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Research and Development for DOE Environmental Restoration and Waste Management

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ABSTRACT

The U.S. Department of Energy (DOE) recently consolidated its environmental restoration and waste management activities. Within that new organization, DOE has committed to support Research, Development, Demonstration, Testing and Evaluation (RDDT&E) activities with the following objectives: rapidly advance beyond currently available technologies; provide solutions to key technical issues that will improve effectiveness, efficiency, and safety; and enhance DOE's ability to meet its 30-year compliance and cleanup goals.

DOE has already supported a number of R&D activities in this area and plans to continue that support in the future. DOE's Office of Technology Development is interested in eliciting broad participation from qualified organizations who can contribute to RDDT&E activities. This presentation addresses the on-going and future R&D, with an emphasis on the private sector activities.

To focus private sector capabilities on the high-priority needs of DOE, a series of competitive solicitations was started in FY 1990. On May 1, 1990, on behalf of DOE's Office of Technology Development, Argonne National Laboratory issued a Request for Proposals that solicited proposals for research and development in the areas of (1) groundwater remediation, (2) soil remediation, (3) characterization of contamination and geological and hydrological features, and (4) containment of contaminated sites. In response to this solicitation, Argonne National Laboratory received 147 proposals. Fifteen of the proposals totaling $5.7 million were funded in FY 1990. The scope of work and evaluation criteria used in the procurement and the workscope of the resultant contracts are reviewed in this paper. Significant accomplishments resulting from the funded R&D as of this conference will be summarized.

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The FY 1991 plans for competitive private sector research and development activities will also be presented at the conference. Funding levels, technical workscope, evaluation criteria, and schedule for the FY 1991 Request for Proposals will be detailed.

BACKGROUND AND OBJECTIVES

The Department of Energy (DOE) has recently consolidated its Environmental Restoration and Waste Management activities. Within that new organization, DOE's Office of Technology Development (OTD) is overseeing Research, Development, Demonstration, Testing, and Evaluation (RDDT&E) activities within the to reduce cost, reduce risk, and otherwise improve the technologies to meet cleanup goals. The DOE's Office of Environmental Restoration and Waste Management is seeking to establish and maintain an aggressive national program for applied RDDT&E to resolve major technical issues and rapidly advance beyond currently employed technologies for environmental restoration and waste management operations.

Currently available technology is not adequate to assess environmental contamination, take permanent remedial action, and eliminate or minimize the environmental impact of future operations. Technical resources to address these shortcomings exist within the DOE system and the private sector, but the involvement of the private sector in attaining permanent and cost-effective solutions has been limited. In April 1990, a Request for Proposals (RFP) was announced with the objective of acquiring private-sector contractors that will perform the needed R&D to help DOE meet its cleanup goals. This acquisition was the first step in recruiting the capabilities of the private sector for meeting the critical needs of this national-priority program.

In addition, this acquisition effort has helped to create an awareness of the Department's needs, provide detailed technical information to the private sector, and form a basis for broader private sector involvement in future work.

The contracts awarded are for R&D only; that is, they address the development of technologies up to, but not including, pilot plant/field demonstration. Demonstration, Testing and Evaluation (DT&E) activities are addressed in a separate effort. The two efforts are fully coordinated in both initial acquisition and subsequent technology development to ensure an effective and efficient transition of technologies from R&D to DT&E to full implementation.

PROCUREMENT HISTORY

The Office of Environmental Restoration and Waste Management was formed by Secretary Watkins in early 1989. By late 1989, it was clear that the private sector had both the capabilities to aid DOE in attaining its cleanup goals and interest in participation. To improve communications with the private sector, DOE hosted a Symposium on Industry and University Contract Opportunities in Applied Research, Development, Demonstration, Testing and Evaluation in San Francisco, December 12-13, 1989. At that meeting, DOE officials stated their commitment to increasing the involvement of the private sector in technology development activities. The applied R&D contracting activity, shown in Fig. 1, began with an announcement in the Commerce Business Daily on April 13, 1990, and a parallel mailing of the announcement

to the San Francisco meeting participants. On May 1, package was mailed to 338 potential offerors. A preproposal conference, held at O'Hare International Airport near Chicago, was attended by 160 potential offerors. All questions and answers from this conference were sent to potential offerors as an amendment to the RFP.

