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DOE/MC/29109-3356

Systems Analysts for Engineers, Economists and Environmental Scientists

ENGINEERING COMPUTER OPTECNOMICS, INC.

**ROAD TRANSPORTABLE ANALYTICAL
LABORATORY (RTAL) SYSTEM**

**QUARTERLY TECHNICAL REPORT
SEPTEMBER - NOVEMBER 1992**

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93 JAN 19 AM 8:54

WORK PERFORMED UNDER CONTRACT NO. DE-AC21-92MC29109

15 JANUARY 1993

SUBMITTED TO:

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CONTRACT OBJECTIVE

The goal of this contractual effort is the development and demonstration of a Road Transportable Analytical Laboratory system to meet the unique needs of the Department of Energy (DOE) for rapid, accurate analysis of a wide variety of hazardous and radioactive contaminants in soil, groundwater, and surface waters. This laboratory system will be designed to provide the field and laboratory analytical equipment necessary to detect and quantify radionuclides, organics, heavy metals and other inorganics, and high explosive materials. The planned laboratory system will consist of a set of individual laboratory modules deployable independently or as an interconnected group to meet each DOE site's specific needs. Modules that will be considered for inclusion in the system are:

- Radiochemistry Laboratory
- Chemical Analysis Laboratory
- Biomonitoring Laboratory
- Field Analytical Instrument Laboratory
- Robotic Sampler/Monitor Base Station
- Decontamination Trailer
- Operations Control Center
- Protected Living Quarters

Each module will provide full protection for operators against radioactive particulates and conventional environmental contaminants.

The use of a road transportable, fully independent, highly reliable laboratory system will save the DOE significant time and money by eliminating costly, paper-intensive, and time-consuming shipment of samples to central laboratories. The integrated laboratory system will be able to provide a full range of accurate analyses within 16 hours (after sample preparation). At the same time, the system will provide full protection for the operating personnel and the sensitive analytical equipment against the environmental extremes and hazards encountered at DOE sites.

BACKGROUND

The 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 manufacturing 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. This was done 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 degraded, 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 remediation progress, and for post-closure monitoring of facilities. The 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 likely presence of radionuclides in the samples. 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), and a substantial amount of additional paperwork. It can be very difficult to ship samples off-site from DOE facilities because of requirements established to ensure against inadvertent release of radioactive materials.

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

The current effort addresses the unique requirements of the DOE for a Road Transportable Analytical Laboratory system capable of screening for a wide variety of hazardous and radioactive contaminants in soil, groundwater, and surface waters. This laboratory is being designed to provide the field and laboratory analytical equipment necessary to detect and quantify radionuclides, organics, heavy metals and other inorganics, and high explosive materials.

The Road Transportable Analytical Laboratory (RTAL) will consist of a set of individual laboratory modules, listed above, deployable independently or as an interconnected group to meet each DOE site's specific needs. To meet the goals cited above, the RTAL

must provide the following features:

- Shock and vibration protected for road transport
- Easily prepared for transport
- Shielded against low levels of radioactivity
- Decontamination showers
- Controlled underpressurization
- Filtration of incoming and exiting air through HEPA filters
- Sample pass-thru from the outside into a glove box
- Personnel shower
- Integral electrical generator and motor
- Integral heating, ventilation and air conditioning (HVAC) system capable of handling wide range of outside temperatures and humidities
- Controlled air flow from "clean" to "dirty" areas
- Insulation in walls, floor and roof
- Integral fuel tanks
- Integral tanks for water and wastewater
- Rugged, redundant design for maximum availability
- Hardened equipment for maximum reliability
- Designed for long life
- Designed for minimum acquisition and maintenance costs
- Designed for ease of repair and maintenance
- Designed for ease of exterior decontamination
- Innocuous appearance to minimize public apprehension during transport and deployment

The use of a road transportable, fully independent, highly reliable laboratory system, the RTAL, will save the DOE significant time and money by eliminating costly, paperwork-intensive and time-consuming shipment of samples to central laboratories. 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 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 will be conducted in two phases. Phase I, encompassing work at Maturity Level 4, is for the evaluation of an optimized design of the RTAL system to most effectively meet the needs of the DOE. This phase will incorporate 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 designs, and optimization of the final design. The phase I results will include a quantitative analysis of the cost and time savings to be provided by the RTAL

system compared to current procedures for off-site sample analyses.

Phase II of this effort represents a transition to Maturity Level 5, Full-Scale Demonstration. A full-scale, fully operational prototype RTAL system will be constructed. This system will be tested at an appropriate DOE site to demonstrate the performance of the system and further 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 TERMMTM and Superfund TERMMTM modular transportable analytical laboratory and operational control systems.

