trap.

7.4 Use liquid nitrogen to cool the trap. Heat the soil.

7.5 Distill the water from the soil. The distillation temperature can be increased incrementally to 105°C until at least 5 mL of water is collected.

7.6 When the distillation is complete transfer the distillate to a tared vial and determine the weight.

7.7 Prepare the sample for liquid scintillation by EPA Method 906.0. The detection limit of 500 pCi/L can be measured using this method assuming a minimum of 5 ml of water is recovered from the sample. If less than 5 mL of water is recovered, re-distill the sample using a larger sample aliquot.

7.8 If the water is highly colored, add 1.5 mL of 30% H_2O_2 and allow the distillate to react overnight. Do not tightly seal the scintillation vial.

7.9 Destroy the excess H_2O_2 with 1 g of manganese dioxide.

7.10 A 5.0 mL aliquot of the distillate will be used for the analysis and the result used to back calculate the pCi/g.

8.0 Quality Control

8.1 See FFTA QAPP for quality control requirements.

9.0 References

RESL Analytical Chemistry Branch, Procedures Manual, IDO-12096, edited by Louis Z. Bodnar and Donald R. Percival, 1982.

Radiochemical Analytical Procedures for Analysis of Environmental Samples, EMSL-LV-0539-17, edited by F.B. Johns, P.B. Hahn, D.J. Thomas, and E.W. Bretthauer, 1979.

Result and Error Evaluation System, (REES) User's Guide, United States Testing Company.

"Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements,:L.A. Currie, NUREG/CR-4007, U.S. Nuclear Regulatory

Commission, September, 1984.

"Handbook for Analytical Quality Control in Radioanalytical Laboratories," L.G. Kanipe, EPA-600/7-77-088, August 1977.

"Establishing a Quality Assurance Program for Analytical Chemistry Laboratories within the Nuclear Industry," Annual Book of ASTM Standards, Volume 12, C1009-83.

OR-7121, "Tritium by Cryogenic Distillation," IT Analytical Services, Oak Ridge, TN, 1992.

Statement of Work for Soil Preparation for Common Organic, Inorganic, and Selected Radiological Analyses

1.0 Scope and Application

This procedure describes how to aliquot Mound soil and soil-like samples for laboratory preparation and analysis. This procedure applies only to samples collected for analysis under the OU9 Site-Wide QAPP. This procedure applies to soil analysis for metals, semi-volatiles, pesticide/PCBs, cyanide, anions, explosives, and radiological analyses which do not have a prescribed soil preparation procedure. This procedure should not be used for volatile organic analysis. Soils for volatile organic analysis will be prepared and homogenized as described in the method of analysis.

2.0 Summary

A representative aliquot of a sample is taken in the laboratory by either visually examining and taking a representative portion from each layer in a sample or taking a core of the sample.

3.0 Interferences

Soil samples are heterogeneous by nature. Because of this nature, target analytes are often channeled and concentrated in the soil in specific layers or locations. This heterogeneity may affect both how representative the sample is of the field location and how representative the laboratory aliquot is of the sample.

Heterogeneous nature of soils can sometimes be eliminated in laboratory aliquoting by visually inspecting the sample for layering and selecting a representative aliquot or by taking a core of the sample.

4.0 Equipment

4.1 Spatula or Scoop

4.2 Glass tray, plastic tray, or other material for containing spilled soil

4.3 Large container, i.e. 1000 mL Pyrex beaker

5.0 Reagents/Supplies

5.1 Disposable gloves

6.0 Sample Collection/Holding Time/Preservation

6.1 Sample holding times are specified in the OU9 Site-Wide QAPP, Revision 1, Table IV.4.

7.0 Procedure

7.1 Place a glass tray, plastic tray, or disposable paper beneath the sample container. The tray or paper will be used to contain any soil which accidentally falls off the bottle lip when the cap is opened or falls out while the sample is taken.

7.2 Visually examine the contents of the sample container. If obvious layering is present, then representative portions of each layer must be taken for the aliquot.

If the sample is obviously a core sample (cylindrical soil mass), then use the spatula to core from the top of the sample to the bottom of the sample. This procedure should be representative of the entire core.

If the sample cannot be easily cored, it may be necessary to transfer the sample to a large container and thoroughly and carefully mix the sample with a spatula or scoop. Mixing will not be performed on soil samples for volatile and semi-volatile analyses.

If the sample is neither layered nor a core sample, then use a spatula to core through the middle of the sample. The core should be representative of the entire sample.

7.3 Process the sample as specified in the applicable method.

8.0 Quality Control

8.1 Each analytical method has specific types of quality control samples introduced to evaluate laboratory precision and reproducibility of sample results. Typically, these quality control samples are laboratory duplicates or matrix spike duplicates. These quality control samples permit the laboratory to calculate the relative percent difference and evaluate the soil aliquoting procedure and the precision of the method.

9.0 References and Associated Standard Operating Procedures

None

APPENDIX C

ELECTRONIC DATA DELIVERABLE (EDD)

REPORTING FORMAT

EDD REPORTING FORMAT

The electronic data deliverables (EDDs) for the WESTON database management system are prepared by the laboratory on 3-1\2 or 5-1/4- inch floppy disks in a specified ASCII II format. The following sections describe the format for each data record (i.e., each analyte result), including the fields, field definitions and allowable codes for each field.

An example entry is provided for each field. Where the information for each field may be obtained is also described in the summary under the column heading identified as "source".

1.0 LABORATORY RECORD FORMAT

Field Name	Format	Source	Example
FACILITY ID	A5	CLIENT ID	MND01
LOCATION ID	A4	CLIENT ID	0601
SAMPLE DATE	A9	CHAIN OF CUSTODY	12-JUN-91
SAMPLE ID	A4	CLIENT ID	0001
*	A4		
PREP BATCH #	A8	LAB	911015
LOGGING COMPANY	A4	SET TO 'RFW/'	RFW/
*	A12		
SAMPLE TYPE	A2	CHAIN OF CUSTODY	F/
*	A3		
MATRIX CODE	A2	CHAIN OF CUSTODY	W
LAB ID	A14	LAB	9106-011-001
CLIENT ID	A20	CHAIN OF CUSTODY	MND01-0601-001
PARAMETER CODE	A10	VALID CODE LIST	94-75-7///
*	A2		
LAB CODE	A4	LAB	XYZA
BATCH NUMBER	A14	LAB	9104987
ANALYSIS DATE	A9	LAB	12-JUN-91
ANALYSIS TIME	A4	LAB	1204
ANALYSIS METHOD	A6	VALID CODE LIST	E908
EXTRACTION DATE	A9	LAB	12-JUN-91
EXTRACTION TIME	A4	LAB	1416
*	A8		
PARAMETER QUALIFIER	A2	VALID CODE LIST	U

Field Name	Format	Source	Example
PARAMETER VALUE	A14	LAB	24.01/////1../
*	A1		
UNITS OF MEASURE	A10	VALID CODE LIST	UG/L
VALUE UNCERTAINTY	A12	LAB	25.01
•	A1		
DETECTION LIMIT	A9	LAB	0.5
•	A1		
DILUTION FACTOR	A9	LAB	1.0

Please be aware of the following conventions:

Client ID -- Client ID from the Chain of Custody will be in the form of:

AAAAA-BBBB-CCCC Where: AAAAA = Facility
BBBB = Location ID
CCCC = Sample ID

Note that the location ID may not be zero filled. The Chain of Custody may read: MND01-601-1. Please zero fill to read MND01-0601-0001.
* Set to the number of spaces indicated in the format.