SCOPE OF WORK

The RFP contained detailed instructions for submission of proposals addressing one of four general areas:

- soil remediation
- groundwater remediation
- characterization and sensing of buried objects, contamination, and/or geological/hydrological features, and
- containment of contaminated sites.

Remediation of Soils

Scope of Problem. Soils, sludges, sediments, soils mixed with buried waste and mill tailings at DOE sites are contaminated with radionuclides, toxic metals, and hazardous organic compounds. Contamination has resulted from a variety of operations, including the use of soil columns, ponds, liquid waste storage tanks, and subsurface disposal of waste. The potential for migration of radionuclides and heavy metals from contaminated soils necessitates technologies to treat the contaminated volume in a manner that effectively protects public health, public safety, and the environment. In some instances, contamination is contained largely in the surface soils (e.g., Pu contamination at the Nevada Test Site, and Tc-99 contamination caused by aerial deposition at diffusion plants). In other cases, there is subsurface contamination by hazardous organics, nitrates, metals, inorganic salts, and radionuclides resulting from disposal of wastes in lagoons, shallow-land burial, or leaks from cribs, tanks, and pipes. Soil treatment strategies can be classified as in-situ treatment and retrieval and treatment.

Successful Technology. Novel chemical, physical, thermal, biological, electrical and/or mechanical technologies for remediating DOE waste that can be developed for field demonstration at a DOE site within 18 months and implemented at selected DOE sites within 3 years are desired.

Successful technologies must be able to be implemented at an affordable cost and must satisfy one or more of the following requirements:

- isolation and containment of radioactive constituents or heavy metals,
- long-term immobilization without migration of radioactive constituents or heavy metals,
- removal of radioactive constituents or heavy metals for treatment, degradation of organics or organometallics to innocuous products such as carbon dioxide and water,

- elimination or reduction to acceptable limits of chemical toxicity, or
- removal of chemical constituents for treatment.

Groundwater Remediation

Scope of Problem. Radionuclide, heavy metal, and/or inorganic ion contamination occurs in groundwater at many DOE sites. This contamination has resulted from a variety of operations, including the use of liquid waste storage tanks and disposal of liquid wastes to cribs (engineered leach fields), trenches, and ponds. Many contaminants are dispersed in the soil column (unsaturated zone) and the groundwater. Because of the migration potential of these contaminants, technologies are needed to treat the contaminated groundwater in a manner that effectively protects the environment and human populations. Both extraction and in-situ technologies for treating these contaminants can be considered.

In addition, contamination of groundwater with organics is a problem at many DOE sites. The two most common contaminants are trichloroethylene (TCE) and carbon tetrachloride. Other organics used at DOE sites that may contaminate the groundwater include nonvolatile organics that are soluble (extractants and complexing agents) and insoluble (PCBs and pesticides). Organic contaminants in the subsurface can exist in soluble form (dissolved in the groundwater) or as an insoluble separate phase (free-phase organics) floating on the water table, sinking to the base of the water table, or sinking to the base of the aquifer.

Successful Technology. Novel chemical, physical, thermal, biological, electrical and/or mechanical technologies for remediating groundwater at DOE sites that can be developed for field demonstration at a DOE site within 18 months and implemented at selected DOE sites within 3 years are desired.

Successful technologies able to be implemented at an affordable cost and must satisfy one or more of the following requirements:

- removal or destruction of organics in the presence of other wastes,
- isolation of heavy metal, radioactive and/or inorganic constituents,
- removal of heavy metal, radioactive and/or inorganic constituents,
- reduction of concentrations to acceptable limits, or
- elimination of impacts to surrounding environment.

