Road Transportable Analytical Laboratory (RTAL) System

Quarterly Report

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U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, West Virginia 26507-0880

MASTER

By
Engineering Computer Optecnomics, Inc.
1356 Cape St. Claire Center
Annapolis, Maryland 21401-5216

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CONTRACT OBJECTIVE

The goal of the Road Transportable Analytical Laboratory (RTAL) Project is the development and demonstration of a system to meet the unique needs of the DOE for rapid, accurate analysis of a wide variety of hazardous and radioactive contaminants in soil, groundwater, and surface waters. This laboratory system has been designed to provide the field and laboratory analytical equipment necessary to detect and quantify radionuclides, organics, heavy metals and other inorganics. The laboratory system consists of a set of individual laboratory modules deployable independently or as an interconnected group to meet each DOE site's specific needs.

After evaluating the needs of the DOE field activities and investigating alternative system designs, the modules included in the RTAL are:

- Radioanalytical Laboratory
- Organic Chemical Analysis Laboratory
- Inorganic Chemical Analysis Laboratory
- Aquatic Biomonitoring Laboratory
- Field Analytical Laboratory
- Robotics Base Station
- Decontamination/Sample Screening Module
- Operations Control Center
- Protected Living Quarters

Each module provides full protection for operators and equipment against radioactive particulates and conventional environmental contaminants. This is especially important in areas where radioactive particulates from environmental matrices, e.g. soils, are aerosolized by wind or volatile chemicals are present. These contaminants can adversely affect sensitive chemical and radiochemical analyses as well as potentially being harmful to personnel.

The goal of the integrated laboratory system is a sample throughput of 20 samples per day, providing a full range of analyses on each sample within 16 hours (after sample preparation) with high accuracy and high quality assurance. The RTAL will provide the DOE with very significant savings in terms of both cost and time. This will accelerate and improve the efficiency of clean-up and remediation operations throughout the DOE complex. At the same time, the system will provide full protection for operating personnel and sensitive analytical equipment against the environmental extremes and hazards encountered at DOE sites.

INTRODUCTION

U.S. Department of Energy (DOE) facilities around the country have, over the years, become contaminated with radionuclides and a range of organic and inorganic wastes. The major types of contamination found at the various sites have been summarized in the "Environmental Restoration and Management Five Year Plan" and, except for radionuclides (at most locations) and high explosives (at a few locations), are representative of the types of wastes found at many industrial facilities.

The DOE faces additional unique challenges in cleaning up this contamination. Many of the DOE sites encompass large land areas and were originally sited in relatively unpopulated regions of the country to minimize risk to surrounding populations. In addition, many times wastes were stored underground at the sites in 55-gallon drums, wood boxes or other containers until final disposal methods could be determined. Over the years, these containers have deteriorated, releasing contaminants into the surrounding environment. This contamination has spread, in some cases polluting extensive areas.

Remediation of these sites requires extensive sampling to determine the extent of the contamination, to monitor cleanup and remediation progress, and for post-closure monitoring of facilities. The U.S. Environmental Protection Agency (EPA) has found that shipping samples to a central laboratory for analysis is a slow and expensive process. The EPA is emphasizing the use of field instrumentation and transportable laboratories to provide critical analytical data (which form the basis for remediation decisions) faster and at lower cost. The use of field systems can cut several weeks to months off the turnaround time for analytical information.

The DOE's problems in getting samples analyzed is further compounded by the almost universal presence of radionuclides in the samples. The DOE's samples require wipe tests for surface contamination before shipment and after receipt, specialized transportation containers and procedures (depending on the level of radioactivity present in the sample), and a substantial amount of additional paperwork. It can be very difficult and time-consuming to ship samples off-site from DOE facilities because of requirements established to ensure against inadvertent release of radioactive materials. The occasional improper shipment of radioactive materials from DOE facilities has also led to periodic curtailment of all shipments to ensure that proper shipping procedures are followed. Such curtailments can cause havoc to projects where accurate sample analytical data is critical to decision-making and also because environmental samples degrade over time.

Thus, the DOE would benefit greatly if it had reliable road transportable, fully independent laboratory systems that could perform on-site the full range of analyses required. Such systems could accelerate clean-up and remediation efforts by providing critical analytical data more rapidly, and save money by eliminating handling, transportation and manpower costs associated with sample shipments.

