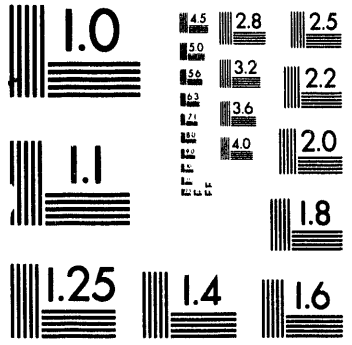
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U. S. Department of Energy

Environmental Cleanup Technology Development Program

Business and Research Opportunities Guide

Environmental Restoration
and Waste Management

1993

Preface

The end of the Cold War and growing concern about industrial competitiveness have created fundamentally new challenges and opportunities for the nation and the U. S. Department of Energy. The economic imperative requires the Department to reorient programs and redirect resources toward partnerships that contribute to industrial competitiveness while maintaining a strong science and technology base. In order to sharply focus on industrial competitiveness and job creation, the Department will enhance the framework for the technology partnerships efforts by increasing the achievement of dual-use benefits from mission-oriented work. Dual-use means accomplishing goals that serve both the private missions of the Department and commercialization interests of the private sector. This approach has lead to the vision statement whereby the Department will be the:

> "Recognized leader and partner with industry in developing and transferring science and technology to enhance economic performance and to serve the public needs."

To become a recognized leader, the Department must demonstrate excellence throughout all technology transfer programs. To become a recognized partner with industry in developing and transferring science and technology, the department must earn trust from industrial partners by timely, fair, reliable, consistent, and productive relationships and listen to its customers. To enhance economic performance, the Department must structure technology transfer such that customers are helped quickly and efficiently. To serve public needs, the Department must leverage activity budgets to the maximum extent possible toward market-driven goals.

To obtain the vision, numerous initiatives will be developed that include streamlining the technology transfer process, planning for success, and reaching small business. The streamlining will seek to optimize existing processes (personnel exchange agreements, licensing, reimbursable work for others, cost-shared procurements, and Cooperative Research and Development Agreements) to increase access to Departmental resources by interested partners. Planning for success requires that the Department be organized to achieve the necessary results, and that individuals have clear responsibilities and are held accountable for coordinating their efforts. Small businesses create 80 percent of the new jobs in the United States economy. The Department will work with existing public and private networks to reach these small businesses and address the opportunities through assistance programs.

The Department's Environmental Restoration and Waste Management program is the largest environmental program in the world. Through this program, the Department is responsible for cleaning up tens of thousands of acres of wastes, contaminated soil, groundwater, and structures, at 120 sites in 36 states and territories. The need for cleanup abounds; there is much to do.

There are many cases where no effective long-term technology exists to cleanup hazardous and nuclear waste sites. Even if a technology exists, there is a lack of clear cleanup standards which reduces the ability to determine acceptable goals for developing new technologies or applying existing technologies. Even with technologies and standards, there are too many sites requiring attention to take action simultaneously to meet all cleanup demands. Therefore, much greater control over the cleanup efforts must be gained to achieve results based on reasonable priorities.

The priorities must reflect a careful assessment of human exposures and risk, environmental threats, responsible land use planning, socioeconomic considerations, and a commitment to regulatory compliance. The priorities must be developed with stakeholders. The process will involve using interim remedies until an effective long-term remedy can be put in place when a feasible technology becomes available. Significant long-term progress will require cleanup standards, land-use planning, new technologies, and cooperation with stakeholders on developing priorities and evaluating risks.

T. Grumbly
Assistant Secretary
for Environmental
Restoration and
Waste Management

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Chapter 1 Introduction

DOE EM Mission

The U.S. Department of Energy (DOE) Office of Environmental Restoration and Waste Management (EM) is charged with overseeing a multi-billion dollar environmental cleanup effort. EM leads an aggressive national research, development, demonstration, testing, and evaluation program to provide environmental restoration and waste management technologies to DOE sites, and to manage DOE-generated waste. In carrying out this program, EM program managers work to ensure that individual projects comply with environmental mandates and adhere to relevant public acceptance criteria.