Characterization and Sensing of Buried Objects, Contamination, and/or Geological/Hydrological Features

Scope of Problem. Most DOE sites have some form of subsurface contamination; these range from buried concentrated waste forms such as tanks or trenches to dispersed contaminants in soil or water. Many are involved in, or are soon to begin, the Remedial Investigation/Feasibility Study (RI/FS) process.

Specific needs are locating, characterizing, and three-dimensional mapping of buried tanks and other concentrated waste forms; locating contamination in groundwater and vadose zones; tracking the migration of contaminants; and characterizing soils. Worker safety is of particular concern with buried wastes. Current subsurface sensing and characterization methods for dispersed contaminants primarily involve a time-consuming, expensive process for drilling wells, taking samples, sending them to laboratories, and waiting for results. Drilling is very expensive and leads to possibilities for additional spread of contamination. Sampling often disturbs the environment to such an extent that results may be invalid. Particularly during remediation activities, lack of real-time analysis leads to costly delays in operations involving people and equipment. Groundwater monitoring may continue for many years. Accurate determination of the spatial distribution, movement, and concentrations of contaminants is essential to the assessment of remediation needs and for the design of remediation measures. In remedial action programs, soils need to be characterized in real time to determine requirements for disposition.

Efficient and effective characterization, accurate assessment, and adequate remediation of dispersed waste in the subsurface require integration of three-dimensional geologic data with knowledge of:

- the physical, chemical, and biological processes controlling the transport and distribution of contaminants,
- chemical forces binding contaminants to soil particles, and
- biological mechanisms that transform toxic substances into nontoxic compounds or vice versa.

Successful Technology. Novel chemical, physical, thermal, biological, electrical and/or mechanical technologies are desired for characterization and sensing of buried objects, contamination, and/or geological/hydrological features. Successful technologies will be developed for field demonstration at a DOE site within 18 months and implemented at selected DOE sites within 3 years.

A successful technology must yield rapid, reliable measurements. Since many near-term instruments are specific to certain contaminants or are applicable to certain geological conditions, several may need to be combined for complete characterization of a given site. Successful technologies must be able to be implemented at an affordable cost and must satisfy one or more of the following requirements:

- improve information content and level of confidence of site characterizations,
- reduce environmental or personnel risk of characterization activities, or
- substantially reduce the time or cost required for site characterization.

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Containment of Contamination at Sites

Scope of Problem. Contamination by hazardous and radioactive materials in soils, sludges, and groundwaters exists at many DOE sites. Where concentrated sources of contamination exist but immediate restoration cannot be initiated, it is desirable to temporarily contain the source of contamination and prevent dilution or migration of contaminants, thereby avoiding further environmental damage and escalation of the restoration costs. Sources of such contamination include ponds, liquid waste storage tanks, and subsurface disposal of waste.

Successful Technology. Novel chemical, physical, thermal, biological, electrical and/or mechanical technologies for containment of DOE waste that can be developed for field demonstration at a DOE site within 18 months and implemented at selected DOE sites within 3 years are desired.

A successful technology must yield an improved technology for containment of contaminants. Successful technologies must be applicable at an affordable cost and must satisfy one or more of the following requirements:

- short-term isolation or containment of radioactive, inorganic, and organic constituents,
- immobilization of contaminants, or
- changes in subsurface migration patterns away from environmentally sensitive areas (e.g., drinking water aquifer) or toward remediation site.

EVALUATION CRITERIA

Evaluations of RFPs in the above four areas were conducted according to DOE-approved procurement rules using the evaluation criteria set forth below. The two major evaluation areas, technical and business/management and cost/price, are presented below. The technical and business/management proposal criteria were weighted four times more important than cost/price considerations.

Technical and Business Management Evaluation Criteria

Criteria and Weighting

The following are the technical and business/management evaluation criteria that were used. These four criteria were weighted of equal importance.

