

FINAL WORK PLAN FOR
REMEDIAL INVESTIGATION AT
NAVAL AIR STATION
MOFFETT FIELD, CALIFORNIA

VOLUME IV: QUALITY ASSURANCE PROJECT PLAN

MARCH 30, 1988

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for:

U.S. DEPARTMENT OF ENERGY
CONTRACT DE-AC05-84OR21400

Submitted to:

DEPARTMENT OF THE NAVY
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA 94066-0720

1.0 QUALITY ASSURANCE PROJECT PLAN (QAPjP)

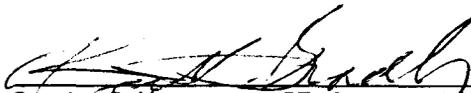
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REMEDIAL INVESTIGATION

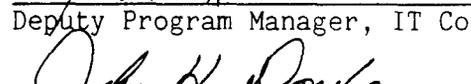
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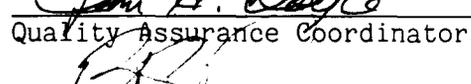
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FINAL WORK PLAN FOR
REMEDIAL INVESTIGATION

DATED 30 MARCH 1988

THIS RECORD CONTAINS MULTIPLE VOLUMES
WHICH HAVE BEEN ENTERED SEPARATELY

VOLUME I OF V IS FILED AS ADMINISTRATIVE
RECORD NO. N00296.000308

VOLUME II OF V IS FILED AS ADMINISTRATIVE
RECORD NO. N00296.000309

VOLUME III OF V IS FILED AS ADMINISTRATIVE
RECORD NO. N00296.000310

VOLUME V OF V IS FILED AS ADMINISTRATIVE
RECORD NO. N00296.000312

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QUALITY ASSURANCE PROJECT PLAN
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Laboratory Coordinator, IT - Guy Sylvester
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Project Hydrogeologist, IT - Russ Mount
Field Operations Coordinator, IT - Howard Fleck
Senior Project Scientist, Maxima - Adam Szluha
California Regional Water Quality Board - Tom Berkins

3.0 INTRODUCTION AND PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPjP) describes the methods and procedures that will be used by IT Corporation (IT) at the Naval Air Station (NAS) Moffett Field sites to assure the quality, precision, accuracy, and completeness of the data generated during the field investigation and interim remedial action planning activities. IT will conduct these activities under the management direction of Martin Marietta Energy Systems, Inc.

This QAPjP has been prepared to provide assurance by IT and its subcontractors that the work performed will be of the quality required to satisfy the project objectives and will be responsive to requirements of the U.S. Environmental Protection Agency (USEPA).

This QAPjP is based on the Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80 (US EPA, December 29, 1980) and the January 1986 Draft Supplement to the Interim Guidelines (Region 9).

The QAPjP focuses on the acquisition of environmental data of known and acceptable quality. Other aspects of the project, such as engineering analysis, report preparation, and records, will be controlled by the internal requirements of IT's Quality Assurance Program. The IT Quality Assurance Program is documented in the IT Environmental Projects Group Southeast Region Quality Assurance Procedures Manual, the IT Engineering Operations Quality Assurance Manual, the IT Analytical Services Quality Assurance Manual, and the ITAS Cerritos Laboratory Specific Quality Assurance Manual. The policies and procedures specified in these manuals define acceptable practices applicable to most environmentally related projects, regardless of the specific aim of the project.

These Quality Assurance Manuals are controlled proprietary documents. Copies will be supplied to regulatory agencies upon written request.

3.1 PROJECT DESCRIPTION

NAS Moffett Field is located adjacent to San Francisco Bay in the Santa Clara Valley near the cities of Mountain View and Sunnyvale, California. It is bounded by salt evaporation ponds to the north, Stevens Creek Boulevard to the west, U.S. Highway 101 (Bayshore Freeway) to the south, and Macon Road to the east. There are nineteen sites being investigated at NAS Moffett Field under the Remedial Investigation.

The 19 sites covered in this QAPjP are as follows:

1. Runway Landfill
2. Golf Course Landfill
3. Area in Vicinity of Marriage Road Ditch
4. Industrial Wastewater Holding Ponds
5. Fuel Farm French Drains and Bulk Tanks
6. Runway Aprons
7. Area in Vicinity of Hangars 2 and 3
8. Waste Oil Transfer Area
9. Old Fuel Farm
10. Chase Park area (and Runway)
11. Engine Test Area
12. Fire Fighting Training Area
13. Equipment Parking Area
14. Abandoned Tanks 19, 20, 67, 68
15. Sumps and Oil/Water Separators (Nos. 25, 42, 54, 58, 59, 62, 63, 64, and 65)
16. Steam Cleaning Rack Sump No. 60
17. Paint Shop Sump No. 61
18. Dry Cleaners Sump No. 66
19. Leaking Tanks 2, 14, 43, and 53.

A description of each of the above sites is contained in the Work Plan (Volume I).

In general, the chemicals present at the sites include fuels and volatile organic compound (VOC) priority pollutants; other priority pollutants such as polychlorinated biphenyls (PCBs) are of concern at some sites.

Background information including the objectives and rationale of the planned sampling effort are presented for Sites 1-10 in Chapter 2 and Sites 11-19 in Chapter 3 of the Sampling and Analysis Plan.

3.2 PROJECT OBJECTIVES

The objective of the Remedial Investigation is to characterize and define the extent of contamination at the nineteen sites to be investigated.

Specific objectives are as follows:

- To evaluate and design interim remedial actions to reduce the impact or migration of environment contaminants. These remedial measures are not intended to necessarily provide the final remedial solution at each site.
- To confirm, characterize, and define the lateral and vertical extent of chemicals of concern at each of the sites.
- To supplement and refine the geologic, geochemical, hydrogeologic, and chemical data bases that exist for the study sites.
- To evaluate chemical migration pathways, site geohydrology, and specifics of ground water movement and/or surface water movement which influence the migration of site related chemicals.

The Remedial Investigation will be conducted in a multi-phased approach, with the data from the early phases being used to help define the investigations for the later phase(s). A summary project schedule is included in Appendix B. Data generated during the Remedial Investigation will provide the basis for a Feasibility Study that will follow the Remedial Investigation phase and will also be useful for any evaluation to be conducted regarding potential risks and hazards to public health and the environment.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Figure 1 shows the project organization, reporting relationships and line authority as it relates to aspects of quality assurance. The principal contractor personnel assigned to conduct the NAS Moffett Field investigation are Keith Bradley (Project Manager), Ken Porter (Deputy Program Manager), Don Mack (Quality Assurance Officer), Jack Doyle (Quality Assurance Coordinator), Tim Roberts (Health and Safety Coordinator), Guy Sylvester (Laboratory Coordinator), H. Fleck (Field Operations Coordinator), and Russ Mount (Project Hydrogeologist). Their responsibilities are described in the following sections. Other personnel will be assigned as deemed necessary.

4.1 PROJECT MANAGER

The Project Manager will be the prime point of contact with Martin Marietta Energy Systems, Inc., and will have primary responsibility for technical, financial, and scheduling matters. His duties will include:

- Reviewing and approving the QAPjP, Work Plan, Solid Waste Assessment Test Plan (SWAT) and Sampling and Analysis Plan
- Assigning duties to the project staff and orienting the staff to the needs and requirements of the project
- Obtaining the approval of the Quality Assurance Coordinator for proposed variances to the Work Plan, QAPjP, and Sampling and Analysis Plan
- Supervising the performance of project team members
- Evaluating training needs for the project staff
- Providing budget and schedule control
- Reviewing subcontractor work and approving of subcontract invoices
- Establishing a project record system
- Ensuring that major project deliverables are reviewed for technical accuracy and completeness before their release
- Ensuring that the requirements of the QAPjP are satisfied

- Regularly communicating project status, progress, and any problems to the Quality Assurance Coordinator.

4.2 DEPUTY PROGRAM MANAGER

The Deputy Program Manager's responsibilities will include:

- Reviewing and approving the QAPjP, Work Plan, SWAT Plan, and Sampling and Analysis Plan
- Providing sufficient resources to the project team so that it can respond fully to the requirements of the investigation
- Providing direction and guidance to the Project Manager as appropriate
- Reviewing the quality of the data gathered during the course of the project and the reviewing final project report
- Other responsibilities as requested by the Project Manager.

4.3 QUALITY ASSURANCE OFFICER

Responsibilities of the IT Quality Assurance Officer as appropriate include:

- Implementing the overall IT Quality Assurance Program as presented in the IT Engineering Operations QA Manual (IT EO QAM)
- Implement and verify, on a generic basis, the provisions of the IT EO QAM
- Preparing office/group, as needed, quality related procedures
- Performing independent project-specific QA audits
- Ensuring that appropriate corrective actions are taken for all nonconformances.

4.4 QUALITY ASSURANCE COORDINATOR

Responsibilities of the project Quality Assurance Coordinator as appropriate, include:

- Being the official contact for quality assurance matters for the project
- Actively identifying and responding to Quality Assurance/Quality Control (QA/QC) needs, resolving problems, and answering requests for guidance or assistance

- Reviewing, evaluating, and approving quality related changes to the Work Plan, the SWAT Plan, the QAPjP, and the Sampling and Analysis Plan
- Actively tracking the progress of quality tasks in this plan and consulting periodically with the Project Manager and Program Manager
- Preparing and submitting QA/QC reports to management
- Ensuring for the Project Manager that appropriate corrective actions are taken for all nonconformances
- Verifying that appropriate methods are specified for obtaining data of known quality and integrity
- Scheduling and performing an appropriate quality assurance verification activity for each site to ensure compliance with requirements and procedures
- Other responsibilities as requested by the Project Manager
- Actively tracking the progress of quality tasks in this plan and consulting periodically with the Project Manager, the Program Manager and the Quality Assurance Officer.

4.5 FIELD OPERATIONS COORDINATOR

The duties and responsibilities are as follows:

- Providing orientation and any necessary training to field personnel (including subcontractors) on the requirements of the Work Plan, QAPjP, SWAT Plan, and Sampling and Analysis Plan prior to the start of work
- Providing direction and supervision to the drilling contractor during the drilling of soil borings and installation of monitoring wells
- Monitoring drilling and sampling operations to ensure that the drilling contractor and sampling team members adhere to all approved Work Plans
- Assuring use of calibrated measurement and test equipment
- Establishing and maintaining a field records managements system
- Coordinating activities with the Project Manager

- Assuming the duties of the Health and Safety Coordinator (HSC) as required.

4.6 PROJECT HYDROGEOLOGIST

The project hydrogeologist will be responsible for:

- Reviewing and implementing geologic data collection plans
- Supervising borehole logging and other geological data interpretation activities
- Overseeing field data documentation and conducting quality checks on drilling logs and other interpretative geologic work products
- Reviewing reports for compliance with State of California and EPA requirements.

4.7 HEALTH AND SAFETY COORDINATOR

The Health and Safety Coordinator will be responsible for seeing that site personnel adhere to the site safety requirements. Additional responsibilities are included in the Moffett Field Health and Safety Plan. In the absence of the Health and Safety Coordinator, the Field Operations Coordinator will assume the role of the Health and Safety Coordinator.

4.8 LABORATORY COORDINATOR

The Laboratory Coordinator will be responsible for the laboratory implementing the requirements of this QAPjP. The Laboratory Coordinator's responsibilities will, as appropriate, include:

- Providing orientation and any necessary training to laboratory personnel on the requirements of the Work Plan, QAPjP, SWAT Plan, and Sampling and Analysis Plan
- Collaborating with the project staff in establishing sampling and testing programs
- Serving as liaison between the laboratory staff and other groups
- Serving as the "collection point" for laboratory staff reporting of nonconformances and changes in laboratory activities
- Notifying the laboratory and quality assurance personnel of specific laboratory nonconformances and changes

- Maintaining laboratory data and checkprints while the project, or testing phase, is in progress
- Releasing testing data and results
- Calibration of equipment
- Storage and control of samples
- Preparing QA/QC reports to lab manager.

4.9 SUBCONTRACTOR ACTIVITIES

The selection of qualified subcontractors will be in accordance with the IT Procurement and Quality Assurance procedures. Subcontractors, such as drillers, geophysical specialists, surveyors, and environmental monitoring specialists, must meet predetermined qualifications developed by the Project Manager which are defined in the procurement bid packages. Each subcontractor bid submittal is reviewed by technical, purchasing, and quality assurance personnel to ensure that the bidders are qualified and can satisfy bid requirements. Subcontractors involved in environmental measurements will be monitored by the Field Operations Coordinator to assure use of calibrated equipment and qualified operators.

4.10 QUALIFICATIONS AND TRAINING OF PERSONNEL

Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. Besides education and experience, specific training will be required to qualify individuals to perform certain activities. Training will be documented on the appropriate form and placed in the project file as a record. Project personnel will receive an orientation to the Work Plan, Sampling and Analysis Plan, SWAT Plan and the QAPjP as appropriate to their responsibilities before participation in project activities. The orientation will be documented.

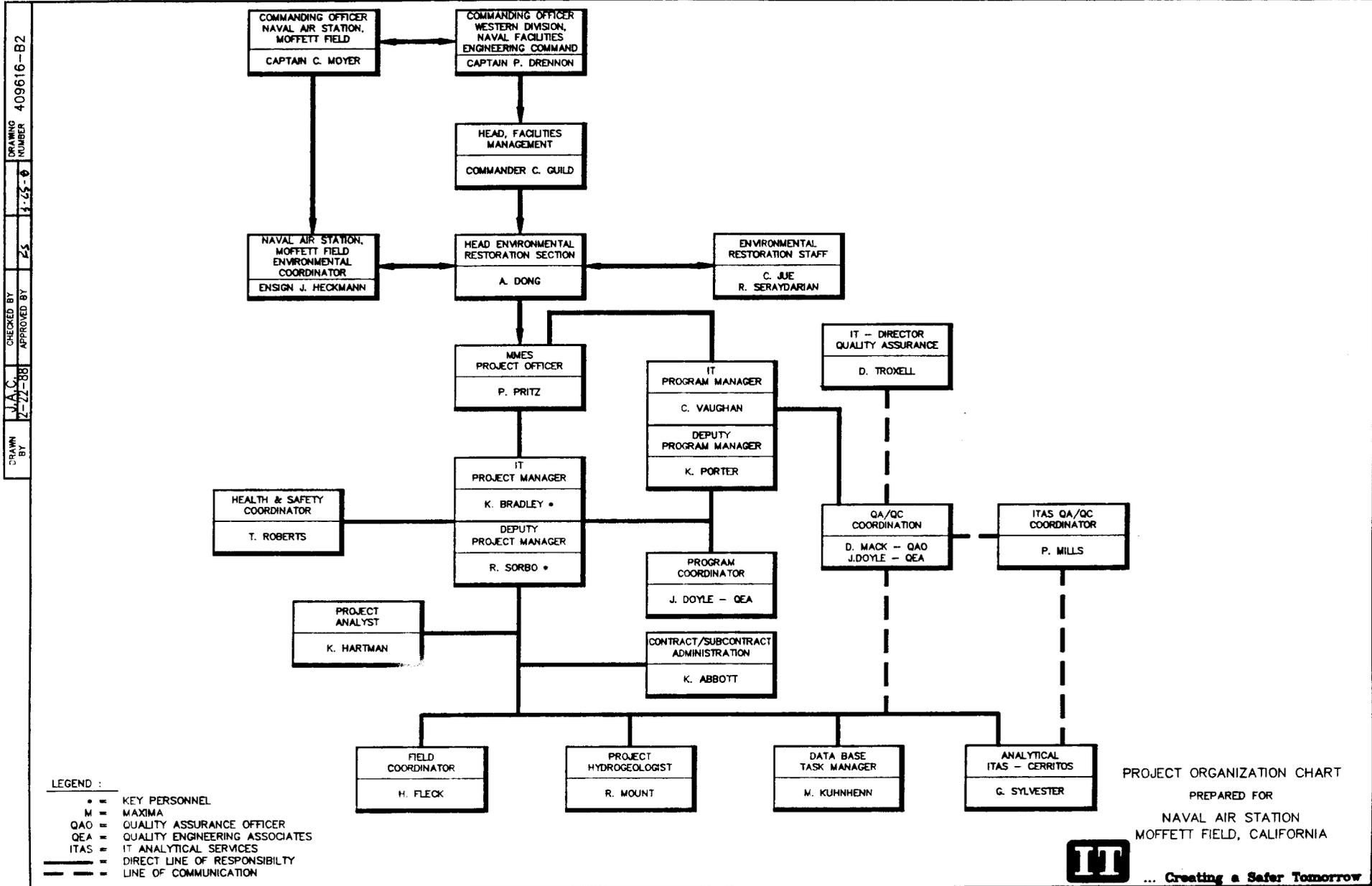


FIGURE 1

5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

The purpose of this QAPjP is to facilitate the implementation of the requirements of the Statement of Work and applicable regulatory requirements and to provide internal means for control and review so that the environmentally related measurements and data collected by IT and its subcontractors are scientifically sound, defensible, and of known acceptable documented quality.

