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**Road Transportable Analytical (RTAL)
Laboratory System**

**Quarterly Report
February - April 1995**

May 1995

Work Performed Under Contract No.: DE-AC21-92MC29109

U.S. Department of Energy
Office of Environmental Management
Office of Technology Development
Washington, DC

For

U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Engineering Computer Optecnomics, Inc.
Annapolis, Maryland

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May 1995

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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 II, 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 II development, from February 1, 1995 through April 30, 1995. The Phase II 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, was also completed during prior work quarters. During this quarter, work continued on Tasks 3 and 4. Task 5 has not yet been initiated in accordance with the project schedule. The progress achieved on Tasks 3 and 4 is discussed below.

Construction of the Radioanalytical Laboratory is nearing completion. This laboratory will support sample preparation in a separate Sample Preparation Room containing three hoods. The

exhaust from the hoods will be HEPA filtered before release. This laboratory module will also have an Analytical Equipment Room with two Germanium Detectors, 24 Alpha Spectrometers, a Liquid Scintillation Counter, and a Gross Alpha/Beta Counter. ECO's Dr. Stanley Finger and Carlos DeAvila made a site visit to Canberra Instruments (Meriden, CT) on February 3 to discuss the details of the analytical instrumentation, their installation and delivery schedule with Canberra personnel.

Mechanical construction of the Radioanalytical Laboratory was completed during March. This includes installation of the electrical generator and motor, heat pumps, air blowers, etc. It also includes installation of extra structural support under the two 5,000 lb. Germanium Detectors that are included in this laboratory's analytical suite. Electrical system wiring was started and was completed in April. Break-in operation of the electrical generator was also started. The electrical wiring and generator testing are the last two steps before installation of the analytical instrumentation.

Construction of the Organic Chemical Analysis Laboratory is also nearing completion. This laboratory module is also divided into a Sample Preparation Room and an Analytical Equipment Room. The hoods in this module will have carbon filters in addition to the HEPA filters mounted in the exhaust lines. The analytical equipment for this module has been ordered, including Gas Chromatograph (GC)/Mass Spectrometer (MS), Purge and Trap GC/MS, GC with Flame Ionization Detector, automated Liquid/Liquid Extractor, automated Solid/Liquid Extractor, Size Exclusion Chromatograph, and Toxicity Characteristic Leachate Procedure (TCLP) Apparatus.

The construction of the Operations Control Center is also very near completion. The Radioanalytical Laboratory is being completed first because more time was needed to install its larger and more extensive array of analytical equipment.

Equipment for the wireless Local Area Network (LAN) was also ordered and has been received. The LAN will be installed concurrently with the analytical equipment. This wireless system will integrate the control and monitoring of the computer-automated analytical equipment among the laboratory modules and the Operations Control Center.

Although the site demonstration task was not scheduled to be initiated yet, considerable effort continues to be expended to ensure a successful demonstration. The Work Plan for the demonstration of the prototype RTAL system at the Fernald Environmental Management Project (FEMP) was revised and a final version was submitted. A Test Plan and accompanying analytical procedures are being prepared and will be submitted as they are completed. The analytical procedures will be based on FEMP or

other DOE site procedures. They are, however, being modified as needed for efficient operation within the prototype RTAL.

Continuing discussions have been held with Henry Gardner, Director of the U.S. Army Biomedical R&D Laboratory (USABRDL), to arrange for the use of their Chemical Analysis Laboratory and Aquatic Biomonitoring Laboratory during the demonstration of the prototype RTAL system. The USABRDL Chemical Analysis Laboratory will provide an Inductively Coupled Plasma (ICP) Spectrometer for analysis of metals in environmental samples. The Aquatic Biomonitoring Laboratory will be used to demonstrate Integrated Environmental Assessment techniques using aquatic organisms for on-site evaluation of acute toxicity, carcinogenicity, genetic toxicity, and neurotoxicity of groundwater, discharge waters, and other environmental media.

Details of the demonstration of the prototype RTAL, including the two modules to be loaned by the U.S. Army, continue to be worked out with Mr. R. Heath and other personnel at FEMP. Several projects have expressed an interest in hosting the demonstration and in continuing to utilize the RTAL after the demonstration is completed. Critical considerations include the generation of the range of sample types to evaluate the prototype RTAL's capabilities for performing radioanalytical, organic and inorganic analyses.

Documentation, e.g. site permits and plans, sample acquisition and utilities, required to support the demonstration have been identified. A significant amount of the site preparation effort must be performed by FEMP with input from ECO. A significant current hold-up in preparing for the demonstration is the delay in FEMP's receipt of funding from DOE to cover internal expenses.

PLANS FOR NEXT QUARTER

The plans for the upcoming quarter, from May through July 1995, call for the continuation of Task 3, Prototype System Construction, and Task 4, On-site Prototype Demonstration.

The external and internal structure of the Radioanalytical Laboratory is complete. Installation of the radioanalytical instrumentation including two Germanium Detectors (5,000 lb. each), 24 Alpha Spectrometers, a Liquid Scintillation Counter, and a Gross Alpha/Beta Counter, will take place during May and June. Upon completion and equipment testing, the Radioanalytical Laboratory will be delivered to the Fernald Environmental Management Project (FEMP) for the demonstration of the prototype RTAL system.

The external and internal structure of the Organic Chemical

Analysis Laboratory is also complete. Analytical instrumentation for this laboratory, including Gas Chromatograph (GC)/Mass Spectrometer (MS), Purge and Trap GC/MS, GC with Flame Ionization Detector, automated Liquid/Liquid Extractor, automated Solid/Liquid Extractor, Size Exclusion Chromatograph, and Toxicity Characteristic Leachate Procedure (TCLP) Apparatus, is being received during April and May and will be installed during May and June. This module will also be delivered to FEMP once installation and testing of the analytical instrumentation is complete.

The Operations Control Center is nearing completion also. All the necessary equipment for this module, including the computers, wireless Local Area Network (LAN), and communications equipment has been ordered and most of it has been received. This module will also be completed and its equipment tested during the upcoming months.

All three modules should be delivered to FEMP by August in time for initiation of the demonstration during September.

OVERALL STATUS ASSESSMENT

The development of the Road Transportable Analytical Laboratory system is proceeding in accordance with the planned schedule. All contractual requirements to date have been met. So far, analytical instrumentation is being delivered on schedule, however, we continue to work closely with the vendors to ensure that their equipment is received on time.

The delay in FEMP's receipt of funding from the DOE to cover internal expenses in connection with the demonstration is a significant concern. FEMP must initiate preparations for the demonstration, i.e. site documents, sample acquisition and utilities, during May to be ready as scheduled.

As long as FEMP is prepared to host the prototype RTAL demonstration, the Phase II effort should be completed in accordance with the project schedule.