Criterion 1. Technical Approach

Background on State of Technology Development - The current state of technology development must be reviewed. Prior related R&D work by the offeror and by others should be reviewed. Where appropriate, literature and meeting presentations should be cited. The review should

be sufficiently detailed that the technical evaluators can understand both the current state of development in the area and the deficiencies in the development which the proposed R&D project will address.

Technical Approach - In the technical approach subsection, the project should be divided into discrete tasks. Sufficient detail should be presented to indicate that the proposed work can be accomplished, and that preliminary plans will result in efficient execution of the proposed work. Necessary experimental design, quality assurance (QA), statistical evaluation, and other tools should be employed to assure adequate data quality for evaluation.

Milestones.
A set of up to six major technical milestones should be identified with a title and a completion date. The start and completion dates for each milestone can be expressed in either calendar months or months after contract award. For each milestone, the proposer should add an explanatory paragraph.

The final milestone should yield an R&D product which DOE can evaluate for either direct application to DOE's Environmental Restoration and Waste Management needs or movement into the DT&E phase. In the latter case, a proposal for funding will be required.

Quality Assurance - All scientific and engineering proposals must specifically address the QA measures which will be implemented to ensure quality data from the project. General organization QA plans, standard operating procedures, etc., may be referenced or appended where appropriate but are not sufficient. Project-specific QA, including data quality objectives, data review, and other appropriate measures must be addressed.

Criterion 2. Organization and Qualifications

Qualifications of Key Personnel - For the principal investigator and other key personnel, a paragraph describing their role in the project and their technical background should be provided. Resumes should be appended to the proposal and are not part of the page count.

Recent Relevant Technical Experience - The organization should present brief descriptions of recent contracts which illustrate technical and management background. Include in the descriptions the source and amount of funding, technical project officer with the funding organization (name, address, and phone number), start and end dates, technical objectives, and major technical accomplishments.

Facilities and Equipment - The offeror should present information indicating that the necessary facilities and equipment are available to accomplish the technical scope. Required special equipment or facilities (hot cells, major analytical instruments, etc.) should be described and their availability to the program must be stated. Lengthy descriptions of routine facilities and equipment are neither needed nor sought.

Organizational Qualifications - The organization must demonstrate that it has the qualifications, besides key personnel and facilities (which are covered in other criteria), to perform the proposed work. In this section, the organization must demonstrate that they have the financial and management resources necessary to conduct the work.

Criterion 3. Relationship of Proposal to DOE Objectives.

Problem/Need - Identify the specific need described in the RDDT&E Plan[1]. Provide additional detail as required to describe any particular urgency, for instance, if this is needed to meet a regulatory commitment. If no need is described in the RDDT&E Plan and you believe one exists, provide a detailed explanation.

Technology/Application - Describe the proposed technology, instrument, process, investigation, etc., and compare to the existing methods of solving the identified problem or addressing the need. Discuss level of related work by others.

Application. Describe the proposed technology, instrument, process, investigation, etc., and compare to the existing methods of solving the identified problem or addressing the need. Discuss level of related work by others.

Criterion 4. Anticipated Benefits to DOE.

Reduction of Health and Environmental Risks - Identify near-term safety benefits or long-term permanent reduction of risk to public, workers, or the environment, compared to current technology.

Reduction of Costs - Discuss cost effectiveness of the proposed activity, i.e., cost savings for R&D dollars to be spent. If known, include total cost of RDDT&E research and reduction of total life-cycle costs. If not known, provide estimates and indicate roughly the level of certainty of the estimate.

Improved Operations - Discuss the degree to which the project can improve reliability of operations, minimize the risk of regulatory restrictions, or aid in attainment of cleanup goals within the schedule set.

Price/Benefit Ratio

Based on the evaluation of the technical proposal, is the proposed cost reasonable and affordable? Assess the reasonable probability of the project yielding a product which will be of benefit to DOE and the magnitude of that benefit.