Project objectives are that:

- Scientific data generated will be of sufficient quality to withstand scientific and legal scrutiny
- Data will be gathered or developed in accordance with procedures appropriate for its intended use
- Data will be of known precision, accuracy, representativeness, completeness, detection limits, and comparability within the limits of the project.

To ensure that these objectives are met, the procedures to be used for assessing the quality of the measurement data are as follows:

- Accuracy and Precision - which is the agreement between a measurement and the true value and the degree of variability in the agreement, respectively.

To determine the precision of the method and/or laboratory analyst, a routine program of replicate analysis is performed. The results of the replicate analyses are used to calculate the relative percent difference (RPD), which is the governing quality control parameter for precision.

For replicate results $R_1 + R_2$

$$RPD = \frac{R_1 - R_2}{\frac{R_1 + R_2}{2}} \times 100\%$$

To determine the accuracy, the evaluation is applied over the entire range of spiking concentrations. To determine the accuracy of an analytical method and/or the laboratory analyst, a periodic program of sample spiking is conducted (minimal 1 spike

and 1 spike duplicate per 20 samples). The results of sample spiking are used to calculate the quality control parameter for accuracy evaluation, the percent recovery (% R).

$$100\% \times \frac{S_1 - S_2}{T_1} = \%R$$

where:

S_1 = Observed spiked sample concentration.
 S_2 = Sample concentration
 T_1 = True concentration of the spike.

Accuracy and precision of data collected in the investigation will depend upon the measurement standards used and the meticulous, competent use of them by qualified personnel.

- Completeness - which is the adequacy in quantity of valid measurements to prevent misinterpretation and to answer important questions. For this project the data completeness objective is 90%.
- Representativeness - which is the extent to which discrete measurements accurately describe the greater picture they are intended to represent.

For this project good representativeness will be achieved through careful, informed selection of sampling sites, drilling sites, drilling depths, and analytical parameters; and through the proper collection and handling of samples to avoid interferences and to minimize contamination and loss.

- Comparability - which is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. For this project comparability among measurements will be achieved through the use of standard procedures and standard field data sheets.
- Quantitation Limits - which is the extent to which the equipment, laboratory or field, or analytical process can provide accurate, minimum data measurements of a reliable quality for specific constituents in replicate field samples. It is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. Tables 5-1a through 5-1d provide a listing of the estimated quantification limits for pollutants. The actual quantitation limit for a given analysis will vary depending on instrument sensitivity and matrix effects.
- Traceability - which is the extent to which data can be substantiated by hard-copy documentation. Traceability documentation exists in two essential forms: one that links

quantitation to authoritative standards and a second that explicitly describes the history of each sample from collection to analysis.

The fundamental mechanisms that will be employed to achieve these quality goals can be categorized as prevention, assessment, and correction. These include:

- Prevention of defects in the quality through planning and design, documented instructions and procedures, and careful selection of skilled, qualified personnel
- Quality assessment through a program of regular audits and inspections to supplement continual informal review
- Permanent correction of conditions adverse to quality through a closed-loop corrective action system.

This QAPjP has been prepared in direct response to these goals. This plan describes the Quality Assurance Program to be implemented and the quality control procedures to be implemented by IT and its subcontractors.

Quantitation Limits are presented in Tables 5-1a through 5-1d. Sample Precision, Accuracy, and Completeness Objectives are listed in Table 5-2. The Matrix Spike Recovery Limits are listed in Table 11-1. The quality assurance objectives for laboratory QC data are designed to screen out data of unacceptable precision or accuracy.

Each laboratory will provide quantification limits for each constituent analyzed. The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the value is above zero. The MDL concentrations are usually determined using uncontaminated reagent water. Similar but higher limits can be achieved using representative wastewaters. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and interferences. The objective for data completeness is 90 percent. The objectives for precision and accuracy for each chemical are based mainly on the capabilities of the approved EPA analytical method with respect to laboratory QC.

For field QC data, no quality assurance objectives have been established by the EPA. Field QC data will be maintained primarily for descriptive purposes and data variability. The Quality Assurance Coordinator will be responsible for reviewing and evaluating the field QC data.

Soil borings and well locations have been chosen to represent the areas of interest at the site. Because of the procedures used to collect samples, store, and transport them to the laboratory, the samples will be as representative as possible of actual conditions given current standard practices.

Similar samples will be collected using consistent sampling methods, analyzed using consistent analytical procedures, and reported in conventional units (e.g., mg/kg or $\mu\text{g/L}$). Therefore, the data will be comparable throughout the project.

Applicable, Relevant and Appropriate Requirements (ARARs) specific to the Moffett Remedial Investigation (RI) have not yet been established. After initial investigations have established contaminants located at Moffett and their sources, ARARs will be established for those contaminants. The ARARs will be established as a result of the RI Risk Assessment (RIRA) process. After definition of the site-specific ARARs, current quantification limits (and analytical methods) will be modified accordingly. It is anticipated that the appropriateness of such modifications will be evaluated again before preparation of the Work Plan for Phase III investigations.

Table 5-1a. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Volatiles

| Parameter | CAS Number | Method | Quantitation Limits ^{a,b} | |
|---------------------------|------------|------------------|--|---|
| | | | Low ^e Water ^c µg/L | Low ^e Soil/Sediment ^d µg/kg |
| Chloromethane | 74-87-3 | CLP ^a | 10 | 10 |
| Bromomethane | 74-83-9 | CLP ^a | 10 | 10 |
| Vinyl chloride | 75-01-4 | CLP ^a | 10 | 10 |
| Chloroethane | 75-00-3 | CLP ^a | 10 | 10 |
| Methylene chloride | 75-09-2 | CLP ^a | 5 | 5 |
| Acetone | 67-64-1 | CLP ^a | 10 | 10 |
| Carbon disulfide | 75-15-0 | CLP ^a | 5 | 5 |
| 1,1-Dichloroethene | 75-35-4 | CLP ^a | 5 | 5 |
| 1,1-Dichloroethane | 75-35-3 | CLP ^a | 5 | 5 |
| trans-1,2-Dichloroethene | 156-60-5 | CLP ^a | 5 | 5 |
| Chloroform | 67-66-3 | CLP ^a | 5 | 5 |
| 1,2-Dichloroethane | 107-06-2 | CLP ^a | 5 | 5 |
| 2-Butanone | 78-93-3 | CLP ^a | 10 | 10 |
| 1,1,1-Trichloroethane | 71-55-6 | CLP ^a | 5 | 5 |
| Carbon tetrachloride | 56-23-5 | CLP ^a | 5 | 5 |
| Vinyl acetate | 108-05-4 | CLP ^a | 10 | 10 |
| Bromodichloromethane | 75-27-4 | CLP ^a | 5 | 5 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | CLP ^a | 5 | 5 |
| 1,2-Dichloropropane | 78-87-5 | CLP ^a | 5 | 5 |
| trans-1,3-Dichloropropene | 10061-02-6 | CLP ^a | 5 | 5 |
| Trichloroethene | 79-01-6 | CLP ^a | 5 | 5 |
| Dibromochloromethane | 124-48-1 | CLP ^a | 5 | 5 |
| 1,1,2-Trichloroethane | 79-00-5 | CLP ^a | 5 | 5 |
| Benzene | 71-43-2 | CLP ^a | 5 | 5 |
| cis-1,3-Dichloropropene | 10061-01-5 | CLP ^a | 5 | 5 |

Table 5-1a. Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) - Volatiles (Continued)

| Parameter | CAS Number | Method | Quantitation Limits ^{a,b} | |
|----------------------|------------|------------------|---|--|
| | | | Low ^e Water ^c μg/l | Low ^e Soil/Sediment ^d μg/kg |
| Bromoform | 75-25-2 | CLP ^a | 5 | 5 |
| 2-Hexanone | 591-78-6 | CLP ^a | 10 | 10 |
| 4-Methyl-2-pentanone | 108-10-1 | CLP ^a | 10 | 10 |
| Tetrachloroethene | 127-18-4 | CLP ^a | 5 | 5 |
| Toluene | 108-88-3 | CLP ^a | 5 | 5 |
| Chlorobenzene | 108-90-7 | CLP ^a | 5 | 5 |
| Ethyl benzene | 100-41-4 | CLP ^a | 5 | 5 |
| Styrene | 100-42-5 | CLP ^a | 5 | 5 |
| Total xylenes | | CLP ^a | 5 | 5 |

^aSpecific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. CLP Scope of Work 7/87.

^bQuantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

^cMedium Water Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 100 times the individual Low Water CRQL.

^dMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 100 times the individual Low Soil/Sediment CRQL.

^eCLP Definition, < 10 ppm of target compound.

Reference: EPA Contract Laboratory Program (CLP)
Contract Required Quantitation Limits (CRQL)

Table 5-1b. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Semivolatiles

| Parameter | CAS Number | Method | Quantitation Limits ^{a,b} | |
|--|------------|------------------|--|---|
| | | | Low ^e Water ^c µg/L | Low ^e Soil/Sediment ^d µg/kg |
| Phenol | 108-95-2 | CLP ^a | 10 | 330 |
| bis(2-Chloroethyl)ether | 111-44-4 | CLP ^a | 10 | 330 |
| 2-Chlorophenol | 95-57-8 | CLP ^a | 10 | 330 |
| 1,3-Dichlorobenzene | 541-73-1 | CLP ^a | 10 | 330 |
| 1,4-Dichlorobenzene | 106-46-7 | CLP ^a | 10 | 330 |
| Benzyl alcohol | 100-51-6 | CLP ^a | 10 | 330 |
| 1,2-Dichlorobenzene | 95-50-1 | CLP ^a | 10 | 330 |
| 2-Methylphenol | 95-48-7 | CLP ^a | 10 | 330 |
| bis(2-Chloroisopropyl)ether | 39638-32-9 | CLP ^a | 10 | 330 |
| 4-Methylphenol | 106-44-5 | CLP ^a | 10 | 330 |
| n-nitroso-dipropylamine | 621-64-7 | CLP ^a | 10 | 330 |
| Hexachloroethane | 67-72-1 | CLP ^a | 10 | 330 |
| Nitrobenzene | 98-95-3 | CLP ^a | 10 | 330 |
| Isophorone | 78-59-1 | CLP ^a | 10 | 330 |
| 2-Nitrophenol | 88-75-5 | CLP ^a | 10 | 330 |
| 2,4-Dimethylphenol | 105-67-9 | CLP ^a | 10 | 330 |
| Benzoic acid | 65-85-0 | CLP ^a | 50 | 1,600 |
| bis(2-Chloroethoxy)methane | 111-91-1 | CLP ^a | 10 | 330 |
| 2,4-Dichlorophenol | 120-83-2 | CLP ^a | 10 | 330 |
| 1,2,4-Trichlorobenzene | 120-82-1 | CLP ^a | 10 | 330 |
| Naphthalene | 91-20-3 | CLP ^a | 10 | 330 |
| 4-Chloroaniline | 106-47-8 | CLP ^a | 10 | 330 |
| Hexachlorobutadiene | 87-68-3 | CLP ^a | 10 | 330 |
| 4-Chloro-3-methylphenol (para-chloro-meta-cresol) | 59-50-7 | CLP ^a | 10 | 330 |
| 2-Methylnaphthalene | 91-57-6 | CLP ^a | 10 | 330 |
| Hexachlorocyclopentadiene | 77-47-4 | CLP ^a | 10 | 330 |
| 2,4,6-Trichlorophenol | 88-06-2 | CLP ^a | 10 | 330 |
| 2,4,5-Trichlorophenol | 95-95-4 | CLP ^a | 50 | 1,600 |
| 2-Chloronaphthalene | 91-58-7 | CLP ^a | 10 | 330 |
| 2-Nitroaniline | 88-74-4 | CLP ^a | 50 | 1,600 |
| Dimethyl phthalate | 131-11-3 | CLP ^a | 10 | 330 |
| Acenaphthylene | 208-96-8 | CLP ^a | 10 | 330 |
| 3-Nitroaniline | 99-09-2 | CLP ^a | 50 | 1,600 |

Table 5-1b. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Semivolatiles (Continued)

| Parameter | CAS Number | Method | Quantitation Limits ^{a,b} | |
|-----------------------------|------------|------------------|--|---|
| | | | Low ^e Water ^c µg/L | Low ^e Soil/Sediment ^d µg/Kg |
| Acenaphthene | 83-32-9 | CLP ^a | 10 | 330 |
| 2,4-Dinitrophenol | 51-28-5 | CLP ^a | 50 | 1,600 |
| 4-Nitrophenol | 100-02-7 | CLP ^a | 50 | 1,600 |
| Dibenzofuran | 132-64-9 | CLP ^a | 10 | 330 |
| 2,4-Dinitrotoluene | 121-14-2 | CLP ^a | 10 | 330 |
| 2,6-Dinitrotoluene | 606-20-2 | CLP ^a | 10 | 330 |
| Diethylphthalate | 84-66-2 | CLP ^a | 10 | 330 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | CLP ^a | 10 | 330 |
| Fluorene | 86-73-7 | CLP ^a | 10 | 330 |
| 4-Nitroaniline | 100-01-6 | CLP ^a | 50 | 1,600 |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | CLP ^a | 50 | 1,600 |
| N-nitrosodiphenylamine | 86-30-6 | CLP ^a | 10 | 330 |
| 4-Bromophenyl phenyl ether | 101-55-3 | CLP ^a | 10 | 330 |
| Hexachlorobenzene | 118-74-1 | CLP ^a | 10 | 330 |
| Pentachlorophenol | 87-86-5 | CLP ^a | 50 | 1,600 |
| Phenanthrene | 85-01-8 | CLP ^a | 10 | 330 |
| Anthracene | 120-12-7 | CLP ^a | 10 | 330 |
| Di-n-butylphthalate | 84-74-2 | CLP ^a | 10 | 330 |
| Fluoranthene | 206-44-0 | CLP ^a | 10 | 330 |
| Pyrene | 129-00-0 | CLP ^a | 10 | 330 |
| Butyl benzyl phthalate | 85-68-7 | CLP ^a | 10 | 330 |
| 3,3'-Dichlorobenzidine | 91-94-1 | CLP ^a | 20 | 660 |
| Benzo(a)anthracene | 56-55-3 | CLP ^a | 10 | 330 |
| bis(2-Ethylhexyl)phthalate | 117-81-7 | CLP ^a | 10 | 330 |
| Chrysene | 218-01-9 | CLP ^a | 10 | 330 |
| Di-n-octyl phthalate | 117-84-0 | CLP ^a | 10 | 330 |
| Benzo(b)fluoranthene | 205-99-2 | CLP ^a | 10 | 330 |
| Benzo(k)fluoranthene | 207-08-9 | CLP ^a | 10 | 330 |
| Benzo(a)pyrene | 50-32-8 | CLP ^a | 10 | 330 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | CLP ^a | 10 | 330 |
| Dibenz(a,h)anthracene | 53-70-3 | CLP ^a | 10 | 330 |
| Benzo(g,h,i)perylene | 191-24-2 | CLP ^a | 10 | 330 |

Table 5-1b. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Semivolatiles (Continued)

^aSpecific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. CLP Scope of Work 7/87.

^bQuantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

^cMedium Water Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL. Compounds are 100 times the individual Low Water CRQL.

^dMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

^eCLP Definition, < 10 ppm of target compound.

Reference: EPA Contract Laboratory Program (CLP)
Contract Required Quantitation Limits (CRQL)

Table 5-1c. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Pesticides/PCBs

| Parameter | CAS Number | Method | Quantitation Limits ^{a,b} | |
|---------------------|------------|------------------|--|---|
| | | | Low ^e Water ^c μg/L | Low ^e Soil/Sediment ^d μg/kg |
| alpha-BHC | 319-84-6 | CLP ^a | 0.05 | 8.0 |
| beta-BHC | 319-85-7 | CLP ^a | 0.05 | 8.0 |
| delta-BHC | 319-86-8 | CLP ^a | 0.05 | 8.0 |
| gamma-BHC (Lindane) | 58-89-9 | CLP ^a | 0.05 | 8.0 |
| Heptachlor | 76-44-8 | CLP ^a | 0.05 | 8.0 |
| Aldrin | 309-00-2 | CLP ^a | 0.05 | 8.0 |
| Heptachlor epoxide | 1024-57-3 | CLP ^a | 0.05 | 8.0 |
| Endosulfan I | 959-98-8 | CLP ^a | 0.05 | 8.0 |
| Dieldrin | 60-57-1 | CLP ^a | 0.10 | 16.0 |
| 4,4'-DDE | 72-55-9 | CLP ^a | 0.10 | 16.0 |
| Endrin | 72-20-8 | CLP ^a | 0.10 | 16.0 |
| Endosulfan II | 33213-65-9 | CLP ^a | 0.10 | 16.0 |
| 4,4'-DDD | 72-54-8 | CLP ^a | 0.10 | 16.0 |
| Endosulfan sulfate | 1031-07-8 | CLP ^a | 0.10 | 16.0 |
| 4,4'-DDT | 50-29-3 | CLP ^a | 0.10 | 16.0 |
| Endrin ketone | 53494-70-5 | CLP ^a | 0.10 | 16.0 |
| Methoxychlor | 72-43-5 | CLP ^a | 0.5 | 80.0 |
| Chlordane | 57-74-9 | CLP ^a | 0.5 | 80.0 |
| Toxaphene | 8001-35-2 | CLP ^a | 1.0 | 160.0 |
| AROCLOR-1016 | 12674-11-2 | CLP ^a | 0.5 | 80.0 |
| AROCLOR-1221 | 11104-28-2 | CLP ^a | 0.5 | 80.0 |
| AROCLOR-1232 | 11141-16-5 | CLP ^a | 0.5 | 80.0 |
| AROCLOR-1242 | 53469-21-9 | CLP ^a | 0.5 | 80.0 |
| AROCLOR-1248 | 12672-29-6 | CLP ^a | 0.5 | 80.0 |
| AROCLOR-1254 | 11097-69-1 | CLP ^a | 1.0 | 160.0 |
| AROCLOR-1260 | 11096-82-5 | CLP ^a | 1.0 | 160.0 |

Table 5-1c. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Pesticides/PCBs (Continued)

- ^aSpecific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. CLP Scope of Work 7/87.
- ^bQuantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.
- ^cMedium Water Contract Required Quantitation Limits (CRQL) for Pesticide TCL Compounds are 100 times the individual Low Water CRQL.
- ^dMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide TCL Compounds are 15 times the individual Low Soil/Sediment CRQL.
- ^eCLP Definition, < 10 ppm of target compound

Reference: EPA Contract Laboratory Program (CLP)
Contract Required Quantitation Limits (CRQL)

Table 5-1d. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Metals

| Parameter | Method | Quantitation Limits ^{a,b} | |
|----------------------------------|---|------------------------------------|------------------------------|
| | | Low Water ^c (mg/L) | Low Soil/Sediment (mg/kg) |
| Aluminum | CLP ^e | 0.2 | 20 |
| Antimony | CLP ^e | 0.06 | 6 |
| Arsenic | CLP ^e | 0.01 | 1 |
| Barium | CLP ^e | 0.2 | 20 |
| Beryllium | CLP ^e | 0.005 | 0.5 |
| Cadmium | CLP ^e | 0.005 | 0.5 |
| Calcium | CLP ^e | 5.0 | 500 |
| Chromium | CLP ^e | 0.01 | 1 |
| Cobalt | CLP ^e | 0.05 | 5 |
| Copper | CLP ^e | 0.025 | 2.5 |
| Iron | CLP ^e | 0.1 | 10 |
| Lead | CLP ^e | 0.005 | 0.5 |
| Magnesium | CLP ^e | 5.0 | 500.0 |
| Manganese | CLP ^e | 0.015 | 1.5 |
| Mercury | CLP ^e | 0.0002 | 0.02 |
| Nickel | CLP ^e | 0.04 | 4 |
| Potassium | CLP ^e | 5.0 | 500 |
| Selenium | CLP ^e | 0.005 | 0.5 |
| Silver | CLP ^e | 0.01 | 1 |
| Sodium | CLP ^e | 5.0 | 500 |
| Thallium | CLP ^e | 0.01 | 1 |
| Vanadium | CLP ^e | 0.05 | 5 |
| Zinc | CLP ^e | 0.02 | 2 |
| Miscellaneous Parameters | | | |
| TPHC | Mod.8015 ^j | 0.05 | 10 |
| Cyanide | CLP ^e | 0.01 | 1 |
| Phenols | 9065 ^f | 0.01 | 0.2 |
| Nitrate | 300.0 ^g | 0.10 | 0.1 |
| Sulfate | 300.0 ^g | 0.20 | 0.2 |
| Chloride | 300.0 ^g | 0.10 | 0.1 |
| Fluoride | 300.0 ^g | 0.10 | 0.1 |
| Tetraethyl Lead | LUFT ^h | 0.05 | 5.0 |
| 2,3,7,8 TCDD/Furans ^k | 613 ⁱ | 0.00001 | 0.001 |
| Tetra-Octa Dioxins/Furans | 8280 ^f | 0.000003 | 0.0003 |
| Field Measurements | | | |
| pH | 150.1 ^g / 9040 ^f | 0.1 std. units | 0.1 std. units |
| Conductivity | 120.1 ^g | 1 umhos/cm | NA |

Table 5-1d. Target Compound List (TCL) and Contract Required
Quantitation Limits (CRQL) - Metals (Continued)

- ^aSpecific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable. CLP Scope of Work 7/87.
- ^bQuantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.
- ^cMedium Water Contract Required Quantitation Limits (CRQL) for Metals are 100 times the individual Low Water CRQL.
- ^dMedium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Metals are 100 times the individual Low Soil/Sediment CRQL.
- ^eCLP Definition, < 10 ppm target compound.
- ^fUS EPA "Test Method for Evaluation Solid Waste", SW846, 2nd edition, 1984.
- ^g"Methods for Chemical Analysis of Water and Wastes" EPA 600/4-79-020, latest revision.
- ^h"Leaking Underground Fuel Tank Field Manual" State Water Resources Control Board, Sacramento, California, December 1987. A copy of the procedure is included in Appendix A.
- ⁱEPA, Method 613, "Methods for Organic Chemical Analysis of Municipal and Industrial Waste Waters", EPA-600/4-82-057.
- ^jModified Method 8015 for TPHC by Gas Chromatograph. The Standard Operating Procedure is included in Appendix A.
- ^kSamples collected for dioxin/furan analysis will first be analyzed for tetra through octa congeners of dioxin/furan. If the tetra chlorinated species are identified, then additional samples will be collected and analyzed for 2, 3, 7, 8 chlorinated isomers of dioxins/furans.

Reference: EPA Contract Laboratory Program (CLP)
Contract Required Quantitation Limits (CRQL)

Table 5-2. Sample Precision, Accuracy, and Completeness Objectives

| Measurement Parameter | Sample Matrix | Precision Objective (% Average RPD) ^b | Accuracy Objective (%) | Completeness Objective (%) | Reference Method |
|------------------------------------|---------------|--|--------------------------|----------------------------|---------------------------|
| Volatile Organics | Water | <15 | As per current CLP | 90 | EPA CLP |
| Volatile Organics | Solids | <25 | As per current CLP | 90 | EPA CLP |
| Extractable Organics | Water | <50 | As per current CLP | 90 | EPA CLP |
| Extractable Organics | Solids | <50 | As per current CLP | 90 | EPA CLP |
| Pesticides/PCBs | Water | <50 | As per current CLP | 90 | EPA CLP |
| | Solids | <50 | As per current CLP | 90 | EPA CLP |
| Total Organic Halides ^a | Water | <40 | 60% ± 40% ave. Recovery | 90 | RCRA 9020 |
| Metals | Water | <20 | 100% ± 25% ave. Recovery | 90 | EPA CLP |
| Metals | Solids | <20 | 100% ± 25% ave. Recovery | 90 | EPA CLP |
| Cyanide | Water | <25 | As per current CLP | 90 | EPA CLP |
| | Solids | <25 | As per current CLP | 90 | EPA CLP |
| Phenols | Water | <25 | 100% ± 25% ave. Recovery | 90 | EPA 420.1 |
| Chloride | Water | <25 | 100% ± 25% ave. Recovery | 90 | EPA 325.3 |
| Total Dissolved Solids | Water | <25 | Analyze in Duplicates | 90 | EPA 160.1 |
| Total Suspended Solids | Water | <25 | Analyze in Duplicates | 90 | EPA 160.2 |
| Specific Conductance | Water | <25 | Analyze in Duplicates | 90 | EPA 120.1 |
| pH | Water | <25 | Analyze in Duplicates | 90 | EPA 150.1 |
| Total Petroleum Hydrocarbons | Water | <25 | NA | 90 | Mod.8015 ^g |
| | Solids | <25 | NA | 90 | Mod.8015 ^g |
| Tetraethyl Lead | Water | <25 | NA | 90 | LUFT ^c |
| | Solids | <25 | NA | 90 | LUFT ^c |
| 2,3,7,8-TCDD | Water | <50 | 60-140 ave. Recovery | 90 | EPA 613 ^d |
| | Solids | <50 | 60-140 ave. Recovery | 90 | EPA Req. VII ^e |
| Tetra-Octa Dioxins/ Furans | Water | 50 | 40-120 ave. Recovery | 90 | EPA 8280 ^f |
| | Solids | 50 | 40-120 ave. Recovery | 90 | EPA 8280 ^f |

Table 5-2. Sample Precision, Accuracy, and Completeness Objectives (Continued)

^aNo criteria specified with the method; extractable organics criteria will be applied.

^bApplied to all samples of the same type from the same location.

^cLUFT - "Leaking Underground Fuel Tank Field Manual", State Water Resources Control Board, Sacramento, California December 1987. A copy of the procedure is included in Appendix A.

^dEPA Method 613, Methods for Organic Chemical Analysis of Municipal and Industrial Waste Waters, EPA-600/4-82-057.

^eU.S. EPA Region VII Methods for Analysis of Dioxins and Furans.

^fUS EPA "Test Methods for Evaluating Solid Waste" SW846, 2nd ed, 1984.

^gMod. 8015 - Modified Method 8015 for TPHC by Gas Chromatograph. The Standard Operating Procedure is included in Appendix A.

NA = Not Available. Criteria to be developed during project.

6.0 SAMPLING PROCEDURES

A detailed Project Sampling and Analysis Plan for Moffett Field has been prepared to document the scope and rationale of exploration and the sampling activities at each of the 19 sites. The Moffett Field Sampling and Analysis Plan is presented as a stand-alone document and is contained as Volume II of the Work Plan.

The following considerations form the basis for the site-specific sampling program:

- Selection of sampling and drilling sites
- Frequency of sampling
- Location and number of monitoring stations to be sampled
- Methods of sampling to be employed
- Media to be sampled
- Number of samples to be collected
- Volume of samples to be collected
- Type and kind of analyses to be performed in the field
- Type and kind of analyses to be performed at the laboratories
- Sample turnaround time
- Procedures and precautions to be followed during sampling
- Methods of preservation and shipment.

Sampling will be frequent enough to identify materials and to describe important material changes. Methods of sampling employed shall preserve the integrity of material parameters. Field procedures for the collection of soil samples for volatile analysis are discussed in Section 5.6 of the Sampling and Analysis Plan.

Any sample obtained during field sampling should be representative of the sample location and free of contaminants from sources other than the immediate environment being sampled. The equipment and the techniques that will be employed to obtain representative samples will be in accordance with approved IT procedures. Rationale for each site-specific sampling program is presented for Sites 1-10 in Chapter 2 and Sites 11-19 in Chapter 3 of the Sampling and Analysis Plan.

The Moffett Field Sampling and Analysis Plan describes sampling locations; the numbers and types of samples to be collected; sampling equipment, procedures, and sample containers; methods of sample preservation; decontamination procedures; shipping and packaging methods; and a sampling schedule. Analytical tests that will be performed are also described. Table 6-1 lists containers, preservatives, and holding times for each type of analysis to be performed on the project and is in accordance with the current revision of Table II of 40 CFR 136.3 (7-1-86 Edition).

The EPA has developed specific procedures for the preparation of sample containers to be used for site investigations. These procedures are part of the EPA contract "Superfund Sample Container Repository" which is held by a contractor. Containers will be purchased from the contractor, who will specify that said containers meet all EPA protocols including cleaning QC release. Specific cleaning procedures may be obtained through the EPA Samples Management Office.

6.1 PREVENTION OF CROSS CONTAMINATION

Before entering the site, the drill rig will have been steam cleaned to remove any surface oil, grease, or other material that has the potential for contaminating the site. Drilling equipment that will be in contact with the soil will be decontaminated before use and between each borehole. Monitoring well screen and casing in contact with ground water will be decontaminated before use. Sampling equipment will be decontaminated before use and between each sample. Each decontamination activity will be recorded on the field activity daily log form. Detailed procedures for decontamination of drilling and sampling equipment and disposal of decontamination by-products are provided in the Sampling and Analysis Plan.

6.2 SAMPLE IDENTIFICATION

Samples will be put into sample containers that have been cleaned, treated with preservative, and pre-labeled by the IT Analytical Services laboratory. The labels on containers provided by the laboratory will state the type of preservative, if any, and the sample type for which the container is intended. As samples are collected and sealed in containers, the containers will be marked. The identification procedure is described in the Work Plan. After collection, identification, and preservation, samples will be maintained under the Chain-of-Custody procedure described in the Sampling and Analysis Plan.

6.3 SAMPLE TURNAROUND TIME

Sample analyses will be scheduled based on site investigation needs and consistent with the sample holding times. The Sampling and Analysis Plan is organized to provide a turnaround time that will meet the project schedule and objectives.

6.4 FIELD DOCUMENTATION

An integral part of the QAPjP for the field activities will be maintaining a Field Activity Daily Log (Figure 2). Information identified on the Field Activity Daily Log will be obtained from site exploration and sampling activities and will be documented by the Field Operations Coordinator.

All information pertinent to field activities will be recorded in a daily field log. Entries in the log will be made in water-resistant ink and will include as a minimum:

- The names and affiliations of field personnel
- A general description of the day's field activities
- Documentation of weather conditions during the previous 48 hours
- Field equipment calibration data
- Field measurements such as temperature, pH, conductance, and readings from personnel safety instruments.

Appropriate field generated data forms will be prepared based on the requirements in the Work Plan (Figures 3, 4, and 5). Data to be recorded will include such information as the monitored location (e.g., boring, well, depth, sampling station, elevation, and field coordinates) and applicable sample analysis to be conducted. Field equipment and equipment calibration will be noted on the Test Equipment List and Calibration Log (Figure 6).