2.0 LOCATION AND SAMPLE ID FIELDS

The following is the format for naming the sample ID for laboratory QC samples:

Field QC

Name	Sample Type	Location ID	Sample ID
Matrix spike	MS	Same as field sample	Same as field sample with a "A" preceding
Matrix spike duplicate	MD	Same as field sample	Same as field sample with a "B" preceding

Lab QC

Name	Sample type	Facility ID	Location ID	Sample ID
Method Blank	MB	QAD01	"9901"	"A001"
Blank Spike	BS	QAD01	"9901"	"B002"
Blank Spike Duplicate	BD	QAD01	"9903"	"C003"
Lab Duplicate	LD	Same as field sample	Same as field sample	Same as field with a "C" preceding

Note:
If there is more than one lab sample for a given batch, sample type, date, and location ID sequentially increment the sample ID.

Example:
The second blank spike duplicate would be labelled sample ID "C002"; the location ID remains "9903".

This convention provides for up to 999 QC samples per sample type, per date, per batch.

Chain of Custody -- indicates that the data are found on the Chain of Custody.

"/" - indicates a space

Lab - indicates the information is provided by the laboratory.

Valid Code List - indicates that only codes listed in the valid code list are to be used. In a case where a code definition does not meet the needs of the data to be recorded, the data administrator will be contacted so that concurrence can be obtained in establishing required coding conventions. ASCII data files that contain all valid code lists will be provided upon completion of contract negations with individual labs. See section 4.0 of this procedure for the valid code list.

Set - indicates that the entry person should set the field to the noted default value.

3.0 FIELD DEFINITIONS

The following defines the fields of information that will be provided in the EDD:

Facility ID - Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the site.

Location ID - Four-character code identifying the sample location.

Sample Date - The date the sample was collected.

Prep Batch No. - Designator assigned by the laboratory indicating the prep batch identifier.

Logging Company - Set to RFW.

Sample Type - The type of sample analyzed. Sample type will be noted on the Chain of Custody.

Matrix Code - Indicates the matrix of the sample. Matrix will be noted on the Chain of Custody.

Lab ID - Identifier assigned by the laboratory.

Batch Number - Identifier assigned by the laboratory.

Analysis Date - Date the sample was analyzed.

Analysis Time - Time the sample was analyzed.

Analysis Method - Sample analysis method.

Extraction Date - Date the sample was extracted.

Extraction Time - Time the sample was extracted.

Parameter Qualifier - Qualifier assigned by the laboratory to the reported parameter value.

Units of Measure - Parameter result units of measure.

Detection Limit - Detection limit associated with parameter results.

Dilution Factor - Dilution factor associated with the parameter results.

4.0 VALID CODE LIST

4.1 Sample Types

Code	Sample Name
AB	AMBIENT BLANK
AK	ANALYTICAL KNOWN
BS	BLANK SPIKE
D	DUPLICATE
EB	EQUIPMENT BLANK
F	FIELD SAMPLE
FB	FIELD BLANK
LD	LAB DUPLICATE
MB	METHOD BLANK
MD	MATRIX SPIKE DUPLICATE
MS	MATRIX SPIKE
PD	POST DIGESTION SPIKE
RB	REAGENT BLANK
S	SPIKE
TB	TRIP BLANK
TK	THEORETICAL KNOWN

4.2 Units of Measure (UOM)

Code	UOM Description
%	UNIT OF MEASURE %SOLIDS
% MOIST	PERCENT MOISTURE
% RECOVERY	PERCENT RECOVERY
% SOLIDS	% SOLIDS
% DIFFRENCE	PERCENT DIFFERENCE
ACI/M3	Actu Curies per cubic meter
CPMA	COUNTS PER MINUTE ALPHA
CPMB	COUNTS PER MINUTE BETA
D/UNITS	DELTA UNITS
DEG C	DEGREES CELSIUS
DEG F	DEGREES FAHRENHEIT
MG/KG	MILLIGRAMS PER KILOGRAM
MG/L	MILLIGRAMS PER LITER
NCI/L	NANOCURIES PER LITER
NG/G	NANOGRAM PER GRAM
NG/L	NANOGRAMS PER LITER
PCI/G	PICOCURIES PER GRAM
PCI/KG	PICOCORIES PER KILOGRAM
PCI/L	PICOCURIES PER LITER
PCI/ML	PICOCURIES PER MILLILITER
PPM	PARTS PER MILLION
STD DEV	STANDARD DEVIATION
SU	STANDARD UNITS
UG/G	MICROGRAMS PER GRAM
UG/KG	MICROGRAMS PER KILOGRAM
UG/L	MICROGRAMS PER LITER
UG/ML	MICROGRAMS PER MILLILITER
UMHOS/CM	MICROMHOS PER CENTIMETER

4.3 Parameter Codes

Code	Parameter Name	Parameter Group Code
I%SOL	% SOLIDS	C
630-20-6	1,1,1,2-TETRACHLOROETHANE	V
71-55-6	1,1,1-TRICHLOROETHANE	V
79-34-5	1,1,2,2-TETRACHLOROETHANE	V
79-00-5	1,1,2-TRICHLOROETHANE	V
75-34-3	1,1-DICHLOROETHANE	V
75-35-4	1,1-DICHLOROETHENE	V
156-59-4	1,2,-CIS-DICHLOROETHENE	V
35822-46-9	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-	D
67562-39-4	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFUR	D
55673-89-7	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFUR	D
39227-28-6	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIO	D
70648-26-9	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	D
57117-44-9	1,2,3,5,7,8-HEXACHLORODIBENZOFURAN	D
57653-85-7	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIO	D
19408-74-3	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIO	D
72918-21-9	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	D
40321-76-4	1,2,3,7,8-PENTACHLORODIBENO-P-DIOXI	D
57117-41-6	1,2,3,7,8-PENTACHLORODIBENZOFURAN	D
96-18-4	1,2,3-TRICHLOROPROPANE	V
120-82-1	1,2,4-TRICHLOROBENZENE	S
95-50-1	1,2-DICHLOROBENZENE	S
107-06-2	1,2-DICHLOROETHANE	V
1760-7-0	1,2-DICHLOROETHANE-d4	O
540-59-0	1,2-DICHLOROETHENE	V
2199-69-1	1,2-DICHLOROETHENE-d4	S
78-87-5	1,2-DICHLOROPROPANE	V
156-60-5	1,2-TRANS-DICHLOROETHENE	V
99-35-4	1,3,5-TRINITROBENZENE	E
10061-01-5	1,3-CIS-DICHLOROPROPENE	V
541-73-1	1,3-DICHLOROBENZENE	S
99-65-01	1,3-DNB	E
10061-02-6	1,3-TRANS-DICHLOROPROPENE	V
106-46-7	1,4-DICHLOROBENZENE	S
110-56-5	1,4-DICHLOROBUTANE	O
544-10-5	1-CHLOROHEXANE	V
60851-34-5	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	D
57117-31-4	2,3,4,7,8-PENTACHLORODIBENZOFURAN	D
1746-01-6	2,3,7,8-TCDD	D
51207-31-9	2,3,7,8-TCDF	D
95-95-4	2,4,5-TRICHLOROPHENOL	S
118-79-6	2,4,6-TRIBROMOPHENOL	O
88-06-2	2,4,6-TRICHLOROPHENOL	S
118-96-7	2,4,6-TRINITROTOLUENE	E
120-83-2	2,4-DICHLOROPHENOL	S