PROPOSAL EVALUATIONS

On June 21, 147 proposals were received from 108 organizations. These 147 proposals were evaluated by 42 technical reviewers drawn from government, the national laboratories and academia. Reviewers were screened for potential conflict of interest and signed both conflict of interest and confidentiality forms. Technical Evaluation Teams of 3 or 4 reviewers evaluated groups of 9-17 technically related proposals in Breckenridge, Colorado, July 8-13. The results of these evaluations were presented to OTD for programmatic concurrance and to Argonne for selection and the Source Evaluation Board (SEB) on July 18 and July 19-20, respectively. The SEB approved the recommendations of the technical evaluators and authorized contract negotiations with 15 offerors for a total of $6 million in R&D funding. Negotiations and preparation of contracts were completed over the next two months, and all contracts were in place by the end of September. Start dates were October 1, 1990, or earlier in some cases.

PROCUREMENT RESULTS

Fifteen fixed-price contracts are in place with 13 private firms, one university in the United States, and one government laboratory in Canada. These contracts are listed in Table 1.

Table 2 presents a key-word summary of the technical areas addressed, organized by the four main technical areas in the RFP. The technical diversity of the contracts illustrates the breadth of the capabilities of the private sector and the breadth of DOE's needs for better technology.

LESSONS LEARNED

The primary objective of placing approximately $6 million in contracts with the private sector in activities which will benefit DOE's R&D needs was accomplished by the deadline of September 30, 1990. Completing a procurement of this magnitude and complexity in 6 months was a challenge for all concerned. Nevertheless, no major problems were encountered.

The scope of work was very broad, in essence spanning all related areas for environmental restoration. In addition, the definition of DOE's technology development needs was not as precise as many potential offerors would have liked. Therefore, many of the proposals were not as well focused on R&D directed at specific DOE problems as we would have liked. Future activities should focus the scope of work on key problem areas where the highest priority for

R&D is needed. This would discourage the submission of proposals in areas where the technology is either already available or technology development activities are already ongoing. Defining DOE's technology development needs as well as communicating them to potential offerors is an ongoing process. Although all available information was supplied to offerors either in the RFP package or by reference, most offerors desired more information. More specific information on R&D needs will be developed for future RFPs.

FUTURE ACTIVITIES

Although selection and placement of $6 million in R&D contracts represents a major milestone, it is just the beginning. The true measure of success is either the movement of the technology toward the DT&E phase of technology development or direct application to DOE environmental restoration problems at the completion of these projects.

Argonne National Laboratory will provide both technical and management oversight to assist the contractors in meeting their milestones and working toward the goal of application of each technology to DOE's needs.

One of the key elements in maintaining both a high level of interest by the private sector and credibility within the Office of Technology Development will be the rapid transition from successful R&D to the Demonstration, Testing, and Evaluation Phase. Accordingly we are developing plans to assure smooth, rapid transition for those selected contractors.

The contracts discussed here are fully funded on fixed-price contracts. Further DOE funding will be needed to support those projects which successfully compete for funds in the DT&E phase.

It is anticipated that contracting with the private sector for applied R&D will be an annual activity, the extent of which will depend on funding levels. To meet DOE's evolving Environmental Restoration and Waste Management needs, different scopes of work, and contracting mechanisms may be used.

ACKNOWLEDGMENT

Thanks to all of the organizations and people involved in the preparation and submission of the 147 proposals received. We are well aware that the preparation of these proposals requires considerable thought and effort and that many late-night hours were spent in meeting the submission deadline.

Staff at Argonne worked diligently to meet the procurement schedule. Charlotte Basinski, Min Pedersen, Margaret Ravasz and Cynthia Wesolowski of the Research and Development Program Coordination Office helped shepherd the process along. Shirley Cross, Norman Goetz, Bernell Bohlmann, Robert Gustavson, Tahra Harris, Richard Martello, in Argonne's Procurement Division, did an effective and timely job.

Clyde Frank, Director of the Office of Technology Development, provided key inspiration during the formulation of the scope of work. DOE-Chicago operations, in particular, Thomas Baillieul, Tony Bindokas, Joel Haugen, and Steven Webster, provided guidance and support during the process.