6.5 VARIANCE SYSTEM

Procedures that properly address all specific conditions encountered during a field program cannot be prepared. Variances from approved operating procedures in the Work Plan the SWAT Plan, the Sampling and Analysis Plan, the QAPJP, or the Health and Safety Plan will be documented on a Variance Log (Figure 7). The Field Operations Coordinator will initiate and chronologically maintain the Variance Log. The Variance Log requires the approval of the Project Manager and the Quality Assurance Coordinator before work proceeds. Variances affecting project scope, costs or schedule must be approved by the Martin Marietta Energy Systems Project Officer. As appropriate, Regulatory Agencies will be notified of any variances that significantly affect project scope or objectives. Any variance from the Health and Safety Plan must be signed off by the Health and Safety Coordinator. Approval by the Project Manager can be initiated on a verbal basis via telephone with follow-up sign-off. In no case will an IT subcontractor initiate a variance. If a variance is proposed by the client, it will be so recorded. Copies of the Variance Log will be kept on site until the field work is complete and then will be sent to the project files.

6.6 FIELD DATA MANAGEMENT

The intended use of field data is to assess the nature of the site and the extent of potential problems resulting from past activities at the site and to identify, evaluate, and recommend appropriate actions.

Numerical analyses, instrument readings and recordings, measurements and tests will be documented and subjected to internal review. Field records will be legible and sufficiently complete to permit reconstruction of data gathering activities by a qualified individual other than the originator when data are

reduced. The method of data reduction will be identified and recorded. Field generated data sheets will be collected and reviewed weekly for accuracy and completeness by the Field Operations Coordinator. The data sheets will be assembled into packages that represent each borehole, monitoring well, etc. These data sheet record packages will be sent to the IT Regional Office in Martinez, California, for review, examination, analysis of data, and for the technical staff to use in preparing the required studies and reports. Reporting of field data will be included in the First Draft Report which will be approved by the Project Manager, Quality Assurance Coordinator, and Deputy Program Manager.

6.7 DECONTAMINATION OF EQUIPMENT AND SUPPLIES

Specific decontamination procedures are addressed throughout Section 5.0 of the Sampling and Analysis Plan. Refer to the specific sections of sampling procedures and methods.

Table 6-1. Sample Containers, Preservatives, and Holding Times

| Analysis | Sample Type | Container | Preservative | Holding Time |
|------------------------------------|-------------|--|--|---|
| Volatile Organic Compounds | Water | 40 mL amber glass vials (three) Teflon-backed septum No head space | Cool to 4°C Add two drops of 1:1 HCl | 14 days |
| | Soil | Brass sleeve or 40 mL glass vial | Cool to 4°C | 14 days |
| Base/Neutral and Acid Extractables | Water | 1 liter amber glass bottle Teflon-lined cap | Cool to 4°C | 7 days for extraction 40 days for analysis. |
| | Soil | Brass sleeve or 500 mL glass jar | Cool to 4°C | Same as water |
| Heavy Metals | Water | 1 liter polyethylene bottle | Cool to 4°C 5 mL conc. HNO ₃ | 6 months for most heavy metals. |
| | Soil | Lexan sleeve or 500 mL glass jar | Cool to 4°C | Same as water |
| Mercury | Water | 250 mL glass bottle | Cool to 4°C | 28 days |
| | Soil | 500 mL glass jar | Cool to 4°C | 28 days |
| TDS, Anions and Cations | Water | 1 liter polyethylene bottle Teflon-lined cap No head space | Cool to 4°C | 7 days (12 hours for alkalinity) |
| Nitrate | Water | 1 liter polyethylene bottle Teflon-lined cap | Cool to 4°C | 24 hours |
| PCBs | Water | 1 liter amber glass bottle | Cool to 4°C | 7 days for extraction, 40 days for analysis |
| | Soil | Brass sleeve or 500 mL glass jar | Cool to 4°C | Same as water |
| Dioxin/Furans | Soil | Brass sleeve or 500 mL glass jar | Cool to 4°C | 30 days for extraction, 45 days for analysis |

Table 6-1. Sample Containers, Preservatives, and Holding Times (Continued)

| Analysis | Sample Type | Container | Preservative | Holding Time |
|-------------------------------------|-------------|----------------------------------|--------------|--------------|
| Total Petroleum Hydrocarbons (TPHC) | Water | 2-40 mL glass vials | 4°C | 14 days |
| | Soil | Brass sleeve or 40 ml glass vial | 4°C | 14 days |
| Tetraethyl Lead (TEL) | Water | 1 liter polyethylene bottle | 4°C | 14 days |
| | Soil | Lexan sleeve or 500 ml glass jar | 4°C | 14 days |

References: 40 Code of Federal Regulations Part 136.3, Table II



FIELD ACTIVITY DAILY LOG

| | | | | |
|-----------|-------|--|----|--|
| DAILY LOG | DATE | | | |
| | NO. | | | |
| | SHEET | | OF | |

| | | | | | | | |
|---|--|-----------------------|--|---------------------|--|--|--|
| PROJECT NAME | | PROJECT NO. | | | | | |
| FIELD ACTIVITY SUBJECT: | | | | | | | |
| DESCRIPTION ON DAILY ACTIVITIES AND EVENTS: | | | | | | | |
| | | | | | | | |
| | | | | VISITORS ON SITE: | | CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS. | |
| | | | | WEATHER CONDITIONS: | | IMPORTANT TELEPHONE CALLS: | |
| IT PERSONNEL ON SITE: | | | | | | | |
| | | (FIELD ENGINEER) DATE | | | | | |

FIGURE 2

PROJECT NAME/NUMBER: _____

DATE: _____

TOTAL FEET DRILLED: _____

NUMBER OF BOREHOLES: _____

TOTAL HOURS ON-SITE: _____

DOWN TIME: _____

DELAY TIME: _____

NUMBER OF PERSONNEL: IT _____ DRILLER _____

METHOD OF DRILLING: _____

NUMBER OF SAMPLES TAKEN: _____

TYPE OF SAMPLES: SOIL _____ -ROCK _____ WATER _____

PROTECTIVE CLOTHING: _____

MATERIALS USED:

CEMENT: _____

SAND: _____

BENTONITE PELLETS: _____

PVC PIPE/SIZE: _____

PVC SCREEN/SIZE: _____

OTHER MATERIALS: _____

FIELD TESTS/SURVEYS CONDUCTED: _____

PROBLEMS ENCOUNTERED: _____

COMMENTS: _____

CERTIFIED BY:

DRILLING CHIEF: _____ IT SUPERVISOR: _____

DAILY DRILLING ACTIVITY LOG

FIGURE 3

VISUAL CLASSIFICATION OF SOILS

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

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

NOTES:

FIGURE 4

SAMPLE COLLECTION LOG

| | | | | | | |
|-------------|----|--|--|--|--|--|
| DATE | | | | | | |
| TIME | | | | | | |
| PAGE | OF | | | | | |
| PAGE | | | | | | |
| PROJECT NO. | | | | | | |

PROJECT NAME _____

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE _____

COMPOSITE YES NO DEPTH OF SAMPLE _____

COMPOSITE TYPE _____ WEATHER _____

ANALYSIS

| ANALYSIS REQUESTED | PRESERVATIVE USED | CONTAINER USED | AMOUNT COLLECTED |
|--------------------|-------------------|----------------|------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

FIGURE 5A

PREPARED BY: _____



TEST EQUIPMENT LOG AND CALIBRATION LOG

TEST _____

| EQUIPMENT NUMBER | EQUIPMENT NAME | DATE/ TIME | STANDARDS USED | EQUIPMENT READING | COMMENTS | INITIALS |
|---------------------|-------------------|---------------|-------------------|----------------------|----------|----------|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

FIGURE 6

NOTE:
THIS LIST SHALL BE COMPLETED FOR ALL TESTS.
ONLY EQUIPMENT SUBJECT TO CALIBRATION NEED BE LISTED.



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7.0 SAMPLE CUSTODY PROCEDURES

Chain-of-custody procedures will require documented sample possession from the time of collection to disposal, which is in accordance with IT internal procedures and the federal guidelines. Figure 8 is a copy of IT's chain-of-custody record form. A sample is considered in custody if:

- It is in the sampler's or the transferee's actual possession
- It is in the sampler's or the transferee's view, after being in his/her physical possession
- It was in the sampler's or the transferee's physical possession and then he/she secured it to prevent tampering
- It is placed in a designated secure area.

The IT Analytical Services laboratory will not accept samples collected by IT personnel for analysis without a correctly prepared Chain-of-Custody Record and a Request for Analysis form (Figure 9).

7.1 FIELD CUSTODY PROCEDURES

Field custody procedural activity includes:

- Before sampling begins, the Field Operations Coordinator will instruct site personnel in the chain-of-custody procedures, as necessary.
- Confirmation that the quantity, types, and locations of samples are as outlined in the Sampling and Analysis Plan.
- The Field Operations Coordinator determines whether proper custody procedures and report forms were used during the field work and documents the results in Field Activity Daily Log.
- The Field Operations Coordinator has overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the laboratory. Each individual that collects a sample is responsible for sample custody until transferred to someone else via the Chain-of-Custody Record.
- Shipment information is recorded for shipment of samples at the end of the shift, day, or collection period on the Field Activity Daily Log.

7.2 SAMPLE LABELING

Sample labels must contain sufficient information to uniquely identify the sample in the absence of other documentation. Labels will include as a minimum:

- Project name and number
- Unique sample number
- Sample location
- Sampling date and time
- Signature of individual collecting the sample
- Preservation method employed.

The sample label (Figure 10) will be directly affixed to the sample container and will be completed using indelible ink.

7.3 TRANSFER OF CUSTODY AND SHIPMENT

Transfer of custody and shipping procedures include:

- A Chain-of-Custody Record will be initiated in the field for each sample. A copy of this record will accompany each sample.
- In the event that the laboratory sample custodian judges sample custody to be invalid (e.g., samples arrive damaged or custody seals have been broken), a Nonconformance Report form will be initiated. The Project Manager will be advised immediately and the samples will not be analyzed unless the Project Manager so authorizes. The Project Manager and Quality Assurance Coordinator will be notified. The Project Manager will make a decision as to the fate of the sample(s) in question. The sample(s) will either be processed "as is" with custody failure noted along with the analytical data, or rejected with sampling rescheduled if necessary. The Project Manager and Quality Assurance Coordinator will sign-off the Nonconformance Report, noting the reason for disposition.
- Each time responsibility for custody of the sample changes, the new custodian will sign the record and note the date.
- The custody of individual sample containers will be documented by recording each container's identification on an appropriate Chain-of-Custody Record.

- The analyses to be performed for each sample will be recorded on an IT Analytical Services (ITAS) Request for Analysis form.
- Upon sample destruction or disposal, the custodian responsible for the disposal will complete the Chain-of-Custody Record, file a copy, and send a copy to the Project Manager or to his designated representative for record keeping.

7.4 LABORATORY RECEIPT AND ENTRY OF SAMPLES

Upon receipt at the laboratory, a sample is removed from the shipping container. Sample identification is compared to the information contained on the sample bottles and sample packing lists or included chain-of-custody documents. If discrepancies exist, appropriate notes (signed and dated) are made on the chain-of-custody document and the shipping and receiving supervisor is notified.

The following items are checked upon receipt of samples with the chain-of-custody or the accompanying forms:

- The seals and tapes on the cooler are unbroken and uncut
- The sample containers in the cooler are intact
- The identification on the sample bottles corresponds to the entries on accompanying forms
- The number of sample containers received (i.e. bottles) is equal to the number of samples listed on the chain-of-custody or accompanying forms.

Identification numbers are stamped on stickers and securely wrapped about each sample. If samples are to be shipped from one laboratory to another, proper chain-of-custody and packaging procedures will be maintained.

7.5 PRE-ANALYSIS STORAGE

Personnel from the appropriate IT Cerritos laboratory group receive and log in the samples. These personnel have the responsibility of picking up samples that are specific to their group from shipping and receiving. The samples are then placed into temporary storage until analysis.

Samples are stored as prescribed in the IT Cerritos Quality Assurance Manual. Methods of storage are intended generally to:

- Retard biological action
- Retard hydrolysis of chemical compounds and complexes
- Reduce volatility of constituents
- Reduce adsorption effects.

Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

7.6 POST-ANALYSIS STORAGE

Anticipation of reanalysis prescribes proper environmental control. If reanalysis is not anticipated, environmental conditions are not observed, and the samples are stored at room temperature. Disposal of samples will be in accordance with federal and state regulations.

Samples requiring refrigeration are required by the laboratory to remain refrigerated for three months unless prior arrangements have been made by the Project Manager.

SAMPLE LABEL

| | | |
|---|--|---|
|  | INTERNATIONAL TECHNOLOGY CORPORATION |  |
| Project Name _____ | | |
| Project No. _____ | | |
| Sample No. _____ | | |
| Collection Date/Time _____ | | |
| Collector's Name _____ | | |
| Sample Location _____ | | |
| Sample Type/Depth/Description _____ | | |
| Analyze For _____ Preservative _____ | | |
| Bottle _____ of _____ Filtered _____ Nonfiltered _____ | | |
| 23-8-85 | | |

FIGURE 10

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 GENERAL CALIBRATION PROCEDURES AND FREQUENCY

Laboratory and field measuring and testing equipment will be identified and calibrated in accordance with the requirements of Section 5.5 of IT's Engineering Services QA Manual, Contract Laboratory Program (CLP), and IT's Cerritos Laboratory Specific Quality Assurance Manual when CLP protocol is not established. Measuring equipment, test equipment, and reference standards will be calibrated at prescribed intervals and/or before use. Calibration frequency will be based on the analytical methods employed, the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience. Laboratory instrument calibration frequency will be performed as dictated by the CLP contract. Table 8-1 identifies the laboratory equipment that will require calibration when used. A summary of typical field equipment calibration requirements and frequency of procedures is provided in Table 8-2.

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

Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other means. A label with the identification number and the date when the next calibration is due will be attached to the equipment. If this identification is not possible, records traceable to the equipment will be readily available for reference.

8.2 CALIBRATION FAILURES

Scheduled periodic calibration of testing equipment will not relieve field or laboratory personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, he should remove the device from service, tag it so it is not inadvertently used, and notify the Laboratory Coordinator or Field Operations Coordinator as appropriate, so that recalibration can be performed or substitute equipment can be obtained.

Equipment that can no longer be calibrated or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use, or tagged to indicate it is out of calibration. Such equipment will be repaired and recalibrated or replaced as appropriate. Any such action should be reported in the field activities daily log or appropriate laboratory log.

8.3 CALIBRATION RECORDS

Records will be prepared and maintained for each piece of calibrated measuring and test equipment and each piece of reference equipment to indicate that established calibration procedures have been followed (Figure 6). Records for equipment used will be kept in the project files.

Much of the measuring and test equipment used for field geophysical surveys is calibrated or checked as part of its operational use. For this equipment, records of the calibrations or checks will be kept in the files of projects for which the work was performed, or as part of the responsible organization's calibration record system.

Table 8-1. Summary of Typical Equipment Calibration Requirements for ITAS Laboratory Operations

| Instrument to be Calibrated | Standard Reference | Calibration Technique | Acceptable Performance Specifications |
|---|--|---|---|
| Atomic absorption spectrophotometry | Three levels plus one blank, bracketing the sample concentrations; certified standards from chemical supply house are used | Direct reading using serial standard | As per current CLP dilution of commercial |
| Analytical balances | Class "S" weight check | Annual or as needed out of house service to calibrate | At least every 3 months, one must meet 95 percent confidence using Class "S" weight |
| Gas chromatographs (GC) | Three levels plus one blank; at least one level of reference standard at theoretical concentration of sample | (±) 95 percent of the original curve | As per current CLP |
| Gas chromatographs/mass spectrometers (GC/MS) | All in-house solutions. (DFTPP), (SPCC), and (CCC) | Reference standards, retention | As per current CLP time, and additive percent recovery for surrogates |
| Infrared spectrophotometer | Mineral oil Iso Octane n-Hexadecane Polystyrene | Standard curve In-house Out of house | Standard curve must be linear |

Table 8-1. Summary of Typical Equipment Calibration Requirements for ITAS Laboratory Operations (Continued)

| Instrument to be Calibrated | Standard Reference | Calibration Technique | Acceptable Performance Specifications |
|---|---|---|--|
| Inductively coupled plasma spectro-photometer | Certified standards from chemical supply house | Serial dilutions of commercial standards; direct readouts | As per current CLP |
| Ion chromatograph | Inorganic and organic acids | Standard curve and bracket technique | Standard curve must have linearity |
| Microscope | Out of house reference slides | Service 18 months or as needed | N/A |
| pH meter | Commercial buffers | | Bracket technique 90 percent of slope |
| Total organic carbon (TOC) analyzer | Potassium biphthalate out of house | Standard curve | 10 percent of original curve |
| UV/VIS spectro-photometer | Three levels of in-house standards; photometric linearity | Standard curves | 10 percent of original curve |

Linearity for IC is accomplished by plotting 5 points and applying the correlation coefficient. The criteria is 0.997 or better. Linearity for IR is accomplished by plotting 7 points. Each standard is analyzed in duplicate and at two separate concentrations (4x for each standard). The criteria is 0.997 or better.