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
105-67-9	2,4-DIMETHYLPHENOL	S
51-28-5	2,4-DINITROPHENOL	S
121-14-2	2,4-DINITROTOLUENE	E
606-20-2	2,6-DINITROTOLUENE	E
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	E
78-93-3	2-BUTANONE	V
110-75-8	2-CHLOROETHYLVINYLETHER	V
91-58-7	2-CHLORONAPHTHALENE	S
95-57-8	2-CHLOROPHENOL	S
0000	2-CHLOROPHENOL-d4	O
95-49-8	2-CHLOROTOLUENE	V
321-60-8	2-FLUOROBIPHENYL	O
367-12-4	2-FLUOROPHENOL	O
591-78-6	2-HEXANONE	V
91-57-6	2-METHYLNAPHTHALENE	S
95-48-7	2-METHYLPHENOL	S
88-74-4	2-NITROANILINE	S
88-75-5	2-NITROPHENOL	S
91-94-1	3,3'-DICHLOROBENZIDINE	S
99-09-2	3-NITROANILINE	S
72-54-8	4,4'-DDD	P
72-55-9	4,4'-DDE	P
50-29-3	4,4'-DDT	P
534-52-1	4,6-DINITRO-O-CRESOL	S
101-55-3	4-BROMOPHENYL-PHENYL ETHER	S
59-50-7	4-CHLORO-3-METHYLPHENOL	S
106-47-8	4-CHLOROANILINE	S
7005-72-3	4-CHLOROPHENYL-PHENYLETHER	S
108-10-1	4-METHYL-2-PENTANONE	V
106-44-5	4-METHYLPHENOL	S
100-01-6	4-NITROANILINE	S
100-02-7	4-NITROPHENOL	S
83-32-9	ACENAPHTHENE	S
208-96-8	ACENAPHTHYLENE	S
67-64-1	ACETONE	V
75-05-8	ACETONITRILE	V
107-13-1	ACRYLONITRILE	V
AC-227	ACTINIUM-227	R
AC-228	ACTINIUM-228	R
309-00-2	ALDRIN	P
IALKL	ALKALINITY	F
5103-71-9	ALPHA CHLORDANE	P
319-84-6	ALPHA-BHC	P
MALTO	ALUMINUM, TOTAL	M
AM-241	AMERICIUM-241	R
INH3N	AMMONIA	C
INH4	AMMONIUM	C
120-12-7	ANTHRACENE	S
MSBTO	ANTIMONY, TOTAL	M

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
SB-124	ANTIMONY-124	R
SB-125	ANTIMONY-125	R
12674-11-2	AROCLOR-1016	P
11104-28-2	AROCLOR-1221	P
11141-16-5	AROCLOR-1232	P
53469-21-9	AROCLOR-1242	P
12672-29-6	AROCLOR-1248	P
11097-69-1	AROCLOR-1254	P
11096-82-5	AROCLOR-1260	P
MASEP	ARSENIC, EP LEACHATE	M
MASTO	ARSENIC, TOTAL	M
MBAEP	BARIUM, EP LEACHATE	M
MBATO	BARIUM, TOTAL	M
BA-133	BARIUM-133	R
BA-140	BARIUM-140	R
71-43-2	BENZENE	V
56-55-3	BENZO(A)ANTHRACENE	S
50-32-8	BENZO(A)PYRENE	S
205-99-2	BENZO(B)FLUORANTHENE	S
191-24-2	BENZO(G,H,I)PERYLENE	S
207-08-9	BENZO(K)FLUORANTHENE	S
65-85-0	BENZOIC ACID	S
100-51-6	BENZYL ALCOHOL	S
BERA	BERYLLIUM	M
MBETO	BERYLLIUM, TOTAL	M
BE-7	BERYLLIUM-7	R
319-85-7	BETA-BHC	P
BI-211	BI-211	R
111-91-1	BIS(2-CHLOROETHOXY)METHANE	S
111-44-4	BIS(2-CHLOROETHYL)ETHER	S
39638-32-9	BIS(2-CHLOROISOPROPYL) ETHER	S
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER	S
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	S
BI-210	BISMUTH-210	R
BI-212	BISMUTH-212	R
BI-214	BISMUTH-214	R
MB-SO	BORON, SOLUBLE	M
MB-TO	BORON, TOTAL	M
IBROM	BROMIDE	C
108-86-1	BROMOBENZENE	V
74-97-5	BROMOCHLOROMETHANE	O
75-27-4	BROMODICHLOROMETHANE	V
460-00-4	BROMOFLUOROBENZENE	O
75-25-2	BROMOFORM	V
74-83-9	BROMOMETHANE	V
85-68-7	BUTYL BENZYL PHTHALATE	S

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
MCDEP	CADMIUM, EP LEACHATE	M
MCDTO	CADMIUM, TOTAL	M
MCASO	CALCIUM, SOLUBLE	M
MCATO	CALCIUM, TOTAL	M
86-74-8	CARBAZOLE	S
75-15-0	CARBON DISULFIDE	V
56-23-5	CARBON TETRACHLORIDE	V
CE-139	CERIUM-139	R
CE-141	CERIUM-141	R
CE-144	CERIUM-144	R
CS-134	CESIUM-134	R
CS-137	CESIUM-137	R
57-74-9	CHLORDANE	P
ICL	CHLORIDE	C
ICCL	CHLORIDE BY IC	C
108-90-7	CHLOROBENZENE	V
75-00-3	CHLOROETHANE	V
67-66-3	CHLOROFORM	V
74-87-3	CHLOROMETHANE	V
25168-05-2	CHLOROTOLUENE	V
MCREP	CHROMIUM, EP LEACHATE	M
MCRSO	CHROMIUM, SOLUBLE	M
MCRTO	CHROMIUM, TOTAL	M
CR-51	CHROMIUM-51	R
218-01-9	CHRYSENE	S
MCOTO	COBALT, TOTAL	M
CO-57	COBALT-57	R
CO-58	COBALT-58	R
CO-60	COBALT-60	R
MCUSO	COPPER, SOLUBLE	M
MCUTO	COPPER, TOTAL	M
57-12-5	CYANIDE	M
ICNTO	CYANIDE, TOTAL	M
2051-24-3	DECACHLOROBIPHENYL	O
319-86-8	DELTA-BHC	P
MD-SO	DEUTERIUM	R
84-74-2	DI-N-BUTYL PHTHALATE	S
117-84-0	DI-N-OCTYL PHTHALATE	S
53-70-3	DIBENZ(A,H)ANTHRACENE	S
132-64-9	DIBENZOFURAN	S
124-48-1	DIBROMOCHLOROMETHANE	V
74-95-3	DIBROMOMETHANE	V
1770-80-5	DIBUTYLCHLORENDATE	O
75-71-8	DICHLORODIFLUOROMETHANE	V
75-09-2	DICHLOROMETHANE-METHYLENE CHLORIDE	V
60-57-1	DIELDRIN	P
84-66-2	DIETHYL PHTHALATE	S
131-11-3	DIMETHYL PHTHALATE	S
959-98-8	ENDOSULFAN I(ALPHA)	P