A special acknowledgment is due to the 42 technical reviewers drawn from 35 national laboratories, 4 federal agencies and 3 universities to cover the broad range of technologies represented in the proposals.

Table 1. Private Sector Contractors - FY 1990 Activities

Atomic Energy of Canada Ltd.; Chalk River, ON
Removal and Waste Volume Reduction to Remediate Groundwater Containing Certain Radionuclides, Toxic Metals and Organics

Applied Research Associates, Inc.; Alburquerque, NM
Minimally Invasive Three-Dimensional Site Characterization

Bladon International, Inc.,; Des Plaines, IL
Subcontractors: Institute of Gas Technology,
TIMCO
Design, Manufacture and Evaluation of a Hydraulically Installed, Multi-Sampling Lysimeter

Duratek Corp.; Columbia, MD
Subcontractors: Vitreous State Laboratory of Catholic University of America,
Westinghouse Electric Corporation
Development of a Combined Soil Wash/In-Furnace Vitrification System for Soil Remediation

EIC Laboratories, Inc.; Norwood, MA
Fiber Optic Raman Spectrograph for *in Situ* Environmental Monitoring

Electro-Petroleum, Inc. (EPI); Wayne, PA
Subcontractor: Lehigh University
Electrokinetic Treatment of Containment Soils, Sludges, and Lagoons

ENVIROGEN; Lawrenceville, NJ
Biodegradation of Chlorinated Hydrocarbons in a Vapor Phase Reactor

IIT Research Institute; Newington, VA
Composting of Soils/Sediments and Sludges Containing Toxic Organics Including High Energy Explosives

Membrane Technology and Research Inc.; Menlo Park, CA
Combined Air Stripping/Membrane Vapor Separation Systems

Nuclear Diagnostics Systems (Dixcom Technology Group, Inc.); Brunswick, TN
Bulk Soil Assay System

Table 1. Private Sector Contractors - FY1990 Activities (cont'd)

Rizzo & Associates; Monroeville, PA
High Resolution Shear Wave Seismic Reflection Surveying for Hydrogeological Investigations

Science Application International Corp. (SAIC); Oak Ridge, TN
Subcontractor: Bio-Recovery Systems, Inc.
Remediation of Groundwater Containing Radionuclides, Heavy Metals, Inorganic Ions and/or Organics Using the AlgaSORB Biosorbent System

Science Engineering Associates, Inc.; Alburquerque, NM
Development of the SEAMIST Concept for Site Characterization and Monitoring

Sizemore Technical Services, Inc.; Round Rock, TX
Chromate Reduction and Heavy Metal Fixation in Soil

University of Michigan; Ann Arbor, MI
Assessment of Subsurface VOCs Using a Chemical Microsensor Array

Table 2. Technical Areas Addressed by Contracts

Groundwater Cleanup

Chemical Binding/Filtration/Cold Vaporization - Atomic Energy of Canada Ltd.

Vapor-Phase Biodegradation of TCE, etc. - ENVIROGEN

Membrane Vapor Removal of VOCs - Membrane Technology and Research, Inc.

AlgaSORB Heavy Metal Adsorption/Removal - Science Application International Corp.

Soil Cleanup

Soil Washing/Vitrification - Duratek Corp.

Electrokinetic Movement of Contaminants - Electro-Petroleum Inc./Lehigh

Composting to Destroy Explosives - IIT Research Institute

Site Characterization

Penetrometer/SEMT/Seismic System - Applied Research Associates, Inc.

Lysimeter - Bladon International, Inc.

Membrane Instrumentation and Sampling - Science Engineering Associates, Inc.

Fiber Optic Raman Spectrograph - EIC Laboratories, Inc.

SAW Microsensor Arrays for VOCs - University of Michigan

Portable Gamma Ray Imaging - Nuclear Diagnostics Systems

High Resolution Seismic Reflection - Rizzo and Associates

Containment

Chromate Reduction and Immobilization - Sizemore Technical Services, Inc.