Table 8-2. Field Measurement and Test Equipment List

| Instrument To Be Calibrated | Standard Reference | Calibration Technique | Acceptance Specifications |
|---|--|---|--|
| Amber Science Model 1051 Conductivity meter | Buffer solution of known conductivity (1000 mhos) | Refer to IT equipment calibration instruction, C1-1 | Standard solution value |
| Beckman #21 pH/temperature meter | Two buffer solutions pH-4, pH-7 or pH-10 | Refer to IT equipment calibration instruction, C1-4 | Buffer solution values |
| Organic vapor analyzer (OVA) | Methane-in-air standard, other organic gases as required | Refer to IT instruction and Service Manual, MI 2R900 AC | Calibration gas values, ppm |
| HNu photoionization detector (PID) | Gas standard kit | Refer to IT equipment calibration instruction, C1-2 | Meter indicates standard ppm concentrations and zero setting |
| Electric tape | NA | Battery check | Audio check |
| Interface Probe | NA | Battery check | Audio check |
| Explosimeter, MSA Combustible Gas and Oxygen Alarm, Model 621 | 261 Calibration kit | Refer to IT calibration instruction, C1-3 | LEL meters reads 47-55% Oxygen meter reads 20.8% |
| ENVIRO-LABS Pressure Transducers and Data Logger (Model DL-120-MCP) | S/N 4799, 0-25 PSI S/N 4635, 0-5 PSI | Pressure Transducers Factory Calibrated annually | System software - functions B6 and B7, compare displayed values to digital voltmeter |

9.0 ANALYTICAL PROCEDURES

9.1 OVERVIEW OF STANDARD LABORATORY OPERATING PROCEDURES

Actions that are routinely followed when analyzing samples include:

- Holding times and the amount of sample available are reviewed and the analyses prioritized.
- Analyses should be performed within holding times according to accepted procedures.
- A calibration curve consisting of at least three standards and a reagent blank should be prepared as specified in the methodology.
- Preparation and analysis of at least one procedural blank should be completed for each group of samples analyzed.
- At least one matrix spike and matrix spike duplicate sample should be analyzed for every 20 samples processed to monitor the percent recovery and accuracy of the analytical procedure.
- One matrix spike and one matrix spike duplicate should be analyzed for every 20 samples of inorganics procured.

The analytical procedures for the analyses required by the Moffett Field Sampling Plan are referenced in the respective IT Analytical Services (ITAS) laboratory manual. The IT Cerritos laboratory currently maintains appropriate California state certification, participates in the EPA CLP program and is approved by the Department of the Navy. At the present time the IT Cerritos, California laboratory meets all certification requirements for this project with the exception of dioxin/furan analysis. The IT Cerritos laboratory will remain the laboratory of choice until the ITAS laboratory at Santa Clara Valley, California has received the requisite certifications/approvals. The EPA-approved ITAS laboratory at Knoxville, Tennessee will conduct dioxin/furan analysis because of the special safety precautions and required operational approvals.

9.1.1 Organic Compounds

The required organic analyses will be performed by IT's Cerritos laboratory. The initial instrumental technique employed will be the gas chromatography/mass spectrometry (GC/MS) method. The IT Cerritos laboratory is a participant in the EPA Contract Laboratory Program (CLP) for organic analyses.

For soil samples requiring volatile analysis the following sub-sampling technique will be followed: The brass/lexan sleeves are turned upright and uncapped. The top half-inch layer of soil is discarded. The actual analytical sample is obtained subsequently taking a soil core (approximately 2 inches long by 0.5 inches in diameter) from the center of the sleeve. Care is taken not to use soil which has contacted the sleeve walls.

If the soil sample is collected in 40 ml vials rather than sleeves, the vials will be filled as completely as possible to minimize headspace. The portion for volatile analysis is taken prior to any other laboratory analysis.

9.1.2 Metals and Cyanide

The analyses for target compound list metals and cyanide will be performed by the IT Cerritos Laboratory. Analysis will be performed by inductively coupled plasma spectroscopy (ICP) or atomic absorption spectroscopy (AA). The IT Cerritos Laboratory will perform inorganic analyses by EPA CLP inorganic protocol as shown on Table 9-1.

9.2 ANALYTICAL PROCEDURES

The analytical procedures to be used for this project are listed in Table 9-1. Appropriate procedural QA/QC will be followed.

Table 9-1. Analytical Methods for Samples Collected During Remedial Investigation

| Parameter | Method Number | |
|---|--------------------------------------|--------------------------------------|
| | Waters | Soils |
| pH | 150.1 ^a | 9040 ^b |
| Specific Conductance | 120.1 ^a | 9050 ^b |
| Total Dissolved Solids (TDS) | 160.1 ^a | -- |
| Major Anions | | |
| Fluoride | 300.0 ^a | 300.0 ^a |
| Nitrate | 300.0 ^a | 300.0 ^a |
| Sulfate | 300.0 ^a | 300.0 ^a |
| Bicarbonate/carbonate | 310.1 ^a | 310.1 ^a |
| Major Cations | | |
| Calcium | CLP ^c | CLP ^c |
| Magnesium | CLP ^c | CLP ^c |
| Potassium | CLP ^c | CLP ^c |
| Sodium | CLP ^c | CLP ^c |
| Volatile Organic Target Compound List (VOCs) | CLP ^c CLP ^c | CLP ^c CLP ^c |
| Base, Neutral, and Acid Extractable Target Compound List (BNAs) | CLP ^c | CLP ^c |
| Polychlorinated Biphenyls (PCBs) | CLP ^c | CLP ^c |
| Metals | | |
| Aluminum | CLP ^c | CLP ^c |
| Antimony | CLP ^c | CLP ^c |
| Arsenic | CLP ^c | CLP ^c |
| Barium | CLP ^c | CLP ^c |
| Beryllium | CLP ^c | CLP ^c |
| Cadmium | CLP ^c | CLP ^c |
| Calcium | CLP ^c | CLP ^c |
| Chromium | CLP ^c | CLP ^c |
| Cobalt | CLP ^c | CLP ^c |
| Copper | CLP ^c | CLP ^c |

Table 9-1. Analytical Methods for Samples Collected During Remedial Investigation (Continued)

| Parameter | Method Number | |
|------------------------------|------------------------|---------------------------|
| | Waters | Soils |
| Iron | CLP ^C | CLP ^C |
| Lead | CLP ^C | CLP ^C |
| Magnesium | CLP ^C | CLP ^C |
| Manganese | CLP ^C | CLP ^C |
| Mercury | CLP ^C | CLP ^C |
| Nickel | CLP ^C | CLP ^C |
| Potassium | CLP ^C | CLP ^C |
| Selenium | CLP ^C | CLP ^C |
| Silver | CLP ^C | CLP ^C |
| Sodium | CLP ^C | CLP ^C |
| Thallium | CLP ^C | CLP ^C |
| Vanadium | CLP ^C | CLP ^C |
| Zinc | CLP ^C | CLP ^C |
| Miscellaneous Parameters | | |
| Cyanide | CLP ^C | CLP ^C |
| Phenols | 9065 ^b | 9065 ^b |
| Chloride | 300.0 ^a | 300.0 ^a |
| Total Petroleum Hydrocarbons | Mod. 8015 ^g | Mod. 8015 ^g |
| Tetraethyl Lead | LUFT ^d | LUFT ^d |
| 2,3,7,8-TCDD ^h | 613 ^e | EPA Reg. VII ^f |
| Tetra-Octa Dioxins/Furans | EPA 8280 ^b | EPA 8280 ^b |

References: ^a"Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, latest revision.

^b"Test Methods for Evaluating Solid Waste," EPA, SW-846, 2nd revision.

^cU.S. EPA Contract Laboratory Program, EPA CLP, SOW 7/87, Exhibit D.

^d"Leaking Underground Fuel Tank Field Manual", State Water Resources Control Board, December 1987. A copy of the procedure is included in Appendix A.

^eEPA Method 613, "Methods for Organic Chemical Analysis of Municipal and Industrial Waste Waters," EPA-600/4-82-057.

^fU.S. EPA Region VII Methods for Analysis of Dioxins and Furans.

^gModified Method 8015 for TPHC by Gas Chromatograph. The Standard Operating Procedure is included in Appendix A.

^hSamples collected for dioxin/furan analysis will first be analyzed for tetra through octa congeners of dioxin/furans. If the tetra chlorinated species are identified, then additional samples will be collected and analyzed for 2,3,7,8 chlorinated isomers of dioxin/furans.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

10.1 DATA REDUCTION AND VALIDATION

Data collected during the field activities will be validated by checking the procedures used and comparing the data to previous measurements. The Field Operations Coordinator will be responsible for checking field QC samples to ensure that field measurements and sampling protocols have been observed and adhered to. These checks will include:

- Use of standard operating procedures
- Calibration method and frequency
- QC bottle lot number
- Date/time sampled
- Preservation
- Samplers
- Laboratory
- Chain-of-custody number
- Date shipped
- Airbill number

The field data will be reported in the following units:

- Water levels - Reported to the nearest 0.01 foot after two measurements agree
- pH - Digital reading rounded to 0.1 pH units
- Electrical conductivity - Reported to 100 micromhos/cm
- Survey Data - Well casing elevations surveyed to 0.01 feet; coordinates to 0.1 feet

Data reduction, validation, and reporting will be performed as follows and as described in the ITAS Quality Assurance Manual. Analytical data are generated by the GC/MS computer software, the GC computer, the ICAP computer, AA, ion

chromatograph, and associated laboratory instrumentation. Outputs include identifications of compounds, concentrations, retention times, and comparisons to standards. Outputs are in graphic form (chromatograms), bar graphs (spectra), and printed in tabular form in the standard formats specified for each analysis. If incomplete or incorrect outputs are received, corrective actions are taken according to procedures established for each type of analysis, consistent with manufacturer recommendations.

In the data review process, the data are compared to information such as the sample history, sample preparation, and quality control (QC) sample data to evaluate the validity of the results. Corrective action is minimized through the development and implementation of routine internal system controls. Analysts are provided with specific criteria that must be met for each procedure, operation, or measurement system.

Data validation includes dated and signed entries by analysts and group leaders on the worksheets and logbooks used for samples, the use of sample tracking and numbering systems to track the progress of samples through the laboratory, and the use of quality control criteria to reject or accept specific data.

Steps and checks used to validate precision and accuracy of the measured parameters and to support the representativeness, comparability, and completeness include:

- Description of the calibration performed
- Description of routine instrument checks (noise levels, drift, linearity, etc.)
- Documentation of the traceability of instrument standards, samples, and data
- Documentation of analytical methodology and QC methodology

- Description of the controls taken to determine and minimize interference contaminants in analytical methods (use of reference blanks and check standards for method accuracy and precision)
- Description of routine maintenance performed
- Documentation of sample preservation and transport when shipped elsewhere

Note: The EPA Region IX document, QA/QC Requirements for Receiving the Data Generated by Responsible Parties will be used as a guide for the review of laboratory data reporting requirements.

Laboratory validation responsibilities are as follows:

- Analyst - Responsible for the actual analyses performed. If several types of analyses are performed, there will be more than one analyst. The data is organized and placed into the job envelope.
- Analyst or Group Leader - Responsible for reviewing: data, calculations, and the results for 20 percent of all jobs. If an analyst performs this function, it is always a second, independent analyst from the analyst performing the analyses. This person is responsible for initialing and dating each page reviewed. Records are to be kept in logbooks to track jobs reviewed.
- Analyst or Group Leader - Responsible for verifying that the results as reported have been correctly typed. The chemist verifying the typing is the same chemist who performed the analyses. In a job where more than one chemist has performed the analyses, the chemist working with the "main" group is responsible for signing the report.
- Group Leader - Responsible for reviewing 100 percent of all reports to verify that the information, format, data, completeness and typing are correct. Revised reports, duplicate analyses and secondary group results are to be checked for comparable results as well. Initials of this person are to be placed at the bottom left corner of each report. This person is responsible for organizing the job envelope(s) for final review by the Lab Manager, Operations Manager, Technical Director or EPA Project Manager.
- QA/QC Coordinator - Responsible for reviewing at least 5 percent of all job envelopes. The QA/QC Coordinator verifies that all steps documented are accomplished as stated, and will take corrective action and proceed further with an investigation if the protocol is not adhered to.

- Technical Director/Special Projects Manager - Ultimately responsible for the issued report. Final approval for release of the report is given and the report is then signed. The lab manager has the authority to designate specified personnel to manage this responsibility.

10.2 DATA REPORTS

The format and content of a data report is dependent upon project needs, such as: whether or not explanatory text is required, client or contract requirements, and government agency reporting formats. The IT Quality Assurance Program does not specify a report format; however, the following items are applicable to data presentation:

- The final data presentation shall be checked in accordance with data verification requirements and approved by the Laboratory Manager
- Data are presented in a tabular format whenever possible
- Data will be formatted as a Certificate of Analysis
- Each page of data is identified with the project number and name; date of issue; and, if appropriate, client name
- Data presentation includes:
 - a. Sample identification number used by the ITAS-Cerritos laboratory and/or the sample identification provided to the laboratory, if different than identification used in the laboratory
 - b. Chemical parameters analyzed, reported values, and units of measurement
 - c. Quantification limit of the analytical procedure if the reported value is less than the quantification limit
 - d. Results of quality control sample analysis if appropriate
 - e. Achieved accuracy, precision, and completeness of data if appropriate
 - f. Footnotes referenced to specific data if required to explain reported values.
 - g. Analytical methods used. These will be specifically referenced on all laboratory reports. Any method modification will be included in the case narrative.

- h. Data for field QC samples, reported in the same format as action samples. A modified CLP data package consisting of QA/QC summary data sheets will be provided for all internal laboratory QC samples.
- i. Laboratory data stored so that complete CLP data packages can be subsequently assembled for EPA designated review.

11.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

11.1 FIELD QUALITY CONTROL PROCEDURES

In order to check the quality of field data, quality control (QC) samples are collected for either laboratory or field analysis.

11.1.1 Soil and Water Samples

Field quality control sampling will be established to check sampling and analytical accuracy and precision. All QC samples will be shipped according to the Chain of Custody procedures specified in Section 7.1. Field QC samples will include the following types of samples:

- Duplicates
- Splits
- Blanks and Background Samples
 - Equipment blank
 - Field Bottle Blank
 - VOA Travel Blank
 - Background.

Field QC samples will have discrete sample numbers and be submitted as "blind" to the laboratories. These samples will be analyzed as if they were original field samples. Results of these samples will be included in the analytical report.

Results for QC samples will not be used to adjust the results obtained for original samples. If contaminants are found in the blanks, attempts will be made to identify the source of contamination, and corrective action will be initiated in accordance with Section 15.0.

11.1.1.1 Duplicates

A duplicate is a sample that is collected in parallel with its original sample for each analytical parameter. The procedure for obtaining the duplicate is identical to its original. The same container type, preservative and sampling technique are used.