DOE is firmly committed to working with industry to effectuate this cleanup effort. We recognize that private industry, university, and other research and development programs are valuable sources of technology innovation. We further believe that business partners can gain a competitive market edge by commercializing technologies successfully demonstrated in DOE test beds.

Purpose of the Guide

The primary purpose of this document is to provide you with information on potential business opportunities in the following technical program areas:

- Remediation of High-Level Waste Tanks
- Characterization, Treatment, and Disposal of Mixed Waste
- Migration of Contaminants
- Containment of Existing Landfills
- Decommissioning and Final Disposition
- Robotics

EM has a number of acquisition and technology transfer tools available to assist organizations in pursuing promising environmental cleanup business and research opportunities. These include: solicitation of private sector technologies via phased procurements, grants and cooperative agreements, environmental restoration and waste management Small Business Technology Integration Program (SB-TIP), Cooperative R&D Agreements (CRADAs), limited data withholding, technical personnel exchange assignments, consulting arrangements, Office of Research and Technology Application (ORTA), contracting and financial assistance, technology licensing, and licensing of intellectual property. These technology transfer opportunities are discussed in

the following paragraphs with the details and points of contact. In addition, the central point of contact will provide you with information on current procurements, technology transfer, and research programs presented along with the appropriate contacts in Chapter 2.

Solicitation of Private Sector Technologies Via Phased Procurements

DOE EM has developed an acquisition policy and strategy that uses phased procurements to span the technology development applied concept feasibility continuum through full-scale remediation. Solicitation tools include Research Opportunity Announcements (ROAs), Program R&D Announcements (PRDAs), unsolicited proposals, Requests for Proposals, Program Opportunity Notices, and Invitations for Bid.

ROA

EM uses ROAs to solicit industry and academic proposals for potential contracts in applied research. The process is open all year. Proposals are peer-reviewed as part of the competitive selection process. Typically, ROAs are published annually in the *Commerce Business Daily,* and multiple awards are made. EM will select several contracts per year for ROA awards. Additionally, the ROA includes a partial set-aside for small businesses with 20 percent of the awards going to small businesses. To be placed on the mailing list or to request the information package for the latest ROA, use the following:

CONTACT

U. S. Department of Energy
Attn: Thomas L. Martin, M.S. I07
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, WV 26507-0880
(304) 291-4087

PRDA

PRDAs are program research and development announcements used to solicit a broad mix of R&D and DT&E proposals. A PRDA is used to solicit proposals for projects in areas where R&D or DT&E is required within broadly defined areas of interest, but where it is difficult to describe the work in detail. PRDAs may be used to solicit proposals for contracts, grants, or cooperative agreements. Multiple awards, which may have dissimilar approaches or concepts, are generally made. Numerous PRDAs may be issued each year. PRDA information can be obtained from:

CONTACT

Morgantown Energy Technology Center
P.O. Box 880
Collins Ferry Road
Morgantown, WV 26507-0880
(304) 291-4079

Grants and Cooperative Agreements

EM uses financial assistance awards like grants and cooperative agreements when the technology is developed for a public purpose.

Financial assistance proposals are solicited through the *Federal Register.* These announcements are called Program Rules. A Program Rule can either be a one-time solicitation or an open-ended, general solicitation with annual or more frequent announcements concerning specific funding availability and desired R&D agreements.

EM awards grants and cooperative agreements if 51 percent or more of the overall value of the effort is related to a public interest goal. Such goals include possible non-DOE or other Federal agency participation and use, advancement of present and future U.S. capabilities in domestic and international environmental cleanup markets, technology transfer, advancement of scientific knowledge, and education and training of individuals and business entities to advance U.S. remediation capabilities. EM's first Program Rule will be issued in late 1993.

CONTACT

John Wengle
U.S. Department of Energy
Program Integration Division, EM-532
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-8491

Small Business Technology Integration Program (SB-TIP)

The SB-TIP seeks the participation of small businesses in the EM programs. Through workshops and frequent communication, the SB-TIP provides information on opportunities for funding and collaborative efforts relative to advancing technologies for DOE environmental restoration and waste management applications.