The current effort addresses the unique requirements of the DOE for a Road Transportable Analytical Laboratory (RTAL) system capable of analyzing for a wide variety of hazardous and radioactive contaminants in soil, groundwater, and surface waters. This effort is based on the earlier laboratories and operations control centers developed by Engineering Computer Optecnomics (ECO), Inc. for the U.S. Environmental Protection Agency, and the U.S. Departments of Defense and State. These include counter-terrorist systems for use in areas contaminated with chemical or biological warfare agents. The advances achieved in the development of these earlier systems have been incorporated into the development of the RTAL.

The RTAL has been designed to provide for the efficient and effective operation of the field and laboratory analytical equipment necessary to detect and quantify radionuclides, organics, heavy metals and other inorganics. The integrated RTAL system will be able to provide a full range of accurate analyses on-site. At the same time, the RTAL system will provide full protection for the operating personnel and the sensitive analytical equipment against the environmental extremes and the hazards encountered at DOE sites.

APPROACH

The development of the Road Transportable Analytical Laboratory system is being conducted in two phases. Phase I, encompassing work at Maturity Level 4, Major Sub-systems, was for the development and optimization of the RTAL system design to most effectively meet the needs of the DOE. This phase incorporated development of detailed performance requirements (based on documented data and meetings with potential DOE users of the RTAL system), development and evaluation of alternative system configurations, and optimization of the final design. The work required under Phase I was completed on schedule and within budget.

Phase II of this project represents a transition to Maturity Level 5, Full-Scale Demonstration. A full-scale partial prototype of the RTAL system is being constructed. This partial prototype consists of the following three modules:

- Radioanalytical Laboratory
- Organic Chemical Analysis Laboratory
- Operations Control Center

The Operations Control Center will be capable of accepting data from robotic site contaminant mapping equipment. In addition, the DOE and the U.S. Army have agreed in principle to augment the demonstration of the prototype RTAL with the following two Superfund TERMM™ laboratory modules, also designed and constructed by ECO, to be loaned by the Army:

- Inorganic Chemical Analysis Laboratory
- Aquatic Biomonitoring Laboratory

This five-module prototype system will be tested at an appropriate DOE site to demonstrate the performance of the system and to quantify the cost and time savings it provides.

Upon completion of Phase IIb, ECO, Inc. will enter into commercial production of the Road Transportable Analytical Laboratory system, providing full warranties and guarantees for the product. The RTAL system will be integrated into ECO's existing line of TERMM™ and Superfund TERMM™ modular transportable analytical laboratory and operational control systems.

PROGRESS DURING QUARTER

This report documents the progress achieved on the development of the RTAL system during the fifth quarterly period of the Phase IIb development, from November 1, 1995 through January 31, 1996. The Phase IIb effort under this contract is divided into five tasks:

- Task 1 - NEPA Documentation
- Task 2 - Drawings
- Task 3 - Prototype System Construction
- Task 4 - On-Site Prototype Demonstration
- Task 5 - Final Report

Task 1 was completed earlier, resulting in the granting of a Categorical Exclusion. Task 2, Drawings, and Task 3, Prototype System Construction, were also completed during prior work quarters. During this quarter, work continued on Task 4. Task 5 has not yet been initiated in accordance with the project schedule. The progress achieved on Task 4 is discussed below.

The prototype RTAL was delivered to Fernald Environmental Management Project (FEMP). The 3 unit system, consisting of a Radioanalytical Laboratory, Organic Chemical Analysis Laboratory and Operations Control Center, was placed in operation near

FEMP's OU-1 waste pits. FEMP was unable to provide electrical or water hook-up's, as originally planned. This did not affect the demonstration as the RTAL is designed to operate independently. The units are therefore operating independently, using their onboard generators to provide electricity and onboard water supply and wastewater tanks for water supply and disposal. The prototype RTAL operated without any umbilicals during the entire period of the demonstration. Thus, this is an excellent demonstration of the system's ability to operate independently for extended periods.

ECO personnel received the required training for the demonstration during the week of November 13, 1995. This included RadWorker II, General Employee and other site-specific training. ECO's chemists and health physicist started full-time operations to finalize lab set-up on November 27. Hewlett-Packard and Canberra technicians started final set-up and check-out of their analytical systems on November 27. ECO provided a draft project-specific Chemical Hygiene Plan to FERMCO which was revised and issued by FEMP. ECO personnel received project-specific chemical hygiene training on December 18. This was the final training required for the demonstration of the prototype RTAL. FEMP Safety and Health personnel determined that fire alarm and sprinklers were not required in the RTAL modules.