Duplicate soil samples will be obtained by collecting two sets of samples with the California Modified Sampler for a total of six sleeves. Two sleeves adjacent to one another within the core barrel will be considered duplicates of one another.

For field duplicates, no quality assurance objectives have been established by the EPA. Field QA/QC data will be maintained primarily for descriptive purposes.

For laboratory duplicates the percent RPD criteria are established by the CLP for the GC/MS volatile and semi-volatile methods, the GC pesticide method, and the inorganic methods. For criteria not yet statistically generated, the criteria will be set at 0-25 percent RPD.

A minimum of one sample per week or 10%/parameter/matrix/site whichever is greater will be collected from locations suspected of being contaminated.

11.1.1.2. Split Sample

A split sample is a sample obtained at the identical time and place of the original. When collecting the split, the sample is divided equally between the sample containers of the original and its split sample. The frequency of split samples will be 5%/parameter/matrix/site. Split samples will be sent to Martin Marietta Energy Systems as a means of verifying the data.

11.1.1.3. Blank Samples

Blank samples are used to determine cross-contamination between sample collection and during shipment to the laboratory.

For liquids, the frequency of blank or background sample collection will be one sample/day/shipment/laboratory. Only one type of blank need be collected. The different types of blanks are listed below in order of collection preference.

Equipment Blank

After decontamination has been performed on sampling equipment, and prior to use, a reagent grade water rinsate is collected from the piece of equipment (e.g., a bailer, submersible pump). For soil gas, blank samples will be taken from the decontaminated syringes. Analysis of this type of sample determines decontamination effectiveness.

Field Bottle Blank

A field bottle blank is HPLC/ASTM-Type 2-grade water which is transferred from its original container to a sample container at the sample location. Theoretically, the transfer will expose the water to ambient contaminants which would be measured during lab analysis. A blank will be collected when decontamination of the equipment is not necessary or possible. The field blank will be analyzed for all parameters specified for the sample location.

VOA Travel Blank

These blanks consists of an HPLC/ASTM Type 2 grade water sample which is carried into the field by samplers along with actual samples, shipped to the laboratory, and analyzed exactly like all other samples. All VOA vials will be packed in the same cooler as the VOA blank.

11.1.1.4 Background Sample

Background samples will be analyzed for the complete analytical suite. It is expected that one sample location will serve as the background for both water and soil.

11.1.2 Photovac Tip

The following Photovac TIP QA/QC procedure will be followed according to the TIP Standard Operating Procedures in Appendicies A and B of the Sampling and Analysis Plan.

- TIP readings will be reported at each sampling point together with the GC reading for chlorinated compounds with the corresponding quantification limits.
- Duplicate sample analyses are performed for each 10 sample analyses after a 5-minute minimum resting period. Results of

duplicate analyses are properly recorded in the daily logs. A minimum of one duplicate analysis per day is required.

- Blank sample analyses are performed for each 10 sample analyses after a 5-minute minimum resting period. Results of blank sample analyses are properly recorded in the daily log. A minimum of one blank analysis per day is required.
- Instrument calibration is required three times a day: at the beginning of the work day, in the middle of the day, and at the end of the day.
- TIP calibration will be checked and recorded three times daily using appropriate gas standard.

After each reading the TIP will be thoroughly aerated until its decontamination is complete. Small adjustments may be necessary to correct for zero drift.

11.1.3 Photovac Gas Chromatograph (GC)

The following GC QA/QC procedures will be followed according to the GC Standard Operating Procedures.

- Before sampling, syringes will be purged with zero air and checked by injecting a syringe volume into the gas chromatograph.
- Probes, syringes, adaptors, and vacuum lines will be used only once between thorough cleanings. Probes will be steam cleaned, syringes will be purged with zero air and baked under a heating lamp, and adaptors and lines will be cleaned by baking under a heating lamp.
- A duplicate sample analysis for each compound of interest is performed for every 10 sample analyses, or daily, whichever is more frequent and the relative percent difference is calculated and recorded in the project notebook.
- A blank sample analysis is performed for every 10 sample analyses, or daily, or after high level sample introduction.
- Instrument calibration is performed using appropriate sample standards three times a day: at the beginning of the work day, in the middle of the work day, and at the end of the day. Percent recovery from standard analysis is recorded as instrument performance verification.

11.2 LABORATORY QUALITY CONTROL PROCEDURES

These control limits are specified in the Organic CLP SOW 7/87 Exhibit E.

11.2.1 Volatile Organics

Samples for volatile organics analysis will be analyzed according to current CLP procedures. An initial calibration curve will be prepared using a mixture of standards at five different concentrations and a mixture of three internal standards. Each GC/MS tune will be verified every 12 hours to ensure that its performance on bromofluorobenzene meets the applicable USEPA criteria. The continuous calibration is also verified prior to sample analysis by re-analysis of the mid-range standard.

All standards, method blanks, and samples will be spiked before analysis with surrogate standards as specified in CLP procedures. Surrogate standards are defined as non-priority pollutant compounds used to monitor the percent recovery efficiencies of the analytical procedures on a sample-by-sample basis. Samples exhibiting surrogate standard responses outside the established control limits will be re-analyzed. If the problem is not resolved by reanalysis, the Project Manager will be notified that resampling is required.

At least one method blank every 12 hours will be purged and analyzed for volatile organic compounds. Volatile organics analysis requires a method blank consisting of 5 milliliters of organic free water spiked with the appropriate surrogate standards. Results of the method blank analyses will be maintained with the corresponding sample analyses.

Matrix spike and matrix spike duplicate analyses will be performed as described in Section 11.2.3.2.

11.2.2 Extractable Organics

Samples for extractable organics analysis will be analyzed according to current CLP procedures. An initial calibration curve will be prepared using a mixture of standards at five different concentrations and a mixture of six internal standards. Each GC/MS tune will be verified every 12 hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the applicable USEPA criteria. The continuous calibration is also verified prior to sample analysis by re-analysis of the mid-range standard.

All standards, method blanks, and samples will be spiked before analysis with surrogate standards as specified in CLP procedures. Surrogate standards are defined as non-priority pollutant compounds used to monitor the percent recovery efficiencies of the analytical procedures on a sample-by-sample basis. Samples exhibiting surrogate standard responses outside the established control limits will be reanalyzed.

At least one method blank for every 20 samples will be extracted and analyzed for base/neutral and acid extractable compounds. Extractable organics analysis requires a method blank consisting of 1 liter of organic free water spiked with the appropriate surrogate standard. Results of the method blank analysis will be maintained with the corresponding sample analyses.

Matrix spike and matrix spike duplicate analyses will be performed as described in Section 11.2.3.2.

11.2.3 Polychlorinated Biphenyls (PCBs) and Pesticides

Samples for PCB analysis will be analyzed according to current CLP procedures.

11.2.3.1 Qualifying the Column

Each time a new column is installed into a specific gas chromatograph, or the chromatographic conditions are changed, (i.e., change of flow rates, detectors, electronics, etc.), three different concentration standards will be analyzed to determine calibration factors and linearity specific to these conditions. This process occurs in a 24 hour period. Calibration factors will be calculated for each pesticide and PCB. If the linearity for the

calibration factors is ≤ 10 percent, the samples analyzed on that gas chromatograph can be directly quantitated from the range. If the linearity is > 10 percent, a calibration curve will be generated for each compound to be qualified.

11.2.3.2 Standard and QC Solutions

Once the column has been qualified, a 72 hour evaluation run will be performed with three concentration standards. Retention time windows will be developed for each pesticide and PCB from the three concentration standards. The range will be determined by calculating three times the standard deviation of the three retention times for the individual compounds, and applying it to the daily retention time for that same component.

Percent difference in retention time shift for the spiked surrogate will be calculated. A 2 percent difference in retention time is allowable. Percent recovery of the surrogate will be calculated to determine accuracy and precision of all analytical steps involved.

Once the gas chromatograph is qualified, daily evaluation standards will be injected before any samples are injected. Afterwards, a specified number of sample evaluation mixes and/or standards will be injected to establish daily retention times and linearity for all PCB's and pesticides in question. Quality control standards will be injected at specific intervals, at least every 20 samples. Additional quality control standards will be run to measure pesticide recovery and reproducibility of analysis.

At least one method blank for every 20 samples will be extracted and analyzed for pesticides and PCB's. Pesticides/PCB analysis requires a method blank consisting of one liter of organic-free water spiked with the appropriate surrogate standards. Results of the method blank analysis will be maintained with the corresponding sample analyses.

Matrix spike and matrix spike duplicate analyses will be performed on one of every 20 samples per matrix type analyzed. A separate aliquot of the sample will be spiked with the appropriate TCL compounds before extracting the

sample. The percent recoveries for the respective compounds will then be calculated. Should the percent recovery values fall outside the appropriate QC limits, the other QC parameters will be evaluated to determine whether an error in spiking occurred or whether the entire set of samples required reextraction and analysis. Table 11-1 lists the matrix spike limits for each parameter.

The relative percent error for each parameter will then be calculated from these matrix spike and matrix spike duplicate analyses. Should the average relative percent error fall outside the appropriate QC limits, the other QC parameters will be evaluated to determine whether the duplicate sample should be reextracted and analyzed or whether the entire set of samples should be reextracted and analyzed.

11.2.4 Metals and Miscellaneous

For the inorganics, at least one method blank, consisting of reagent water and reagents used in the method, will be analyzed for every day of sampling.

Duplicate and matrix spike analyses will also be conducted at the same frequency as for the organics, though not necessarily on the same samples, due to potential sample volume limitations.

Evaluation of the QC data and any corrective action necessary will be the same as for the organics.

11.2.5 General Chemistry Laboratory Controls

In addition to instrument calibration and the analysis of quality control samples, the following controls will be implemented:

- Reagents and solvents will be of certified composition. Reagent storage environment and duration will meet EPA guidelines.
- Laboratory equipment such as balances will be regularly calibrated.
- Volumetric measurements will be made with certified glassware.

- Data reduction computations will be independently checked.
- Qualified personnel will be used for laboratory analyses.
- Holding times and sample storage provisions will conform to EPA guidelines (40 CFR 136 [49 FR No. 209, page 19]).

The IT Cerritos Laboratory QA/QC Coordinator is responsible for preparing quality control standards and for sending quality control samples into the laboratory for analysis. Statistical analyses will then be performed utilizing the results of QC sample analyses.

The IT Cerritos Laboratory QA Manual (Section 10.0) describes the methodology used for the statistical evaluation of QC data. In general, IT laboratories will apply precision and accuracy criteria to each parameter that is analyzed. When analysis of a sample set is completed, the quality control data are reviewed and evaluated through the use of control charts to validate the data set.

Control charts may be established for all analytical parameters. A minimum of ten measurements of precision and accuracy are required before control limits can be established. Control limits of three standard deviations shall be utilized for all samples. Once established, control limits are updated as additional precision and accuracy data become available to the Quality Control Coordinator.

All precision and accuracy analyses will be calculated utilizing Northwest statpak, which uses ± 3 STD deviations for the acceptable criteria limits. Additional statistics for organics CLP work will be done in accordance with SOW 787.

As discussed in Section 11.1.12, IT will split samples with Martin Marietta Energy Systems (MMES) for their independent analysis. The frequency will be 5 percent splits. Samples intended to be used as internal duplicates or spikes for the lab will be the sample sent to MMES. This means three results will be reported for the same samples; two from IT and one from MMES.

IT labs also are subject to EPA's laboratory verification process as part of the Contract Laboratory Program and to the NEESA certification program. MMES may, at their discretion, audit the laboratory or field operations during this project.

Table 11-1. Matrix Spike Recovery Limits^a

| Parameter/Matrix Spike Compound | Method | Water | Sediment/Soil |
|---|------------------|------------------|------------------|
| Major Anions | | | |
| Fluoride | 300.0 | 44-134 | 10-121 |
| Nitrate | 300.0 | 60-140 | 81-111 |
| Sulfate | 300.0 | 60-142 | 60-142 |
| Bicarbonate/Carbonate | 310.1 | N/A ^f | N/A ^f |
| Major Cations | | | |
| Calcium | CLP ^b | 75-125 | 75-125 |
| Magnesium | CLP ^b | 75-125 | 75-125 |
| Potassium | CLP ^b | 75-125 | 75-125 |
| Sodium | CLP ^b | 75-125 | 75-125 |
| Volatile Organics | | | |
| 1,1-Dichloroethene | CLP ^b | 61-145 | 59-172 |
| Trichloroethene | CLP ^b | 71-120 | 62-137 |
| Chlorobenzene | CLP ^b | 75-130 | 60-133 |
| Toluene | CLP ^b | 76-125 | 59-139 |
| Benzene | CLP ^b | 76-127 | 66-142 |
| Base-Neutral, and Acid Extractable Priority Pollutants (BNA) | | | |
| 1,2,4-Trichlorobenzene | CLP ^b | 39-98 | 38-107 |
| Acenaphthene | CLP ^b | 46-118 | 31-137 |
| 2,4-Dinitrotoluene | CLP ^b | 24-96 | 28-89 |
| Di-n-butyl Phthalate | CLP ^b | 11-117 | 29-135 |
| Pyrene | CLP ^b | 26-127 | 35-142 |
| N-Nitroso-Di-n-Propylamine | CLP ^b | 41-116 | 41-126 |
| 1,4-Dichlorobenzene | CLP ^b | 36-97 | 28-104 |
| Pentachlorophenol | CLP ^b | 09-103 | 17-109 |
| Phenol | CLP ^b | 12-89 | 26-90 |
| 2-Chlorophenol | CLP ^b | 27-123 | 25-102 |
| 4-Chloro-3-Methylphenol | CLP ^b | 23-97 | 26-103 |
| 4-Nitrophenol | CLP ^b | 10-80 | 11-114 |
| Polychlorinated Biphenyls (PCB) Aroclor - 1248 | CLP ^b | 46-197 | 46-197 |
| Metals | | | |
| Aluminum | CLP ^b | 75-125 | 75-125 |
| Antimony | CLP ^b | 75-125 | 75-125 |
| Arsenic | CLP ^b | 75-125 | 75-125 |
| Barium | CLP ^b | 75-125 | 75-125 |
| Beryllium | CLP ^b | 75-125 | 75-125 |
| Cadmium | CLP ^b | 75-125 | 75-125 |
| Calcium | CLP ^b | 75-125 | 75-125 |
| Chromium | CLP ^b | 75-125 | 75-125 |

Table 11-1. Matrix Spike Recovery Limits^a (Continued)

| Parameter/Matrix Spike Compound | Method | Water | Sediment/Soil |
|---------------------------------|--|--------|---------------|
| Cobalt | CLP ^b | 75-125 | 75-125 |
| Copper | CLP ^b | 75-125 | 75-125 |
| Iron | CLP ^b | 75-125 | 75-125 |
| Lead | CLP ^b | 75-125 | 75-125 |
| Magnesium | CLP ^b | 75-125 | 75-125 |
| Manganese | CLP ^b | 75-125 | 75-125 |
| Mercury | CLP ^b | 75-125 | 75-125 |
| Nickel | CLP ^b | 75-125 | 75-125 |
| Potassium | CLP ^b | 75-125 | 75-125 |
| Selenium | CLP ^b | 75-125 | 75-125 |
| Silver | CLP ^b | 75-125 | 75-125 |
| Sodium | CLP ^b | 75-125 | 75-125 |
| Thallium | CLP ^b | 75-125 | 75-125 |
| Vanadium | CLP ^b | 75-125 | 75-125 |
| Zinc | CLP ^b | 75-125 | 75-125 |
| Miscellaneous Parameters | | | |
| Cyanide | CLP | 75-125 | 75-125 |
| Phenols | 9065 | 80-115 | 60-150 |
| Chloride | 300.0 | 68-134 | 60-150 |
| 2,3,7,8 TCDD | ^d 613/ Reg. VII ^e | 60-140 | 60-140 |
| Tetra-Octa Dioxins/Furans | 8280 | 40-120 | 40-120 |
| Total Petroleum Hydrocarbons | Mod8015 ^g | 58-136 | 60-150 |
| Tetraethyl Lead | LUFT ^c | 50-125 | 50-125 |

^aThese limits are for advisory purposes only. If outside the limit, the QC Coordinator will review the data (taking into consideration matrix type, dilution factors, interferences, etc.) to decide whether reanalysis is required.