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
33213-65-9	ENDOSULFAN II(BETA)	P
1031-07-8	ENDOSULFAN SULFATE	P
72-20-8	ENDRIN	P
7421934	ENDRIN ALDEHYDE	P
53494-70-5	ENDRIN KETONE	P
100-41-4	ETHYLBENZENE	V
EU-152	EUROPIUM-152	R
EU-154	EUROPIUM-154	R
EU-155	EUROPIUM-155	R
206-44-0	FLUORANTHENE	S
86-73-7	FLUORENE	S
IFLOR	FLUORIDE	C
462-06-6	FLUROBENZENE	O
GD-153	GADOLINIUM-153	R
5103-74-2	GAMMA CHLORDANE	P
58-89-9	GAMMA-BHC (LINDANE)	P
76-44-8	HEPTACHLOR	P
1024-57-3	HEPTACHLOR EPOXIDE	P
37871-00-4	HEPTACHLORODIBENZO-P-DIOXIN	D
38998-75-3	HEPTACHLORODIBENZOFURAN	D
118-74-1	HEXACHLOROBENZENE	S
87-68-3	HEXACHLOROBUTADIENE	S
77-47-4	HEXACHLOROCYCLOPENTADIENE	S
34465-46-8	HEXACHLORODIBENZO-P-DIOXIN	D
55684-94-1	HEXACHLORODIBENZOFURAN	D
67-72-1	HEXACHLOROETHANE	S
2691-41-0	HMX	E
193-39-5	INDENO(1,2,3-CD)PYRENE	S
IIOD	IODIDE	C
I-131	IODINE-131	R
IR-192	IRIDIUM-192	R
MFESO	IRON, SOLUBLE	M
MFETO	IRON, TOTAL	M
FE-59	IRON-59	R
78-59-1	ISOPHORONE	S
LA-140	LANTHANUM-140	R
MPBEP	LEAD, EP LEACHATE	M
MPBSO	LEAD, SOLUBLE	M
MPBTO	LEAD, TOTAL	M
PB-210	LEAD-210	R
PB-212	LEAD-212	R
PB-214	LEAD-214	R
MLISO	LITHIUM, SOLUBLE	M
MLITO	LITHIUM, TOTAL	M
MMGSO	MAGNESIUM, SOLUBLE	M
MMGTO	MAGNESIUM, TOTAL	M
MMNEP	MANGANESE, EP LEACHATE	M
MMNSO	MANGANESE, SOLUBLE	M
MMNTO	MANGANESE, TOTAL	M
MN-54	MANGANESE-54	R

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
MHGEP	MERCURY, EP LEACHATE	M
MHGTO	MERCURY, TOTAL	M
HG-203	MERCURY-203	R
72-43-5	METHOXYCHLOR	P
MMOTO	MOLYBDENUM	M
544-85-4	N-DOTRIACONTANE	O
621-64-7	N-NITROSO-DI-N-PROPYLAMINE	S
86-30-6	N-NITROSODIPHENYLAMINE	S
91-20-3	NAPHTHALENE	S
MNISO	NICKEL, SOLUBLE	M
MNITO	NICKEL, TOTAL	M
NB-95	NIOBIUM-95	R
INO3N	NITRATE	C
ICNO3	NITRATE BY IC	C
IN3N2	NITRATE NITRITE	C
INO2	NITRITE AS NITROGEN	C
ICNO2	NITRITE BY IC	C
98-95-3	NITROBENZENE	E
4165-60-0	NITROBENZENE-D5	O
NP-237	NP-237	R
348-51-6	O-CHLOROFLUROBENZENE	O
3268-87-9	OCTACHLORODIBENZO-P-DIOXIN	D
39001-02-0	OCTACHLORODIBENZOFURAN	D
IPO4O	ORTHO PHOSPHATE	C
O-18	OXYGEN-18	R
1718-51-0	P-TERPHENYL-d14	O
36088-22-9	PENTACHLORODIBENZO-P-DIOXIN	D
30402-15-4	PENTACHLORODIBENZOFURAN	D
87-86-5	PENTACHLOROPHENOL	S
I%MST	PERCENT MOISTURE	C
IPETN	PETN	E
IPH	PH	F
85-01-8	PHENANTHRENE	S
108-95-2	PHENOL	S
OPHL	PHENOL-d5	O
4165-62-2	PHENOL-d5	O
PU-238	PLUTONIUM-238	R
PU-239	PLUTONIUM-239	R
PU-239/240	PLUTONIUM-239/240	R
MK-SO	POTASSIUM, SOLUBLE	M
MK-TO	POTASSIUM, TOTAL	M
K-40	POTASSIUM-40	R
PA-233	PROTACTINIUM-233	R
PA-234	PROTACTINIUM-234 METASTABLE	R
129-00-0	PYRENE	S
RA-223	RADIUM-223	
RA-224	RADIUM-224	R
RA-225	RADIUM-225	R
RA-226	RADIUM-226	R
RA-228	RADIUM-228	R

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
121-82-4	RDX	E
RU-103	RUTHENIUM-103	R
RU-106	RUTHENIUM-106	R
SC-46	SCANDIUM-46	R
MSEEP	SELENIUM, EP LEACHATE	M
MSETO	SELENIUM, TOTAL	M
ISIO2	SILICA	C
MSISO	SILICON, SOLUBLE	M
MSITO	SILICON, TOTAL	M
MAGEP	SILVER, EP LEACHATE	M
MAGSO	SILVER, SOLUBLE	M
MAGTO	SILVER, TOTAL	M
AG-110	SILVER-110	R
MNASO	SODIUM, SOLUBLE	M
MNATO	SODIUM, TOTAL	M
NA-22	SODIUM-22	R
ISPCD	SPECIFIC CONDUCTANCE	F
SR-85	STRONTIUM-85	R
SR-89	STRONTIUM-89	R
SR-90	STRONTIUM-90	R
100-42-5	STYRENE	V
ISO4	SULFATE	C
ICSO4	SULFATE BY IC	C
ITEMP	TEMPERATURE	F
877-09-8	TETRACHLORO-M-XYLENE	P
41903-57-5	TETRACHLORODIBENZO-P-DIOXIN	D
30402-14-3	TETRACHLORODIBENZOFURAN	D
127-18-4	TETRACHLOROETHENE	V
479-45-8	TETRYL	E
MTLTO	THALLIUM, TOTAL	M
TL-208	THALLIUM-208	R
TH-227	THORIUM-227	R
TH-228	THORIUM-228	R
TH-230	THORIUM-230	R
TH-232	THORIUM-232	R
TH-234	THORIUM-234	R
TH-237	THORIUM-237	R
TI-208	TI-SOMETHING	R
SN-113	TIN-113	R
SN-126	TIN-126	R
108-88-3	TOLUENE	V
2037-26-5	TOLUENE-d8 (BY GC)	O
OPHCM	TOTAL HB HYDROCARBONS AS MOTOR OIL	H
TPG	TOTAL LOW BOILING HYD AS GASOLINE	H
TPD	TOTAL PETROLEUM HYD AS DIESEL FUEL	H
IPO4T	TOTAL PHOSPHATE	C
1330-20-7	TOTAL XYLENES	V
8001-35-2	TOXAPHENE	P
79-01-6	TRICHLOROETHENE	V
75-69-4	TRICHLOROFLUOROMETHANE	V