CONTACT

Joe Paladino, HQ-PM
U.S. Department of Energy
Technology Integration Division, EM-521
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-7449

Special Consideration for Small Business Participants

The primary DOE tool is the Small Business Innovative Research program (SBIR) which is an annual competitive grant program that supports phased research and development on advanced concepts related to energy and the environment. DOE also uses the Research Opportunity Announcement (ROA) set-aside for small businesses. The Technology Integration Division uses the Small Business Technology Integration Program (SB-TIP) to support small business efforts in environmental management research and development. Typically, one of every five awards is made to small businesses. The areas of research include groundwater and soils cleanup, waste retrieval and waste processing, and waste minimization.

CONTACT

Joe Paladino, HQ-PM
U.S. Department of Energy
Technology Integration Division, EM-521
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-7449

Cooperative Research and Development Agreements (CRADAs)

DOE uses CRADAs as an incentive for collaborative R&D. CRADAs are agreements between a DOE R&D laboratory and any non-Federal source to conduct cooperative R&D that is consistent with the laboratory's mission. The partner may provide funds, facilities, people, or other resources. DOE provides the CRADA partner access to facilities and expertise; however, no federal funds are provided to external participants. Rights to inventions and other intellectual property are negotiated between the laboratory and participant, and certain data that are generated may be protected for up to five years.

CRADA opportunities can be pursued with the Office of Research and Technology Application (ORTA) contact at each laboratory, or by contacting EM at the:

CONTACT

DOE Central Point of Contact
(800) 845-2096.

Limited Data Withholding

DOE EM has a three-year limited withholding provision in place to encourage commercialization of DOE-funded technology. This provision is designed to assure that, if industry participants provide at least a 20 percent cost share, to the extent permitted, EM, will withhold from public release for three years commercially valuable information resulting from that work. Any patents or data held by a participant before an arrangement with DOE was formulated will be retained by the participant as background patents and data provisions.

Technical Personnel Exchange Assignments

Personnel exchanges provide opportunities for industrial and laboratory scientists to work together at various sites on environmental restoration and waste management technical problems of mutual interest. Industry is expected to contribute substantial cost-sharing for these personnel exchanges. To encourage such collaboration, the rights to any resulting patents go to the private sector company. These exchanges, which can last from three to six months, are opportunities for the laboratories and industry to understand better the differing operating cultures, and are an ideal mechanism for transferring technical skills and knowledge.

Consulting Arrangements and Technical Assistance

Most laboratory operating contractors have provisions allowing employees, specifically scientists and engineers, to consult in their areas of technical expertise. Laboratory employees can sign nondisclosure agreements and are encouraged to do so. Brief periods of advice can be provided as technical assistance without the necessity of formal consulting arrangements.

Offices of Research and Technology Applications

ORTAs serve as technology transfer agents at the Federal Laboratories, providing an internal coordination in the laboratory for technology transfer and an external point of contact for industry and universities. To fulfill this dual purpose, ORTAs license patents and coordinate technology transfer activities for the laboratory's scientific departments. They also facilitate one-on-one interactions between the laboratory's scientific personnel and technology

recipients, and provide information on laboratory technologies with potential applications in private industry or for state or local governments.

EM Central Point of Contact (CPOC)

The EM Central Point of Contact is designed to provide ready access to prospective research and business opportunities in waste management, environmental restoration, and decontamination and decommissioning activities, as well as information on EM-50 IPs and IDs. The EM Central Point of Contact can identify links between industry technologies and program needs, and provides potential partners with a connection to an extensive network of Headquarters and field program contacts.

The EM Central Point of Contact is the best single source of information for private-sector technology developers looking to collaborate with EM scientists and engineers. It provides a real-time information referral service to expedite and monitor private-sector interaction with EM.

To reach the EM Central Point of Contact, call 1-800-845-2096 during normal business hours (Eastern time).

For More Information

For more information about these programs and services, please contact:

Claire Sink, Director
Technology Integration Division, EM-521
Environmental Restoration and Waste Management Technology Development
U.S. Department of Energy
Washington, DC 20585
(301) 903-7928

Additional Purpose

DOE recognizes the important role of private industry and the academic community in this long-term challenge to clean up and manage the nation's radioactive, hazardous, and mixed waste. The additional purpose of this *Business and Research Opportunity Guide* is to inform potential partners and program participants of collaborative opportunities with DOE in the areas of environmental restoration and waste management technology development.