PROGRESS DURING QUARTER

This report documents the progress achieved on the development of the Road Transportable Analytical Laboratory system from the inception of the contract on September 14, 1992 through November 30, 1992. The Phase I effort under this contract is divided into six tasks:

- Task 1 - Information Required for NEPA
- Task 2 - Performance Requirements
- Task 3 - Development of Conceptual Design
- Task 4 - NQA1 Compliance Analysis
- Task 5 - Final Design
- Task 6 - Phase 1 Topical Report

The schedule for the performance of these tasks is provided in Figure 1. In accordance with this schedule, work was performed on Tasks 1 and 2. The progress achieved for these two tasks is discussed below.

Task 1 - Information Required for NEPA

An environmental impact analysis for the Phase I effort was performed to provide information required for the National Environmental Policy Act (NEPA). This environmental impact analysis covered:

- Air Quality
- Water Resources
- Land Use
- Waste Management
- Ecological Impacts
- Socioeconomic Impacts

MONTHS AFTER CONTRACT AWARD

TASK

PHASE I

1. Information Required for NEPA
2. Performance Requirements
3. Development of Conceptual Design
4. NQA1 Compliance Analysis
5. Final Design
6. Phase I Topical Report

TASK

PHASE II

7. NEPA Documentation
8. Construction Drawings
9. Prototype System Construction
10. On-site Prototype Sys. Evaluation
11. Final Report

KEY	
◇	= Start
0	= Completion

Figure 1. Performance Schedule

- Archaeological, Cultural, and Historical Resources
- Noise
- Occupational Safety and Health
- Cumulative Impacts
- Summary of Environmental Impacts
- Permits

The Phase I effort is for the conduct of a series of studies culminating in the development of a final design for the multi-modular Road Transportable Analytical Laboratory system. This phase of the contract does not entail any on-site system performance or require the use of any equipment beyond normal office systems. The construction and demonstration of the prototype RTAL will be performed during Phase II of the contract; a separate NEPA information document will be provided at the initiation of Phase II, covering the environmental impacts of that portion of the contract.

A review of the work to be performed during the current phase of the development effort showed that the Phase I RTAL effort has no potential for adverse impact on the environment. It was also concluded that no federal, state, or local permits or licenses are required for the performance of the Phase I effort.

The NEPA information report was submitted to the Department of Energy for review. The DOE review concurred with the conclusion that the Phase I RTAL development effort has no potential for adverse impact on the environment.

Task 2 - Performance Requirements

The DOE's Office of Environmental Restoration and Waste Management is conducting a study of projected analytical needs across the DOE Complex. The study concentrates on the DOE's nine largest facilities in terms of analytical requirements and extrapolates these data to the entire Complex. The preliminary results of this study (as of September 1992) were obtained and reviewed. The final version of the study is expected to be published during the 2nd quarter of FY 1993.

The study projects that, across the DOE Complex, some 1.2 million sample analyses were performed on 60,000 samples during FY 1991. This demand is projected to grow to 3.3 million analyses on 130,000 samples in FY 1994. The study indicates a slow drop in demand in after FY 1994, but this may be an artifact due to the relative scarcity of remediation project definition in the out-years. Figure 2 shows the distribution of projected analytical demand among the nine major DOE sites that were the focus of the study.

Most of the samples that will be taken and analyzed are for operable unit characterization and for low level/mixed

Estimated Distribution of Sample Analyses Among 9 Major Sites FY 91 - FY 97 (Thousands)

Figure 2

waste disposal, as shown in Figure 3. The types of analyses that will have to be performed are:

- Volatile Organics by GC/MS
- Semi-Volatile Organics by GC/MS
- Pesticides/PCB's by GC
- Toxicity Characteristic Leach Procedure (TCLP)
- Metals by ICP-AES
- Metals by AA
- Anions
- Gross Alpha or Beta
- Gamma Spectroscopy
- Nuclide-Specific Analysis

Figure 4 shows the projected demand for these analytical procedures. These demand projections will be used as a guide in designing and equipping the Road Transportable Analytical Laboratory system.

The DOE study also investigated the radioactivity of the samples to be collected. The study defines four levels of sample radioactivity:

R1 - radiation low enough for bench-top analysis	<10 mR/h, <10 nCi/g alpha
R2 - sample handling must be performed in a hood	10-200 mR/h, <10 nCi/g alpha
R3 - sample handling must be performed in a hot cell	>200 mR/h
R4 - sample handling must be performed in a glove box	<200 mR/h, >10 nCi/g alpha

The vast majority (84%) of the samples projected to be collected are expected to fall into the R1 category, suitable for bench-top handling. Samples falling into the R2 category (handling in a hood) represent 14% of the total. Samples in the R3 and R4 categories (handling in a glove box or hot cell) represent a combined total of only 2% of the samples to be collected. These results clearly indicate that the RTAL system design should emphasize handling of samples on benches and in hoods, with an occasional sample requiring handling in a glove box or hot cell.