4.3 Parameter Codes (Cont.)

Code	Parameter Name	Parameter Group Code
638-67-5	TRICOSANE	O
98-08-8	TRIFLUOROTOLUENE	O
H-3	TRITIUM	R
U-233	URANIUM-233	R
U-234	URANIUM-234	R
U-235	URANIUM-235	R
U-235/236	URANIUM-235/236	R
U-238	URANIUM-238	R
MV-TO	VANADIUM, TOTAL	M
108-05-4	VINYL ACETATE	V
75-01-4	VINYL CHLORIDE	V
Y-88	YTTRIUM-88	R
MZNSO	ZINC, SOLUBLE	M
MZNTO	ZINC, TOTAL	M
ZN-65	ZINC-65	R
ZR-95	ZIRCONIUM-95	R

4.4 Analysis Methods

Code	Analysis Name
ABCRMO	TH
A303A	METALS (BY DIRECT ASPIRATION INTO AIR-ACTYLENE FLAME)
A412D	TOTAL CYANIDE
A429	COMMON ANIONS
A509A	PESTICIDES
A509B	CHLORINATED PHENOXY ACID HERBICIDES
C1.0AM	METALS - CLP SOW ILM01.0, MOD A
C1.0BM	METALS - CLP SOW ILM01.0, MOD B (RESIDENTIAL WELL SAMP)
C1.0CN	CN - CLP SOW ILM01.0
C1.0ML	LANTHANIDES - CLP SOW ILM01.0, MOD C
C1.8PP	PEST/PCBS - CLP SOW OLOM01.8
C1.8DS	SEMIVOA - CLP SOW OLM01.8, MOD D
C1.8DV	VOA - CLP SOW OLM01.8, MOD D
E120.1	CONDUCTANCE
E150.1	PH
E160.1	FILTERABLE RESIDUE (ALSO KNOWN AS TOTAL DISOLVED SOLIDS)
E160.2	TOTAL SUSPENDED SOLIDS
E170.1	TEMPERATURE
E200.7	INDUCTIVELY COUPLED PLASMA (ICP) METALS SCREEN
E206.2	ARSENIC
E213.2	CADMIUM
E218.1	CHROMIUM
E220.1	COPPER
E239.2	LEAD
E239.2	LEAD
E245.1	MERCURY
E249.1	NICKEL
E270.2	SELENIUM
E272.2	SILVER
E289.1	ZINC
E310.1	ALKALINITY
E325.1	CHLORIDE
E335.2	TOTAL CYNIDE
E340.2	FLUORIDE
E350.1	AMMONIA
E350.3	AMMONIA (ISE)
E351.3	TOTAL NITROGEN
E353.2	NITRATE/NITRITE
E354.1	NITRITE
E365.1	TOTAL PHOSPHORUS
E375.2	SULFATE
E410.1	CHEMICAL OXYGEN DEMAND
E413.2	TOTAL RECOVERABLE OIL AND GREASE
E415.1	TOTAL ORGANIC CARBON (TOC)
E418.1	TOTAL RECOVERABLE PETROLEUM HYDROCARBONS
E420.1	TOTAL PHENOLICS
E502.1	ETHYLENE DIBROMIDE (1,2-DIBROMETHANE)
E601	PURGEABLE HALOCARBONS
E602	PURGEABLE AROMATICS
E608	ORGANOCHLORINE PESTICIDES AND PCB'S
E624	PURGEABLES

4.4 Analysis Methods (Cont.)

Code	Analysis Name
E624H	E624H METHOD
E625	EXTRACTABLE PRIORITY POLLUTANTS (BASE/NEUTRAL AND ACID)
E625H	E625H METHOD
E84006	PU
E901.1	GAMMA
E903.A	RA-226
E905	SR/Y
E906	TRITIUM
E908	U
FIELD	FIELD MEASUREMENT
GS	GAMMA SPECTROSCOPY
LGTERM	LONG-TERM (AVERAGING)
RC	RADIOCHEMISTRY
SW1310	EP TOXICITY - METALS
SW6010	INDUCTIVELY COUPLED PLASMA (ICP) METALS SCREEN
SW7060	ARSENIC
SW7420	LEAD
SW7471	MERCURY
SW7740	SELENIUM
SW8010	HALOGENATED VOLATILE ORGANICS
SW8015	NONHALOGENATED VOLATILE ORGANICS
SW8020	AROMATIC VOLATILE ORGANICS
SW8030	ACETONITRILE, ACRYLONITRILE
SW8080	ORGANOCHLORINE PESTICIDES AND PCB'S
SW8140	ORGANOPHOSPORUS PESTICIDES
SW8150	CHLORINATED HERBICIDES
SW8240	GC/MS METHOD FOR VOLATILE ORGANICS
SW8250	EXTRACTABLE PRIORITY POLLUTANTS (BASE/NEUTRAL AND ACID)
SW8270	EXTRACTABLE PRIORITY POLLUTANTS (BASE/NEUTRAL AND ACID)
SW8280	DIOXINS/FURANS
SW8290	DIOXINS/FURANS
SW8330	EXPLOSIVES
SW9010	TOTAL AND AMENABLE CYANIDE
SW9020	TOTAL ORGANIC HALIDES
SW9045	PH (SOIL - FIELD LABORATORY)
SW9081	CATION EXCHANGE CAPACITY
SW9100	TRAXIAL PERMEABILITY
SW9251	CHLORIDE
USATHAMA	EXPLOSIVES
UNK	UNKNOWN

4.4 Analysis Methods (Cont.)

Code	Analysis Name
11104-28-2	AROCLOR-1221
11141-16-5	AROCLOR-1232
53469-21-9	AROCLOR-1242
12672-29-6	AROCLOR-1248
11097-69-1	AROCLOR-1254
11096-82-5	AROCLOR-1260
MASEP	ARSENIC, EP LEACHATE
MASTO	ARSENIC, TOTAL
MBAEP	BARIUM, EP LEACHATE
MBATO	BARIUM, TOTAL
BA-133	BARIUM-133
BA-140	BARIUM-140
71-43-2	BENZENE
56-55-3	BENZO(A)ANTHRACENE
50-32-8	BENZO(A)PYRENE
205-99-2	BENZO(B)FLUORANTHENE
191-24-2	BENZO(G,H,I)PERYLENE
207-08-9	BENZO(K)FLUORANTHENE
65-85-0	BENZOIC ACID
100-51-6	BENZYL ALCOHOL
BERA	BERYLLIUM
MBETO	BERYLLIUM, TOTAL
BE-7	BERYLLIUM-7
319-85-7	BETA-BHC
BI-211	BI-211
111-91-1	BIS(2-CHLOROETHOXY)METHANE
111-44-4	BIS(2-CHLOROETHYL)ETHER
39638-32-9	BIS(2-CHLOROISOPROPYL)ETHER
108-60-1	BIS(2-CHLOROISOPROPYL)ETHER
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE
BI-210	BISMUTH-210
BI-212	BISMUTH-212
BI-214	BISMUTH-214
MB-SO	BORON, SOLUBLE
MB-TO	BORON, TOTAL
IBROM	BROMIDE
108-86-1	BROMOBENZENE
74-97-5	BROMOCHLOROMETHANE
75-27-4	BROMODICHLOROMETHANE
460-00-4	BROMOFLUOROBENZENE
75-25-2	BROMOFORM
74-83-9	BROMOMETHANE
85-68-7	BUTYL BENZYL PHTHALATE
MCDEP	CADMIUM, EP LEACHATE
MCDTO	CADMIUM, TOTAL
MCASO	CALCIUM, SOLUBLE
MCATO	CALCIUM, TOTAL