The Next Step

Once you have gained an understanding of the many opportunities available, DOE EM wants to ensure that you can locate the appropriate DOE program and point of contact. To make this process easier, Chapter 2 provides information on the DOE EM Technology Development programs engaged in technology development activities and the appropriate points of contact.

Chapter 2 DOE Environmental Cleanup Technology Development Programs

Background

DOE's environmental cleanup activities focus on two areas: environmental restoration to clean up DOE's sites and waste management to control and reduce waste generated at DOE sites. To meet these goals, DOE formed the Office of Environmental Restoration and Waste Management (EM). The EM organizational chart is provided in Figure 1. The EM Office of Technology Development (EM-50) is responsible for conducting applied research and development for the Environmental Restoration and Waste Management program.

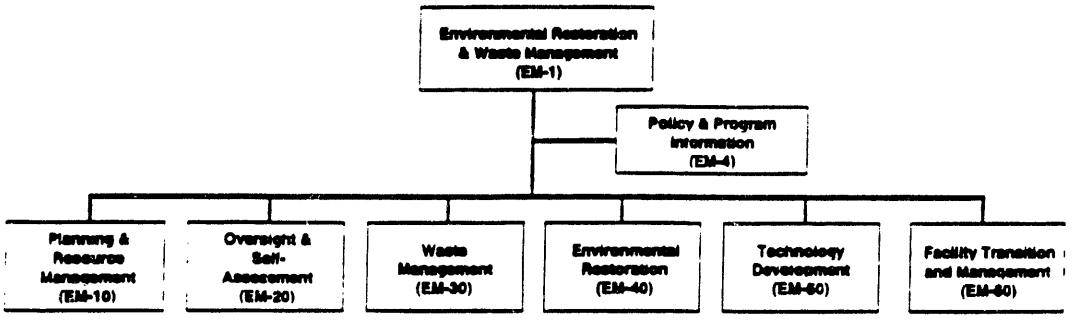

Figure 1. DOE EM's Organizational Structure

Environmental Management Organization

DOE EM has established seven organizational elements to oversee its environmental cleanup activities. The EM Office of Policy and Program Information (EM-4) is the focal point for EM public participation and program information activities. EM Office of Planning and Resource Management (EM-10) provides EM administrative oversight and resource planning. EM Office of Oversight and Self-Assessment (EM-20) provides an independent oversight function to ensure compliance with relevant environmental and safety laws. EM Office of Waste Management (EM-30) is responsible for DOE waste management activities to control and reduce the waste generated by DOE sites. EM Office of Environmental Restoration (EM-40) is responsible for cleaning up and restoring DOE's sites. EM Office of Technology Development (EM-50) conducts environmental restoration and waste management RDDT&E for EM-30 and EM-40 when current technologies are inadequate to meet DOE's environmental cleanup needs. EM Office of Facility Transition and Management (EM-60) plans, implements and manages DOE facility decontamination and decommissioning activities. For more detail, see Appendix B.

Applications of DOE EM Office of Technology Development (EM-50)

Within EM-50, the processes of research, development, demonstration, testing and evaluation (RDDT&E) are conducted in two phases: applied research and development (R&D); and demonstration, testing and evaluation (DT&E). R&D programs identify alternatives to established technologies, and support applied research to prepare them for the DT&E testing scale. DT&E identifies those technologies ready for transition from research into the demonstration arena, and works to bring the technologies to the implementation stage. These programs work closely together to rapidly advance the best methods for use in meeting DOE's cleanup goals. RDDT&E phases are organized into integrated technology programs to focus activities towards the objective of fully operable lifecycle systems that are faster, better, safer and cheaper than conventional approaches.

Integrated Demonstration (ID) and Integrated Program (IP)

The Integrated Demonstration (ID) and Integrated Program (IP) are systems engineering concepts used to describe the interrelated stages of the technology development process. An IP is a set of RDDT&E activities dedicated to meeting needs for technology solutions for a single problem category (e.g., minimization, characterization, treatment, storage, and disposal) common to environmental cleanup activities across the DOE complex. IPs focus the development of a technology base and are centrally-managed.