^bCLP - EPA Contract Lab Program.

^cLUFT - "Leaking Underground Fuel Tanks" State Resources Control Board, December 1987. A copy of this procedure is included in Appendix A.

^dEPA Method 613, Methods for Organic Chemical Analysis of Municipal and Industrial Waste Waters, EPA-600/4-82-057.

^eU.S. EPA Region VII Methods for Analysis of Dioxins and Furans.

^fNA will develop during project. Duplicates (1 in 10) rather than spikes will be used to check reproducibility.

^g"Modified Method 8015 for TPHC by Gas Chromatograph". The Standard Operating Procedure is included in Appendix A.

12.0 PERFORMANCE AUDITS AND FREQUENCY

An individual audit plan will be developed to provide a basis for each audit. This plan will identify the audit scope, activities to be audited, audit personnel, any applicable documents, and the schedule. Checklists will be prepared by the auditors and used to conduct all audits. They will be developed to accomplish the necessary review and to document the results of the audit.

Audits may involve an on-site visit by the auditor. Items to be examined may, as appropriate, include the availability and implementation of approved work procedures, calibration and operation of equipment; packaging, storage and shipping of samples obtained; performance documentation; and nonconformance documentation.

The records of operations will be reviewed to verify that laboratory and field-related activities were performed in accordance with appropriate approved procedures. Items reviewed will include, but will not be limited to, the calibration records of equipment, daily field activity logs, chain-of-custody documentation, and data resulting from field and laboratory operations.

12.1 FREQUENCY OF AUDITS

Audits will be conducted as the scheduled activities dictate. After project and sampling plan schedules are developed, the audit schedule may be revised. The Quality Assurance Coordinator is responsible for scheduling and performing audits. Within 20 working days of completion of an audit, the Quality Assurance Coordinator and/or his representative will prepare and submit an Audit Report. The report will be addressed to the IT Project Managers, Deputy Program Manager, and copies will be sent to the organizational or group audited and Martin Marietta Energy Systems.

Within 30 working days after receipt of the Audit Report, the IT Project Manager will prepare and submit to the Energy Systems Project Manager and the Quality Assurance Coordinator a reply to the audit. This reply will include,

as a minimum, a plan for implementing the corrective action to be taken on nonconformances indicated in the Audit Report, the date by which such corrective action will be completed and actions taken to prevent reoccurrence. If the corrective action has been completed, supporting documentation should be attached to the reply. The Quality Assurance Coordinator will ascertain (by re-audits or other means) whether appropriate and timely corrective action has been taken. Re-audits will be conducted and reported in the same manner as the original audit.

Records of audits will be maintained in the project files. Audit files will include, as a minimum, the Audit Report, the reply to audit, and any supporting documents. It is the responsibility of the Project Manager to conform to the established procedures, particularly as to timely replies to audit reports and implementation of such corrective action as may be indicated.

12.2 PERFORMANCE AND SYSTEM AUDITS

Audits will be performed to review and evaluate the adequacy of field and laboratory performance, and to ascertain whether the QAPjP is being completely and uniformly implemented. The Quality Assurance Coordinator is responsible for such audits and will perform them according to a schedule planned to coincide with appropriate activities on the project schedule and sampling plans. Such scheduled audits may be supplemented by additional audits for one or more of the following reasons:

- When significant changes are made in the QAPjP
- When it is necessary to verify that corrective action has been taken on a nonconformance reported in a previous audit
- When requested by the Project Manager.

The objectives of performance and systems audits are to ensure that the quality assurance program developed for this project is being implemented according to the specified requirements, to assess the effectiveness of the quality assurance program, to identify nonconformances, and to verify that identified deficiencies are corrected. Upon discovery of any significant deviation from

the quality assurance program, the Project Manager shall be informed of the nature, extent, and corrective action taken to remedy the deviation.

In addition to these internal audits, surveillance of selected activities may be performed on a periodic basis.

12.2.1 Performance Audits

A performance audit can be defined as a review of the existing project and quality control data to determine the accuracy of a total measurement system(s) or a component part of the system. The analysis of laboratory performance evaluation samples and the participation in scheduled inter-laboratory studies may be included as part of the performance audit. Laboratory audits are further described in the ITAS Cerritos QA manual.

The IT Cerritos laboratory performs monthly internal audits covering all laboratory functions and activities. Performance audit reporting is summarized in a monthly report to the Technical Director and the Laboratory Manager.

As appropriate, NEESA QA/QC guidelines and procedures will be followed to ensure satisfactory project performance.

12.2.2 Systems Audits

A systems audit consists of an evaluation to determine if the components of a measurement system(s) were properly selected and are being used correctly. A system audit includes a careful evaluation of field and laboratory quality control procedures.

System audits are conducted on a semi-annual basis. The system audit is reported in formal audit reports distributed by the Laboratory Manager.

12.2.3 Field Audits

An individual audit plan will be developed to provide a basis for each field audit. This plan will identify the audit scope, activities to be audited, audit personnel, any applicable documents, and the audit schedule. Checklists will be prepared by the auditors and used to conduct all audits. They will be

developed to accomplish the review of necessary items and to document the results of the audit.

A field operations audit may involve an on-site visit by the auditor. Items to be examined may, as appropriate, include the availability and implementation of approved work procedures, calibration and operation of equipment; packaging, storage, and shipping of samples obtained; documentation procedures and instructions; and nonconformance documentation.

The records of field operations will be reviewed to verify that field-related activities were performed in accordance with appropriate procedures. Items reviewed may include, but are not limited to, the calibration records of field equipment, Daily Field Activity Logs, Chain-of-Custody Records, and data resulting from field operations.

Field audits will be conducted during the Remedial Investigation site work and the potential conduit investigation. Field audit reports will be reported in formal audit reports distributed by the Project Manager.

During an audit and upon its completion, the auditor(s) will discuss the findings with the individuals audited and discuss and agree on corrective actions to be initiated.

Minor administrative findings which can be resolved to the satisfaction of the auditors during an audit are not required to be cited as items requiring corrective action. Findings that are not resolved during the course of the audit and findings affecting the overall quality of the project will be noted on the audit checklists and included in the audit report.

13.0 PREVENTIVE MAINTENANCE PROCEDURES

Periodic preventive maintenance is required for all sensitive equipment. Instrument manuals will be kept on file for reference purposes should equipment need repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks. The frequency of preventive maintenance for field equipment is usually indicated in each operating instruction manual. Otherwise, IT will indicate when routine maintenance checks are necessary so that failures in the field can be minimized.

Laboratory equipment requiring routine maintenance has a control system indicating the date of required maintenance, person maintaining the equipment, and the next maintenance date. Information pertaining to life histories of equipment maintenance will be kept in individual logs for each instrument.

Major instruments in the laboratories are normally covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

A listing is maintained of the critical spare parts that will be on hand to minimize equipment downtime.

Specific laboratory and field equipment preventive maintenance practices, frequency, and spare parts are described in Table 13-1 and Table 13-2.

Table 13-1. Preventive Maintenance Requirements
 for Cerritos Laboratory Operations

| Instrument | Items Checked/Service | Frequency | Critical Spare Parts |
|--|--|---|---|
| Gas chromatograph | Replace column packing, clean detector, change glass wool plug, clean insert, clean insert, replace septa, gas purity checks | Determined by analyst so that the calibration is within required specifications | See GC/MS |
| Atomic absorption spectrophotometer | 3 point calibration performed, Burner head Nebulizer Tygon Tubing | Daily Daily Monthly 6 months | Nebulizers, contact rings, graphite tubes, quartz windows |
| Analytical balance | Internal weight, train, gears, electronics | Annual service | None |
| Inductively coupled plasma spectrophotometer | Sample introduction system Check pumps | Daily Weekly | Touches, nebulizers, pump tubing, torch collars (bonnets) |
| Ion chromatograph | Check plumbing Check filter (inlet) Flush column Check bed support | Daily or when used Weekly After each new sample | Syringes, columns |
| Infrared spectrophotometer | Clean cells | When specifications are off the calibration curve | None |
| pH meters | Gel filled maintenance free | Daily check with 3 calibration standards | None |

Table 13-1. Preventive Maintenance Requirements
 for Cerritos Laboratory Operations (Continued)

| Instrument | Items Checked/Serviced | Frequency | Critical Spare Parts |
|--|--|--|---|
| Total organic carbon analyzer | Check oxygen purity Add phosphoric acid | Tanks are checked prior to purchase When necessary | None |
| GC/MS Gas chromatograph/ mass spectrometer | GC/MS maintenance is the same as GC with the following additions 1) For model 4000 and 5000 DP oil Mech. oil Power Con. Air Filter QEM filter Water bay filter 2010 Interface box Vacuum chaff filter 2) For OWA's Water filter (if applicable) Computer air filter Card gage air filter | Bi-weekly Quarterly Bi-weekly Bi-weekly Bi-weekly Bi-weekly Monthly Observe and change as needed Bi-monthly Monthly | Analyzer parts: consumable parts, filaments, filters, septa, syringes, ferrules, gaskets O-Ring, etc. For printer: spare head, tape, ribbon, etc. |
| Microscope | Serviced by manufacturer or manufacturing rep. | Every 18 months | None |
| Ultraviolet UV/VIS/Spectrophotometers | Lamp Wavelength checked Serviced | As needed During calibration steps As needed | None |

Table 13-2. Preventive Maintenance Requirements
 for Field Equipment

| Instrument | Items Checked/Service | Frequency | Critical Spare Parts |
|-----------------------|------------------------------------|--|----------------------|
| pH meters | Gel filled probe, maintenance free | Daily check with 2 calibration standards | Probe, Battery |
| Conductivity Meters | Maintenance free | Daily check with 3 calibration standards | Probe, Battery |
| Water Level Indicator | Cable length | Annually | None |

14.0 STATISTICAL ASSESSMENT OF DATA QUALITY

The following discussion describes the procedures that will be employed to evaluate the precision, accuracy, and completeness of the chemical test data generated during the investigation.

Accuracy will be assessed by splitting a sample into two portions, spiking, (i.e., adding a known quantity of the constituents of interest to one of the portions), and then analyzing both portions for these parameters. The difference in the concentration levels of the constituents of interest should be equal to the quantity of the spike added to one of the two portions. The actual percent recovery is calculated as follows:

$$\%R = \frac{O_i - O_s}{T_i} \times 100$$

where O_i is the observed spiked sample concentration, O_s is the sample concentration and T_i is the true or actual concentration of the spike. One hundred percent recovery is equivalent to 100 percent accuracy. The coefficient of variation (C_v) of the percent recovery values is calculated as follows:

$$C_v = \frac{\text{Standard Deviation (SD)}}{\text{Mean (APR)}}$$

SD is the standard deviation of the percent recoveries for the various spiked constituents and APR is the average or mean percent recovery.

Precision will be assessed by conducting separate analyses of the duplicate spike samples. A measure of the agreement in the reported values for the two portions is obtained by calculating the relative percent difference (RPD) in the concentration levels of each constituent, where

$$RPD_i = \frac{A_i - B_i}{\frac{A_i + B_i}{2}} \times 100$$

and A_i and B_i are the concentrations of the constituent.

The evaluation of the test data is based in part on criteria adopted by the sample management office of the USEPA. These criteria provide a means of categorizing a data set as being quantitative, semiquantitative, or qualitative. Where applicable, IT will use data qualifiers to clearly identify (flag) results as quantitative and semi-quantitative. Otherwise, reported data is to be considered quantitative. They are as follows:

Organics

| | | |
|------------------|-----|----------------|
| Quantitative | APR | 80% or greater |
| | Cv | 20% or less |
| Semiquantitative | APR | 60% or greater |
| | Cv | 20 to 40% |
| Qualitative | APR | 40% or better |
| | Cv | 70% or less |

Inorganics

| | | |
|------------------|-----|----------------|
| Quantitative | APR | 90 to 110% |
| | Cv | 15% or less |
| Semiquantitative | APR | 80% or greater |
| | Cv | 15 to 30% |
| Qualitative | APR | 80% or less |
| | Cv | 30% or greater |

In addition to evaluating each set of data for accuracy and precision, an assessment will also be made of the completeness of the data. This assessment will involve computing the fraction of the reported values that remain valid after the sampling procedures have been reviewed and the results have been assessed for precision and accuracy. The quality assurance data objectives for the investigation relative to precision, accuracy, and completeness are described in Section 5.0.

For those analyses conducted using EPA CLP protocol, current acceptance criteria established by EPA will be used. These include recoveries of surrogate compounds added to each sample and recoveries of Target Compound

List (TCL) compounds added to the matrix spike and matrix spike duplicate samples.

As part of the data assessment outlined above, precision and accuracy quality control charts will be established for all major analytical parameters. A minimum of 10 measurements of precision and accuracy are required before control limits can be established. Control limits of three standard deviations shall be utilized for all samples. In general, control limits will be updated as additional precision and accuracy data become available. Samples with relative percent differences or percent recoveries exceeding their respective control limits will be reanalyzed.

15.0 NONCONFORMANCES AND CORRECTIVE ACTION PROCEDURES

Nonconforming equipment, items, activities, conditions and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency, or deviation which renders the quality of an item unacceptable or indeterminate. The originator (any IT employee) of a Nonconformance Report (NCR) (Figure 11) will describe the finding on the form provided for this purpose and notify the Project Manager and Quality Assurance Coordinator. Each nonconformance will be reviewed and a disposition given for the item, activity, or condition. The disposition of a nonconformance will be documented and approved by the IT organization responsible for the issuance of the nonconformance. The Quality Assurance Coordinator will concur with the disposition of the nonconformance.

The Laboratory QA/QC Coordinator is responsible for assessment of quality control sample information. If data falls outside accepted limits, the QA/QC Coordinator will immediately notify the Operations Manager and the responsible Group Leader. If the situation is not corrected and an out-of-control condition occurs or is expected to occur, the QA/QC Coordinator will notify the Technical Director and the Laboratory Manager. The Operations Manager and Group Leaders are responsible for identifying the source of the nonconformance and initiating corrective action. Completion of corrective action should be evidenced by data returning to prescribed acceptable limits.

The modification, repair, rework, or replacement of nonconforming equipment, items, or activities will require the reverification of acceptability. In certain instances, as determined by the Project Manager, Program Manager, or Quality Assurance Coordinator, these actions may require that corrective action be completed and verified before site work continues.

The equipment, item, or activity which has the deficiency may be temporarily stopped while the nonconformance is being investigated. If, in the opinion of the Project Manager and the Quality Assurance Coordinator, the nonconformance does not significantly affect the technical quality or use of the work, the

work may continue pending resolution of the nonconformance. The basis for such decisions will be documented on the Nonconformance Report and submitted to the Quality Assurance Coordinator for review and approval. The documentation will include the statement that the decision was made prior to continuing with the work. The records of nonconformance and their dispositions will be kept in the project central files.

In addition, the Project Manager will notify Martin Marietta Energy Systems, Inc. of significant nonconformances which could impact the schedule or results of the work, and will indicate the corrective action taken or planned.



INFORMATION REQUIRED
FOR

NONCONFORMANCE REPORT

PROJECT NO _____ PROJECT NAME _____

DATE _____ ORIGINATOR _____

APPROVED BY _____

REQUIREMENT

(Standard procedure, code, contractual, etc.)

NONCONFORMANCE

(Brief description of nonconformance: e.g., storage time exceeds standard [state time], calibration error, equipment failure, sample prep. error, and test procedure error)

CORRECTIVE ACTION

1. Persons notified — (Operations Manager, Project Manager, Laboratory Manager, etc.)
2. Impact of nonconformance.
3. Recommended action.
4. Corrective action taken — (verbal/written concurrence)

Original: Central Files (File No. _____)
cc: Project team, QA, Others as appropriate

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Fundamental to the success of this QAPjP is the active participation of management in the project. Management will be aware of project activities and will participate in development, review, and operation of the project. Management will be informed of quality assurance activities through the receipt, review, and/or approval of:

- Project specific quality assurance project plans
- Corporate and project-specific QA/QC plans and procedures
- Post audit reports and audit closures
- Corrective action overdue notices
- Nonconformance reports.