4.4 Analysis Methods (Cont.)

Code	Analysis Name
75-15-0	CARBON DISULFIDE
56-23-5	CARBON TETRACHLORIDE
CE-139	CERIUM-139
CE-141	CERIUM-141
CE-144	CERIUM-144
CS-134	CESIUM-134
CS-137	CESIUM-137
57-74-9	CHLORDANE
ICL	CHLORIDE
ICCL	CHLORIDE BY IC
108-90-7	CHLOROBENZENE
75-00-3	CHLOROETHANE
67-66-3	CHLOROFORM
74-87-3	CHLOROMETHANE
25168-05-2	CHLOROTOLUENE
MCREP	CHROMIUM, EP LEACHATE
MCRSO	CHROMIUM, SOLUBLE
MCRTO	CHROMIUM, TOTAL
CR-51	CHROMIUM-51
218-01-9	CHRYSENE
MCOTO	COBALT, TOTAL
CO-57	COBALT-57
CO-58	COBALT-58
CO-60	COBALT-60
MCUSO	COPPER, SOLUBLE
MCUTO	COPPER, TOTAL
57-12-5	CYANIDE
ICNTO	CYANIDE, TOTAL
319-86-8	DELTA-BHC
MD-SO	DEUTERIUM
84-74-2	DI-N-BUTYL PHTHALATE
117-84-0	DI-N-OCTYL PHTHALATE
53-70-3	DIBENZ(A,H)ANTHRACENE
132-64-9	DIBENZOFURAN
124-48-1	DIBROMOCHLOROMETHANE
74-95-3	DIBROMOMETHANE
1770-80-5	DIBUTYLCHLORENDATE
75-71-8	DICHLORODIFLUOROMETHANE
75-09-2	DICHLOROMETHANE-METHYLENE CHLORIDE
60-57-1	DIELDRIN
84-66-2	DIETHYL PHTHALATE
131-11-3	DIMETHYL PHTHALATE
959-98-8	ENDOSULFAN I(ALPHA)
33213-65-9	ENDOSULFAN II(BETA)
1031-07-8	ENDOSULFAN SULFATE
72-20-8	ENDRIN
7421934	ENDRIN ALDEHYDE

4.5 Parameter Value

Code	Parameter Value Qualifier Name
%	% RECOVERY
*	CONTROL LIMITS NOT APPLICABLE
*E	OUTSIDE CALIBRATION
B	PRESENT IN BLANK
D	DUPLICATE ANALYSIS OF A SAMPLE
E	DET BEYOND CALIBRATION RANGE
I	INTERFERENCE
J	PRESENT BELOW DETECTION LIMIT
JB	PRS BLW DET LMT(J)PRS IN BLANK
NA	NOT APPLICABLE
NC	NOT CALCULATED
NR	NOT REPORTED
NS	NOT SPIKED
R	NOT REQUESTED (NR)
S	NOT SPIKED (NS)
U	ANALYZED FOR BUT NOT DETECTED
UJ	NOT DETECTED/ESTIMATED

APPENDIX D

DATA VALIDATION GUIDELINES FOR CHEMICAL AND RADIOLOGICAL ANALYSES

MOUND DATA VALIDATION GUIDELINES FOR CHEMICAL AND RADIOLOGICAL ANALYSES

1.0 INTRODUCTION

These guidelines are presented to ensure that data validation is performed consistently for chemical data collected for the Mound ER Program. However, these guidelines may not be inclusive of all Quality Control Check (QCC) deficiencies or conditions, and validators may need to use professional judgement in these limited cases. These cases may include, but are not limited to, evaluations of a grossly exceeded QCC criteria, QCCs not described in these procedures that could impact data quality, evaluations of trends related to QCC results from multiple field batches, or multiple QCC deficiencies. Additional data validation guidelines may be developed for analyses or methodologies not included in these guidelines. Such guidelines must be approved by the Quality Assurance Manager (QAM) before implementation.

2.0 GENERAL DATA VALIDATION GUIDELINES

2.1 GENERAL GUIDELINES

The following procedures apply to all data packages submitted for data validation.

- The data package is first reviewed for completeness by the data validator. The Data Completeness Checklist in Attachment I is completed for each laboratory data package. Missing data is directed to the Quality Assurance Manager or his/her designee as soon as it is noted by submitting the signed checklist with comments describing the missing information. Data validation is to continue as is feasible until the discrepancy is resolved. Data validation is not performed without a complete data package, unless there is a documented data loss noted by the Quality Assurance Manager.

- All discrepancies in the data package are directed to Quality Assurance Manager for resolution and to determine whether qualification of the data is warranted.

- Data validation of is performed using the guidelines presented in Sections 4.0 of this document.

- Results of the equipment rinsate, ambient, sample bank, and trip blanks are used to qualify sample data. Results of laboratory blanks are used in qualifying field blank data and sample data, as with any investigative sample.

- Any QCCs not specifically found in the following procedures but outlined in the QAPP will be evaluated against the QAPP criteria.

2.2 CALCULATIONS

A portion of all laboratory sample result calculations will be re-calculated and verified following the guidelines described below.

- For manual calculations, 10 percent of all calculations in the batch will be verified.

- For automated calculations, one calculation per batch will be verified.

If a calculation error is found, the data set will be submitted to the laboratory for verification of all the sample calculations. The laboratory will be required to make all necessary corrections to the data.

In addition to verifying sample calculations, the validators verify:

- Initial calibration - at least one RRF and %RSD for volatile organics (BTEX) and one correlation coefficient for total petroleum hydrocarbons.

- Continuing calibration - at least one RRF and %D for volatile organics and one percent recovery for total petroleum hydrocarbons.

- Surrogate - at least one set of surrogates from one sample within a batch for VOA.
- MS/MSD - at least one compound recovery and RPD for each analyte group.
- LCS - at least one compound.

3.0 DATA QUALIFICATION

3.1 DATA QUALIFIERS

The primary data qualifiers to be applied, as described in the CLP Functional Guidelines and in Sections 4.0, are the following:

U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

J - The associated numerical value is an estimated quantity.

R - The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.

N - Presumptive evidence of presence of material.

NJ - Presumptive evidence of the presence of the material at an estimated quantity.

UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

Subqualifiers are used to assist in data assessment by indicating the source of the primary qualifier. These subqualifiers are attached to the primary qualifier, separated by a hyphen. The following is a list of allowable subqualifiers:

SUBQUALIFIERS - ORGANICS

B - Qualified due to method blank or a field blank
C - Qualified due to calibration
H - Holding time exceeded
K - Qualified due to surrogate recovery
S - Qualified due to matrix spike recovery
I - Qualified due to internal standard
P - Pesticide/PCB results have >25% difference on two different columns
(+) - Potential positive bias (added after subqualifier with a parentheses)
(-) - Potential negative bias (added after subqualifier with a parentheses)

Examples of final qualification might be J-C, UJ-S(+), UJ-BC(-), etc.

Use of additional qualifiers and sub-qualifiers must be approved by the Quality Assurance Manager.

4.0 DATA VALIDATION PROCEDURES

The following guidelines are presented for the validation of data generated by chemical methods. The guidelines have been modeled after the EG&G Mound Operable Unit 9 QAPP (DOE. 1993)

4.1 TOTAL NITROGEN - EPA METHOD 351.3
TOTAL PHOSPHORUS - EPA METHOD 365.1

Holding Time: Verify the samples were analyzed within the holding time period specified in Tables 4.3 and 4.7 of the QAPP. Qualify results as estimated with (J) or (UJ) if holding time was exceeded. If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify initial 4 point (3 points plus one reagent blank) calibration had a correlation coefficient ≥ 0.995. Verify that a continuing calibration check was run every 20 samples and its response was within 15% of true value. If any samples were analyzed with a non-compliant calibration standard, then the results associated with the non-compliant standard must be estimated (J).

Blanks: Method blank must be analyzed every 20 samples and contamination must be less than PQL.

Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Qualification level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

If results < PQL, then no action is taken.

If results < 5 x contamination, then report the value with a (U).

If results > 5 x contamination, then no action is taken.

Matrix Spike: Recovery should be 75 - 125%. Follow US EPA Functional Guidelines for Evaluating Inorganic Analysis.

Qualification Guidelines:

If sample result is <4x spike level and %R <75% estimate all positive results and non-detected results;

If %R >125% estimate positive and accept non-detected results; and

If %R <10% reject all results (R).

Matrix Spike Duplicate: The Relative Percent Deviation (RPD) should be < 20%. If >20% use professional judgement.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water and ≤50% for soils. If criteria was not met, estimate (J) all sample results associated with that duplicate sample.

4.2 Total Petroleum Hydrocarbons - EPA Method 418.1 (modified for soils)

Holding Time: Verify the samples were extracted and analyzed holding times specified in Tables 4.3 and 4.4 of the QAPP. Qualify results as estimated with (J) and (UJ) if holding times were exceeded. If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify the initial 5 point calibration curve had a correlation coefficient ≥ 0.995. If the correlation coefficient was less than 0.995, then qualify all results estimated (J, UJ). If the correlation coefficient was grossly outside criteria, then reject (R) all results.

Verify that a continuing calibration check (CCC) was analyzed at the frequency described in Table 3.2 of the QAPP. If the CCC was not run at the frequency specified in the QAPP, then qualify the affected data estimated (J,UJ). If the CCC recovery was below the criteria specified in Table 3.3 of the QAPP and greater than 50 percent, then qualify all results estimated. If the CCC recovery

was below 50 percent reject all results reported non-detect and qualify all positive results estimated. If the CCC recovery exceeded recovery, then qualify positive results estimated (J).

Blanks: Method blank must be analyzed for each batch of samples extracted for each matrix and contamination must be less than PQL.
Equipment blank sample are qualified using qualification guidance levels derived from method blank contamination. Action Level for samples are determined from the maximum contamination levels in method and equipment blank contamination. If the contamination is greater than the PQL, then for each affected analyte:

Qualification Guidance Level = 5 x contamination in blank.

Qualification Guidelines:

- If results < PQL, then no action is taken.
- If results < 5 x contamination, then report the value with a (U).
- If results > 5 x contamination, then no action is taken.

Matrix Spike: Recoveries and relative percent differences should correspond to those specified in Table 3.3 of the QAPP for soils and water.

The positive values for those compounds that fail MS/MSD criteria but have recoveries >10% should be estimated in the unspiked sample.

For a matrix spike analyte which is outside QAPP recovery criteria, but whose recovery is greater than 10%, then positive analyte sample results in associated samples are qualified estimated (J). Non-detected analyte results in associated samples are evaluated on professional judgement.

For a matrix spike analyte which is outside QAPP recovery criteria, but whose recovery is less than 10%, then positive analyte sample results in associated samples are qualified estimated (J). Non-detected analyte results in associated samples are rejected (R).

Surrogates: Surrogates are not applicable.

Laboratory Control Sample: Laboratory control sample (LCS) recoveries must be within QC limits (Table 3.3) or all associated samples must be re-extracted with another LCS. If the QAPP criteria was not met, then:

a. If the recovery is below criteria and greater than 10 percent, qualify positive results estimated, (J) and non-detects unusable, (R).

b. If the recovery is less than or equal to 10 percent, then qualify all results unusable, (R).

c. For recoveries greater than the specified criteria, no action is taken for non-detects and positive results will be qualified estimated, (J). For recoveries which grossly exceed the specified criteria, positive results may be qualified unusable, (R), based on the validator's professional judgment.

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be ≤25% for water and ≤50% for soils. If criteria was not met, then estimate (J) the positive results for that analyte(s) in both samples. If one of the sample result is >PQL and the other is non-detected, then both results are estimated.

4.3 VOLATILE ORGANIC COMPOUNDS

Holding Time: Verify the samples were extracted within the holding time specified in Table 4.6 and Table 4.7 of the QAPP. Qualify results as estimated (J,UJ) if the holding time was exceeded. If the holding time was grossly exceeded, professional judgement may be used for qualifying the data as unusable (R).

Calibration: Verify the Percent Relative Standard Deviation (RSD) for each of the four targets was less than 20 percent. If the RSD > 20 percent and the RSD < 50 percent then estimate (J,UJ) both

positive and negative results. If the RSD > 50 percent, then reject the results.

Verify the Relative Response Factor (RRF) for each of the target compounds is greater than 0.05. If the RRF < 0.05, then reject both positive and negative results.

Verify a continuing calibration check was run every 12 hours. If the continuing calibration check was not run, then qualify all affected results estimated (J,UJ). If the percent difference for each of the target analytes is greater than 25 percent, then qualify the associated positive sample result estimated (J). If the percent difference one of the target compounds is less than -25 percent and greater than -50 percent, then qualify both positive and negative results estimated (J,UJ). If the percent difference for one of the target compounds is less than -50 percent then qualify the associated negative results rejected (R) and the associated positive results estimated (J).

Note: The laboratory is using BTEX compounds for SPCC's and CCC's.

Blanks: A method blank must be analyzed for each batch of samples analyzed and the contamination must be less than the PQL. In addition to the laboratory method blank, field blanks and trip blanks will be submitted for testing and the contamination must be less than the PQL. If the method blanks contain target contaminants, the action level will be based on the largest result reported in the three blanks for each compound. The action level will be based on the 5x rule. Sample results less than 5 times the blank contaminant level will be qualified non-detect (U) at the reported value.