Visits were made to two DOE facilities cited in the environmental analytical requirements projection study, discussed above, as being among the largest generators of samples for environmental analyses - the Idaho National Engineering Laboratory (INEL) and the Los Alamos National Laboratory (LANL). The visit to the INEL, in particular proved to be very worthwhile. A presentation on the Road Transportable Analytical Laboratory project was made to personnel from DOE-ID and EG&G Idaho. This presentation generated much interest in the use of the prototype RTAL to be developed during Phase II of this contract to support

**Estimated Distribution of Sample
Analyses at 9 Sites Among Major
Activities FY 91 - FY 97 (Thousands)**

Figure 3

Estimated Sample Analysis Distribution at 9 Major Sites FY 91 - FY 97 (Thousands)

Figure 4

planned remediation and waste management efforts at the facility. In particular, the remediation effort planned for Pit 9 was strongly recommended as an excellent site for conducting the demonstration of the prototype RTAL.

EG&G Idaho personnel provided an "Analytical Laboratory Study Report for Pit 9 Remediation Activities," prepared by Dames & Moore for EG&G Idaho in July 1992. This report projects analytical requirements for the remediation of this waste pit. Analyses required include:

- Volatile Organics
- Semi-Volatile Organics
- Polychlorinated Biphenyls (PCB's)
- Metals (including mercury)
- TCLP
- Gross Alpha/Beta
- Gross Gamma
- Pu^{239,240}
- Am²⁴¹
- U^{234,235,238}
- Th²³⁴
- Co⁶⁰
- Cs¹³⁷/Ba¹³⁷
- Sr^{89,90}/Y⁹⁰

The report concludes that a transportable analytical laboratory able to process 20 samples per day would be accelerate the Pit 9 remediation. The Pit 9 remediation effort is scheduled to start during FY 1995, coordinating closely with the planned schedule for development of the RTAL prototype. Remediation efforts at Pit 9 are scheduled to last for three years.

In addition to Pit 9, the INEL also has remediation efforts underway or planned for other sites at the facility. For example, the INEL Test Area North (TAN) has groundwater contamination problems that would also benefit from the availability of the prototype RTAL. Thus, the INEL appears to be an excellent location for the planned demonstration of the prototype RTAL, based on their need and desire for such a system. EG&G Idaho personnel plan to provide additional information to further define their requirements for a Road Transportable Analytical Laboratory system.

One goal in visiting the Los Alamos National Laboratory was to get a current review on the Contamination Analysis Automation (CAA) system whose development is being coordinated by the LANL. The goal of this robotic system is to fully automate several frequently used standard EPA analytical methods. Current efforts are aimed at automating EPA Method 3540, Soxhlet soil extraction, and EPA Method 3550, Sonication soil extraction. Both methods are organic analyte sample preparation methods. These automated systems are still

under development. The prototype RTAL will be designed, as much as possible, to accommodate the incorporation of these automated methods when their development is completed.

Several DOE design guidance documents were ordered and are being reviewed to determine specific requirements and recommendations pertaining to the design, construction, and operation of the RTAL. Documents ordered and under review include:

- DOE Order 6430.1A - General Design Criteria
- DOE Order 5480.11 - Radiation Protection for Occupational Workers
- DOE Order 5480.4 - Environmental Protection, Safety, and Health Protection Standards
- DOE Order 5480.1B - Environmental, Safety, and Health Program for DOE Operations

Relevant requirements from these documents will be incorporated into the development of the RTAL.

This task on the development of RTAL performance requirements is continuing in accordance with the schedule provided in Figure 1, presented earlier.

PLANS FOR NEXT QUARTER

The plans for the upcoming quarter, from December 1992 through February 1993, call for the completion of Task 2 (Performance Requirements) and the initiation of Task 3 (Development of Conceptual Designs), as shown in Figure 1. The Task 2 results will include a comprehensive set of system, sub-system and component requirements, supportable on the basis of specific documents or other information sources, which the alternative conceptual designs to be developed in Task 3 will attempt to achieve. It must be recognized that a number of the requirements will conflict, leading to inevitable trade-off's in system design. A series of alternative designs for each RTAL module will be developed to fully assess the impacts of these trade-off's.

OVERALL STATUS ASSESSMENT

The development of the Road Transportable Analytical Laboratory system is on schedule, as shown in Figure 1. All contractual requirements to date have been met. The excellent information collected thus far provides a strong foundation for the continued development of the Road Transportable Analytical Laboratory system, which is expected to continue on or ahead of schedule.

END

**DATE
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10/12/93