Section 12.0 describes the performance and systems audits process to be used during the project. In addition, periodic assessment of quality assurance/quality control activities and data accuracy, precision, and completeness will be conducted and reported by the laboratory.

APPENDIX A

STANDARD OPERATING PROCEDURE (SOP)

TITLE: MODIFIED 8015 FOR TPH BY GC; HIGH BOILING POINT
FUEL HYDROCARBONS

I-Scope and Application:

High Boiling Point Fuel Hydrocarbon (Modified 8015) method provides gas chromatographic conditions for the detection of petroleum hydrocarbons in fuel constituents. Hydrocarbon constituents include commercial jet fuel (C10-C16), diesel fuel (C9-C22), and motor oils in contaminated ground water, sludges, and soils.

II-Summary of Method:

The method (SOP) is purposely non-specific (in the fact that one specific hydrocarbon is not specified) to allow the operator the option of calibrating off a requested volatile fuel hydrocarbon of choice. If the method is requested and no hydrocarbon is specified then the sample is screened and the standard closest to the chromatographic pattern will be utilized as the calibration standard. The calibration standard shall be + or - 10% of the next highest and next lowest concentration of standards. Any fuel hydrocarbon in the range given in section I may be analyzed for with this method, ie: Commercial jet fuel, diesel fuel, motor oil etc... The method can be specific to a requested fuel hydrocarbon, yet the chromatographic conditions will detect for all of the mentioned hydrocarbons, if requested.

The sensitivity of this method usually depends on the level of interferences rather than on the instrument's limitations. Table I, below, lists the limits of quantification when no interferences are present. (Aged fuels may not show a normal pattern.)

The samples (both liquids and soils) are extracted in n-hexane (GC grade) and the direct injection method is used on a gas chromatograph equipped with a flame ionization detector.

| PARAMETER | MATRIX | QUANTIFICATION LIMIT (ppm) |
|--|--------|-------------------------------|
| Diesel | soil | 10.0 mg/Kg |
| Commercial Jet Fuel | liquid | 0.05 mg/L |
| High boiling pt. fuel hydrocarbons. | | |

Quantification Limit shall be defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.

III-Interferences:

Solvents, reagents, glassware, and other sample processing hardware must be demonstrated to be free from interferences under the conditions of analysis by analyzing method blanks.

Prior to analysis of samples, standards, or blanks the analyst must first demonstrate daily, through the analysis of solvent blanks, that the entire GC system is interference free.

A field sample blank prepared from organic-free reagent water and carried through sampling and subsequent storage and handling can serve as a check on contamination introduced to the sample.

IV-Apparatus and Materials:

Gas chromatograph: analytical system complete with a gas chromatograph suitable for on-column injections, all required accessories, including detectors, column supplies, recorder, intergrater, gases, syringes, autosampler, and data system utilized for measuring peak heights and/or peak areas.

Detector: Flame Ionization (FID)

GC column: 10 feet by 1/8 inch ID glass column packed with 10% sp-2100 on supelcoport 80/100 mesh.

Gas tight syringe: one cubic centimeter (cc) with chromatographic needles.

Vials with teflon caps: 8 dram, 40 ml capacity with screw cap.

Septum: Teflon-faced silicon.

Microsyringe: 2-5ul, 100ul, 200ul.

Carrier gas: nitrogen at 30ml/min.

Injector temperature: 180 C

Detector temperature: 330 C

Column temperature: 40 C hold for 3 minutes, 10 C/min run rate to 320 C or until at least 95% of all components are eluted.

V-Reagents:

Stock diesel, jet fuel, motor oil, etc...

Stock standards: stock solutions may be prepared from pure standard materials or purchased as certified solutions. Prepared stock standards in hexane using assayed liquids.

Calibration standards: a minimum of 5 concentration levels are prepared in hexane from the secondary dilution of the stock standards, in hexane. (Concentrations are made at 50, 500, 2500, 6000 and 12000 micrograms per milliliter.)

Fresh standards: are prepared quarterly or sooner if problems are indicated.

Documentation: standards are documented in QA logbooks to record preparation procedures, traceability, dates, and protocols.

VI-Procedure

Extraction: for liquid samples one liter of sample is shaken with 60 mls of methylene chloride for 10 minutes. The organic layer is drained into a K-D fitted with a 10 ml receiver. This is repeated two times, collecting all three extracts in the same K-D. Concentrate sample on steam bath. Exchange the solvent with hexane when volume is less than 5 ml. Concentrate the sample to less than 5 ml. Cool and q.s. the sample to 5 ml with hexane.

Extraction: for soil and sediment samples. 10.0 grams of sample is weighed out. Enough magnesium sulfate is added to yield a dry sandy soil. 10.0 mls of hexane is then added and mixed on a vortex mixer for a minimum of 60 seconds. The mixture is then allowed to stand for at least ten minutes until there is a clear separation. The hexane layer is used for the analysis.

Injection: 2-5uls of the hexane extract using the solvent flush technique is injected onto the column. Hexane blanks are run between each sample when using the auto sampler. A check standard is run every 20 samples.

Calculation: The total area of all peaks is compared to the standard whose total area is nearest that of the sample.

For soils:

$$\frac{\text{Total area of sample peaks}}{\text{Total area of standard peaks}} \times \frac{\text{Concentration of standard (mcg/ml)}}{\text{Sample wt (g)}} \times \frac{\text{Sample dilutions(mls)}}{\text{boiling fuel hydrocarbon}} = \text{mcg/gram of high boiling fuel hydrocarbon}$$

For liquids:

$$\frac{\text{Total area of sample peaks}}{\text{Total area of standard peaks}} \times \frac{\text{Standard concentration (mcg/ml)}}{\text{Sample dilutions(ml) / Sample size (L)}} = \text{mcg/L of high boiling fuel hydrocarbon}$$

If an appropriate sample for calibration does not exist, as in the case of an "aged" fuel, calibration is done using a "non-aged" representative (as based upon the pattern found in the chromatogram) fuel standard. Detection limit is based upon five times the noise level.

VII-Sample Collection, Preservation, and Holding Times.

| Matrix | Preservatives | Volume Req. Container | Holding Times |
|---------|---------------|------------------------|---------------|
| Soils | cool to 4 C | at least 1, 40ml B, G, | 14 days |
| Liquids | cool to 4 C | 1 liter, G | 14 days |

G=glass

B=brass

VIII-Quality Control

The IT-Cerritos Laboratory quality control for this method is as follows:

Preventative Maintenance: All maintenance operations are documented in a log book, instrument specific. Routine and non-routine maintenance is recorded in this log book. Frequency of maintenance performed is based on experience, manufacturer's recommendations and the regulatory methods. Replacement of the column packing, cleaning the detectors, changing the glass wool plug, cleaning the insert, replacing the septa, and checking the gas purity are all part of the documented routine maintenance required for this analysis.

QC Samples: are routinely added to the analysis to track trends and to notify the analyst of any out-of-control situations.

These QC samples take the form of reagent blanks, duplicates, check standards, surrogate standards, matrix spikes, matrix spike duplicates, blind replicates, external standards, and or reference standards.

Matrix spikes and matrix spike duplicates. (MS & MSD) analyses are performed to evaluate the accuracy and precision of the analysis. The spikes are added to the samples at the time of extraction. MS, MSD are analyzed at least 10% of the time and more frequently when requested. The spiking levels are as follows:

SOILS, 1 mL of the 6,000 ug/mL standard is spiked into a 10.0 gram aliquot of sample.

LIQUIDS, 250 uL of the 12,000 ug/mL standard is spiked into a 1.0 liter sample prior to the extraction process.

The percent recoveries generate accuracy data and the relative percent difference (RPD) generates precision data. The data from the accuracy and precision are statistically utilized to generate control charts. The control charts indicate the recovery and RPD criteria for this analysis. (see table II, below)

$$\text{Percent Recovery (\% Rec.)} = \frac{\text{MS(D)} - \text{SR} \times 100}{\text{SA}}$$

$$\text{Relative Percent Difference} = \frac{\text{MS} - \text{MSD}}{(\text{MS} + \text{MSD}) / 2} \times 100$$

MS = Concentration matrix spike
 MSD = Concentration matrix spike duplicate
 SR = Sample result
 SA = Spike added (concentration)

TABLE II

Spike = diesel

| | RPD | % RECOVERY |
|---------|--------------|------------|
| Liquids | less than 20 | 80-120 |
| Soils | less than 50 | 50-150 |

The criteria is based on all hydrocarbons analyzed.

IX-References

- 1- California State Water Resources Control Board.
final revision, December 1987
- 2- California Regional Water Quality Control Board.
San Francisco Bay Region, November, 1986.
- 3- IT-Cerritos Quality Control (Lab Specific) Manual.
January, 1986

LEAKING UNDERGROUND FUEL TANK FIELD MANUAL:
GUIDELINES FOR SITE ASSESSMENT, CLEANUP, AND
UNDERGROUND STORAGE TANK CLOSURE

DECEMBER 1987

STATE OF CALIFORNIA
LEAKING UNDERGROUND FUEL TANK TASK FORCE

ACKNOWLEDGMENTS

This field manual is the product of the Leaking Underground Fuel Tank (LUFT) Task Force. The LUFT Task Force is a multiagency working group designed to develop practical guidance that field personnel can use when dealing with leaking fuel tank situations. LUFT Task Force members contributing in development of this document are:

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- (f) Analyze the standard and adjust instrument sensitivity to give minimum response of at least two times the background. Record and sum up all peak areas of the gasoline standard.
 - (g) Analyze the spike sample in the same manner. Record all peak areas.
 - (h) Analyze the undosed sample in (g) above.
 - (i) Small sample size should be used if the concentration is found to be outside the concentration range of the instrument.
- g. Standard laboratory quality control practices should be used with this method.

Determination of Organolead -- DHS Method

1. Discussion

Organolead compounds constitute the largest single industrial application of organo-metallic chemistry. Estimates indicate that about 1,450 organolead compounds were known in 1968, and the number has increased with synthesis of about 130 new compounds each year. The widespread presence of toxic, volatile, lipophilic organolead compounds in the environment can lead to serious public health effects and damage to the aquatic biota. With the phasing out of leaded fuels, substantial amounts of lead compounds from petroleum sludges are being discharged into waste streams. There is also evidence to suggest that the more toxic organoleads such as tetramethyl-lead can be synthesized from lead salts and simple chemical reagents in aqueous solutions.

Caution: Some organolead compounds are volatile and toxic. Process the samples in a well-ventilated hood.

2. Scope

The method describes the determination of organolead compounds in various types of hazardous material samples. In this method, a rapid organic extraction technique is applied to separate the organo Pb from a matrix with xylene, followed by reaction with 1% Aliquat 336/MIBK on I₂ solution. The extract is then analyzed by a flame atomic absorption spectrophotometer. The detection limit for organolead is 0.05 ppm as lead.

3. Reagents

3.1 (MIBK) methyl-isobutyl ketone (4-methyl-2-pentanone).

3.2 Iodine solution: Weigh 3.0 g of I₂ and dissolve and dilute to 100 ml with benzene. Store in brown bottle.

3.3 Aliquat 336 (tri-capryl methyl ammonium chloride), available from McKesson Company, Minneapolis, Minnesota.

10% V/V Aliquat 336/MIBK

1% V/V Aliquat 336/MIBK

3.4 Xylene.

3.5 PbCl₂ -- Lead chloride

1. Stock PbCl₂ solution. Dissolve 0.3356 g PbCl₂ previously dried at 105°C for 3 hours in 10% Aliquat 336 in MIBK solution and dilute to 250 ml. Store in brown bottle. This solution contains 1,000 µg/ml of Pb.

2. Preparation of intermediate Pb standard: Pipet 10 ml of the stock solution (1,000 µg/ml Pb) and dilute to 100 ml with xylene/MIBK solution (40% xylene).

3.6 Sodium sulfate (Na₂SO₄), anhydrous, crystals.

4. Apparatus

4.1 Erlenmeyer flask with ground glass stopper, 250 ml.

4.2 Mechanical shaker.

4.3 Filter funnel and paper (Whatman No. 40 or equivalent).

4.4 Flame atomic adsorption spectrophotometer and recorder or integrator.

4.5 Lead hollow cathode or electrodeless discharge lamp.

5. Procedure

5.1 Sludges, sediments, and soils: Weigh out to the nearest 0.1 g about 50 g of homogenized sample into an Erlenmeyer flask. Add 100 ml xylene. Stopper the flask and shake it for 1/2 hour on a mechanical shaker. Filter the extract through filter paper and anhydrous sodium sulfate.

5.2 Add 20 ml of MIBK to a 50 ml volumetric flask.

5.3 Pipet 20.0 ml of the xylene extract (Step 5.1) into the flask and mix.

5.4 Pipet 0.1 ml of I₂ solution into the flask and mix for about one minute.

5.5 Pipet 5 ml of 1% Aliquat 336 in MIBK and mix.

5.6 Dilute to volume with MIBK and mix.

6. Standard and Blank Preparation

Prepare appropriate working standards and blank from 100 g/ml Pb standard.

6.1 Add approximately 20 ml of xylene to 50 ml volumetric flask. Pipet the correct amount of the 100 μg/ml Pb standard into the flask to prepare the right standard.

6.2 Add immediately 0.1 ml of I₂ solution and mix well.

6.3 Add 5 ml of 1% Aliquat 336/MIBK and mix well.

6.4 Dilute to volume with MIBK and mix well.

6.5 Blank xylene/MIBK (40% xylene) should be treated as the working standard solutions.

7. Analysis

7.1 Set up the AA according to the manufacturer's instructions. Use background correction to decrease broad band absorption interference.

7.2 Aspirate H₂O into the flame and adjust the acetylene flow to 8.5 l/min and the air flow to 25 l/min.

7.3 Aspirate MIBK containing 40% xylene into the flame.

7.4 Reduce the acetylene flow to about 4.8 l/min and make fine adjustments in the acetylene flow to produce an even flame with no yellow luminescence to obtain optimum conditions.

7.5 Aspirate into the flame blank, working standards, and sample to measure the absorbencies. Estimate the concentrations of organolead in sample.

8. Calculations

Solids:

$$\frac{100 \text{ ml}}{50 \text{ g}} \quad \frac{50 \text{ ml}}{20 \text{ ml}} \quad \frac{\mu\text{g/l}}{1000 \text{ ml/l}} \quad \times F = \mu\text{g/g organolead calculated as Pb.}$$

where F = dilution factor.

E. Quality Assurance (QA) and Quality Control (QC)

1. Definition

Quality Assurance: Systematic procedures that are used to provide assurance to a producer or user of information that defined standards of quality were met. QA covers field and laboratory performance, i.e., the quality control procedures that have been followed.

Quality Control: The activities that are used to implement the quality assurance plan. Quality includes adequacy of the methods employed, reliability of the results, and cost effectiveness.

2. Chain of Custody

A Chain of Custody Record is the disposition of a sample from collection to laboratory delivery. A Chain of Custody Record should be made out after samples are collected and signed by individuals collecting, relinquishing, and receiving samples. See Figure III-4 for an example of a U. S. EPA Chain of Custody form.

3. Laboratory Certification

All soil and water samples should be analyzed by a DHS-certified laboratory. Two certification programs exist in California and both are administered by DHS. Additional information can be obtained from the addresses listed:

. Hazardous Materials Laboratory Certification Program

California Department of Health Services
Hazardous Materials Laboratory
2151 Berkeley Way, Room 234
Berkeley, CA 94704
(415) 540-3003

. Drinking Water Laboratory Certification

California Department of Health Services
Sanitation and Radiation Laboratory
2151 Berkeley Way, Room 465
Berkeley, CA 94704
(415) 540-2201

APPENDIX B