- If the sample result < PQL, then no action is taken.
- If the sample result >PQL and less than 5 x contaminant level, then report the value with a 'U' qualifier.
- If the sample result > PQL and greater than 5 x contaminant level, then no action is taken.

Internal Standards: Internal standards must be added to each sample prior to analysis. If the internal standard is below criteria, then the associated positive sample results will be estimated (J). If the internal standard is above criteria, then the associated positive and negative sample results will be estimated (J,UJ). If the internal standard criteria are grossly exceeded, then professional judgement may be used to reject data results.

Surrogates: If surrogate recoveries do not meet Table 3.3 requirements, then the samples should be re-analyzed. If the surrogate recovery is below criteria and greater than 50 percent, then associated positive and negative results will be qualified estimated (J,UJ). If the percent recovery is less than 50 percent, then associated negative results will be rejected (R) and positive results will be qualified estimated. If the surrogate recovery exceeds criteria, then associated positive sample results will be qualified estimated (J).

Duplicate: Verify a duplicate sample was analyzed for every 10 field samples or less of each matrix. The RPD must be $\leq$25% for water and $\leq$50% for soils. If criteria was not met, then estimate (J) the positive results for that analyte(s) in both samples. If one of the sample result is > PQL and the other is non-detected, then both results are estimated.

5.0 DATA VALIDATION REPORTING PROCEDURES

Validation report contents must be in a narrative format and must follow the outline presented below:

I. TITLE - "Report of Data Validation Results"

II. HEADER - Name of Project, Operable Unit, Description of Task (e.g., Groundwater monitoring), Work Order Number, and date of report.

III. CASE SUMMARY

State the following:

- Case/Batch number
- Number of samples and type of matrix
- Date of Collection
- Chain of Custody identifier, if any
- Type of analysis (Discuss impacts if incorrect method used)
- Condition of samples when received by the laboratory, any lost data
- List the client sample Ids applicable to the report.

IV. DATA COMPLETENESS

V. HOLDING TIMES

Discuss results of holding times and those outside the required holding time.

VI. RESULTS OF LABORATORY QUALITY CONTROL CHECKS

For each laboratory quality control check required to be performed, discuss whether the frequency, acceptance criteria, and corrective actions were met. Summarize which samples were affected and how the data was impacted.

The laboratory quality control checks for each analysis are listed below:

<u>Volatiles</u>

a. GC/MS Tuning
b. Calibration
c. Blanks
d. Surrogate Spike Recoveries
e. Matrix spike/Matrix Spike Duplicate Recoveries
f. Internal Standards
g. Compound Identification
h. System Performance
i. Compound Quantitation and Contract Required Quantitation Limits (CRQLs)

<u>Total Petroleum Hydrocarbons/Anions</u>

a. Calibration

b. Blanks

c. Laboratory Control Sample

d. Matrix Spike/Matrix Spike Duplicate Sample Analysis

e. Compound Identification

f. Compound Quanitation and Contract Required Quantitation Limits (CRQL's)

VII. RESULTS OF ASSOCIATED FIELD QUALITY CONTROL CHECKS

a. Field Duplicates

b. Field Blanks (equipment blanks, etc.)

VIII. OVERALL ASSESSMENT OF DATA

- Discuss overall assessment of data and categorize data in one or more of the following (use these as subsections to this section):
  - Data had no problem/or qualified due to minor problems.
  - Data qualified due to major problems.
  - Data unacceptable.
  - Problems, but does not affect data.

  Discuss how all findings in the review could impact the data usability.

ATTACHMENT I - Data Outlier Summary Forms

ATTACHMENT II - Qualified Data Summary Reports *

ATTACHMENT III - Data Completeness Checklist

Data outlier summary forms presented in Attachment III are to be completed as described in this section.

ATTACHMENT IV - Laboratory Case Narrative

ATTACHMENT V - Chain-of-Custody

5.1 HOLDING TIME FORMS

Complete the appropriate form all samples with date of sampling, date of extraction/date of analysis and write number of days between each event in the right-hand corner and note whether extraction or analysis holding time was exceeded.

5.2 BLANK DATA SUMMARY FORMS

Complete the appropriate form. Enter blank outliers only and note appropriate action level based on 5x or 10x. Enter the associated sample IDs.

5.3 SURROGATE RECOVERY FORMS

Complete header section. Complete remainder of table only for those samples which have surrogate outliers. If no outliers, then write 'None'.

5.4 MATRIX SPIKE RECOVERY FORMS

Complete header section. Complete remainder of table only for those samples which have MS/MSD outliers. Enter the percent recovery as appropriate. The RPD should be entered in parentheses. If no outliers, write 'None'.

5.5 CALIBRATION FORMS

Complete header section, instrument, and date and time for each calibration run. Enter the outlying RF, RRF, RSD, or %D as necessary. List all associated sample IDs at bottom of form.

5.6 FIELD DUPLICATE FORMS

Complete header section and sample IDs. Enter outlying RPD values for analytes. If no values are outside the required range, so state.

5.7 INTERNAL STANDARD FORMS

Complete header section. In area limits box, write actual area values from Form VIII. For IS outliers, enter the sample ID and enter the actual outlying area value.

5.8 INSTRUMENT PERFORMANCE FORM

Complete header section, instrument, column type, date, and time. Enter any outliers; if none, so state.

5.9 REPLICATE DATA SUMMARY FORM

Complete header section. If outliers, enter sample IDs, outlier value, and qualification designation.

5.10 QUALIFIED DATA SUMMARY FORMS

Form 1s for CLP analysis should be copied and the proper qualifiers/subqualifiers added as discussed in Section 4 and attached to the validation report.

5.11 DATA SUMMARY FORMS FOR ANIONS

Complete header section. Fill in remainder if criteria was exceeded.

5.12 SAMPLE CALCULATIONS

A sample calculation should be provided in the upper right hand corner of tables for surrogate recovery, matrix spike recovery, calibration, field duplicate, and replicate tables along with the data validators initials and date. This calculation should show the formula, actual sample values, and final result. Use the following as a guideline for calculations to show:

Initial calibration - at least one RRF and %RSD for VOA,Pest/PCB; two RRF and %RSD for semivolatiles for each.

Continuing calibration - at least one RRF and %D for VOA and/or two for semivolatiles for each continuing calibration.

Surrogate - at least one set of surrogates from one sample within a batch for VOA and pest/PCB, and at least two surrogates from one sample within a batch for SV (one acid, one base).

MS/MSD - at least one compound recovery and RPD for each analyte group.

LCS - at least one compound.

The first draft report of data validation results is delivered to the Quality Assurance Manager or his/her designee within 20 days from date of data receipt for a senior technical review. Requested corrections to the first draft reports must be submitted within 10 calendar days, unless otherwise noted.

6.0 OVERALL DATA ASSESSMENT PROCEDURES

For each qualification, data validators are responsible for evaluating the potential impact of the qualified result on the usability of the data. Any bias must be noted as a potential bias in the text of the validation report, along with the estimated amount of bias if feasible. When the bias is determined to be positive or negative, include either (+) or (-), respectively, after the subqualifier to denote the impact of the bias.