An ID provides an end-to-end system for solving environmental management problems at a site. It addresses specific parts of environmental issues by applying multiple technologies and comparing them at various stages of development.

IDs and IPs are carefully interrelated to formulate a total program. The best technologies from each IP are combined together into systems for use in the IDs. The emphasis of EM-50 is on the development and transfer of new, ready-to-use technology systems directly to potential users.

Applied Research and Development Environmental Cleanup Areas

DOE's applied research and development for environmental cleanup is conducted in six areas:

- High Level Waste Tanks
- Characterization, Treatment, and Storage of Mixed Waste
- Migration of Contaminants

- Containment of Existing Landfills
- Decommissioning and Final Disposition
- Robotics.

Listed in the pages to follow are the research, design, development, test and evaluation programs being developed in a range of technology areas through the EM Office of Technology Development. Descriptions of other crosscutting and program infrastructure initiatives are also included. Detailed descriptions and lists of contacts are provided.

Personnel Roles and Responsibilities

Prior to reviewing program areas, definition of the personnel roles and responsibilities is in order. The U. S. Department of Energy EM complex is comprised of headquarters, field offices, and management and operations contractors including national laboratories. Outside the complex, formal and informal working arrangements are established with industry, trade groups, non-profit concerns, academia, local and state governments, Federal agencies, and foreign governments and agencies. The following definitions highlight the personnel roles and responsibilities to assist in the understanding of the contacts listed in the program areas.

DOE Headquarters Office Director (OD)

Responsible for the formulation, execution, and evaluation of IDs, IPs, and other programs.

DOE Headquarters Division Director (DD)

Implement policy through management and control of specific programs. They manage personnel and financial resources, and control program subelements that are established at the option of the Office Directors.

DOE Headquarters Program Manager (PM)

Responsible for day-to-day management of a program area including integration of the program with other program areas.

DOE Field Office Technical Program Officer (TPO)

Serves as the single point of contact for field management of all assigned EM activities. They draw on site resources to provide support to headquarters for program formulation, execution, and evaluation.

DOE M&O Contractor Technical Program Manager (TPM)

Assigned by each contractor with sufficient technology development activities, to serve as the M&O's single point of contact for the management of EM tasks, and for interfacing with site operations groups.

DOE M&O Contractor Integrated Demonstration Coordinator (IDC)/Integrated Program Coordinator (IPC)

Contractor personnel responsible for planning, coordinating, and implementing related groups of technical efforts involved in approved IDs and IPs.

Technology Development Program Areas

Remediation of High Level Waste Tanks

Tanks containing approximately 385,000 cubic meters of high level, radioactive waste have leaked in the past and the contents are not well characterized. Efforts to mitigate the leaks by liquid removal present problems in characterization and in retrieval/removal of material and its subsequent treatment. Some of the tanks "burp" and the chemistry is not understood. Efforts are underway to develop methods to remove the highly radioactive components.

Underground Storage Tanks ID

The Underground Storage Tank Integrated Demonstration (UST ID) was initiated to develop state-of-the-art technologies that can be applied to remediate radioactive and hazardous waste stored in underground storage tanks at 5 DOE sites: Fernald, Hanford, Idaho Falls, Oak Ridge, and Savannah River. The key feature of this demonstration is a diversity of technologies being developed at multiple sites as part of integrated systems, for application to multiple sites.

Hanford was selected to be the host site for the demonstration based upon its schedule for remediation and the complexity of the tank waste issues. The demonstration was originated to develop, demonstrate, test, and evaluate remediation technologies for underground storage tanks that contained radioactive waste or a mixture of radioactive and hazardous (chemical) waste (petrochemical tanks are excluded).

The Hanford site is located in the southeastern section of Washington State near the cities of Richland, Kennewick, and Pasco. It has operated since 1943 with a primary mission of producing plutonium isotopes. Plutonium was produced by irradiation of enriched uranium in eight nuclear reactors located along the Columbia River. The plutonium was then separated from the remaining uranium and fission products by chemical processes. It was then sent offsite for further purification.