ECO's chemists, health physicist and support personnel operated the labs throughout December, finalizing lab set-up and testing of the onboard analytical equipment. Problems with vendor-supplied equipment were corrected in preparation for the demonstration.

The three modules of the prototype RTAL began full operation on January 2 to demonstrate the sample analysis capabilities of the units. They were in operation continuously and independently during the entire month, including through the "Blizzard of '96." The cold temperatures and intense snow did not degrade the performance of the laboratories or their analytical equipment.

The following analytical procedures were evaluated during the demonstration of the prototype RTAL:

- Volatile organic analysis (VOA)
- Semi-volatile analysis
- Toxicity Characteristic Leachate Procedure (TCLP)
- Total uranium concentration
- Isotopic uranium concentration
- Automated liquid-liquid extraction
- Automated sample concentration

Soil and aqueous samples were included in the studies. Some samples were prepared surrogates, others were actual environmental samples collected at FEMP. Samples containing

mixtures of unknown contaminants were provided by FEMP personnel for the RTAL analysts to characterize qualitatively and quantitatively. Accurate records were maintained of all operations in the laboratories. Turnaround times were determined by the time from receipt of samples to delivery of complete analytical reports.

In all cases, the analyses performed in the RTAL were in excellent agreement with the FEMP analyses - all contaminants of concern were identified in the correct concentrations. Turnaround times ranged from 1 day for the VOA samples to 4 days for the TCLP Semi-volatile samples. Sample throughput of 7 samples per 8-hour shift (equating to 21 per day) was achieved. Excellent quality control was maintained throughout the evaluation tests. FEMP personnel were very impressed with the capabilities of the labs and the results obtained.

This phase of the RTAL demonstration was completed at the end of January, on schedule. The results are being analyzed in detail and will be included in a FEMP report and in the final report for the RTAL Project.

At this time, four of the FEMP operating units are planning to use the prototype RTAL modules in their remediation operations. FEMP's Office of Technology Demonstration is coordinating the future use of the modules among the site's critical clean-up projects and has assumed responsibility for their operation and maintenance.

The U.S. Army Biomedical R&D Laboratory (USABRDL) requested that the demonstration of their Aquatic Biomonitoring Laboratory at FEMP be postponed until April 1996 to allow them to meet other project commitments. USABRDL also requested that their Chemical Analysis Laboratory and Operations Control Center be brought to FEMP at the same time as their Aquatic Biomonitoring Laboratory. This will allow the Army to meet other program commitments and minimize the cost of demonstrating the analyses to be performed in these modules. To minimize site preparation requirements and costs, it was agreed by all parties (FERMCO, ECO and USABRDL) that all the USABRDL modules will be demonstrated during April.

The analyses to be conducted in the Army labs can be performed independently of those in the Radioanalytical and Organic Chemical Analysis Labs. Thus, the separation of these portions of the demonstration will have no effect on the demonstration of the radiochemical and chemical analytical capabilities of the prototype RTAL modules.

The Army modules will be located outside the FEMP process area to ensure that they do not encounter radioactive contaminants, as required by the agreement between METC and USABRDL. USABRDL's Chemical Analysis Lab will simulate the

RTAL's Inorganic Chemical Analysis Laboratory. It will be used for RCRA analysis of heavy metal contaminants (by Inductively Coupled Plasma Spectroscopy) in aqueous samples and TCLP extracts. USABRDL's Aquatic Biomonitoring Laboratory will be used to demonstrate Integrated Biological Assessment techniques for overall hazard quantification.

Personnel from the DOE's Mound facility visited the prototype RTAL at FEMP on November 9. They were very impressed with the capabilities of the modules, especially their ability for extended independent operation in the field performing high-quality radiochemical analyses.

PLANS FOR NEXT QUARTER

The Phase IIb effort for the development and demonstration of the prototype RTAL system is on budget, although the schedule has been revised to accommodate FEMP and USABRDL requirements.

The plans for the upcoming quarter, from February through April 1996, call for the completion of Task 4, On-site Prototype Demonstration, and initiation of Task 5, Final Report. Detailed analysis of data from the completed portion of the RTAL Demonstration has already started.

OVERALL STATUS ASSESSMENT

The Phase IIb effort for the development and demonstration of the prototype RTAL system is on budget. All contractual requirements to date have been met. Good progress continues being made in all areas and significant delays are unlikely. However, since the USABRDL modules will be demonstrated in April, a no-cost extension of the current contract was requested and has been approved by METC. The completion date of the contract is now September 1996.