The waste generated from the different chemical separation processes has been stored in 177 USTs for future retrieval and t eatment for final disposal. There are eight UST design types, ranging in age from 6 to 49 years. Of the 177 USTs, 149 are constructed of a single carbon steel shell with a reinforced concrete shell. The remaining 28 USTs have dual carbon steel liners. The USTs range in operating capacities from 208 to 3,785 cubic meters (55,000 to 1 million gallons). Approximately 225,000 cubic meters (59.4 million gal) of high-level waste is stored in the tanks. The waste has four general physical forms; sludge, supernatant (liquid), salt cake, and slurry. All of the waste is alkaline with a large percentage of sodium nitrate, nitrite salts, and metal oxides.

Research is being conducted to develop requirements and technologies to address radioactive and mixed waste underground storage tanks. Initial efforts on single shell tanks will establish baseline characterization requirements and identify candidate processes for dislodging and conveyance. Other activities will include identifying and designing retrieval systems, high-level waste separation and pretreatment methods, and integrating technologies.

CONTACTS

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U.S. Department of Energy
Waste Management DT&E Division, EM-552
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-7258

Debbie Trader, TPO
U.S. Department of Energy
Richland Operations Office
825 Jadwin Avenue
P.O. Box 550
Richland, WA 99352
(509) 376-0016

Roger Gilchrist, IDC
Technology Development Programs
Westinghouse Hanford Co.
P.O. Box 1970, MS L5-63
Richland, WA 99352
(509) 376-5310

Efficient Separations IP

If the radionuclide constituents could be separated from the largely inert constituents in High Level Wastes (HLW), the number of canisters requiring

geologic storage could be dramatically reduced to a few hundred, saving tens of billions of dollars.

Separations Technologies and Processes (STPs) will be required to process a variety of nuclear wastes under widely varying conditions:

- High-Level Wastes (HLWs)--Liquid or solid wastes that have been generated by reprocessing nuclear fuels

- TRU Wastes (TRUs)--Radioactive wastes that exceed 100 Nci/g of alpha activity from radioactive transuranium elements and have not been generated directly through nuclear reprocessing.

- Low-Level Wastes (LLWs)--Wastes that contain only small quantities of specific radionuclides but not necessarily small quantities of radiation.

- Mixed Wastes (MWs)--Wastes that contain both unnatural radionuclides and materials listed as hazardous wastes in the Resource Conservation and Recovery Act (RCRA).

- Hazardous Wastes--Wastes that contain hazardous chemicals but no unnatural radionuclides.

The ultimate goals of the Efficient Separations program are to:

- Provide Sewage Treatment Plants to process and immobilize a wide spectrum of radioactive and hazardous defense wastes,

- Coordinate Sewage Treatment Plant research and development efforts within DOE,

- Explore the potential uses of separated radionuclides, and

- Transfer demonstrated separations and processing technologies developed by DOE to the U.S. industrial sector to facilitate competitiveness of U.S. technology and industry in the international markets.

The program intends to accomplish these goals by developing new technologies and adapting emerging technologies for use in total-waste-treatment and by integrating STP efforts within DOE. Chemical separations and processing technologies developed by the program will provide alternatives to present technology. This effort will heavily involve U.S. universities and industry. As STPs are developed, they will become available for use by the U.S. industrial community.

With the program mission successfully completed, TRU and most of the high level waste (HLW) associated with storage tanks and calcine bins will be

processed to create a minimum total volume of HLW and TRU, destined for a geologic repository or Waste Isolation Pilot Plant (WIPP), and other wastes will be processed to minimize their environmental effects. The technologies developed for waste processing are also expected to help remediate groundwater and soil-contamination by extracting low-level radionuclides and hazardous chemicals.

CONTACTS

Teresa Fryberger, HQ-PM
U.S. Department of Energy
Waste Management Operations R&D Division, EM-542
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-7688

Bill Kuhn, IPC
Pacific Northwest Laboratory
P.O. Box 999
Richland, WA 99352
(509) 372-0682

Characterization, Treatment and Storage of Mixed Waste

The regulations pertaining to mixed waste involve several regulatory programs which address management of hazardous and radioactive materials. This results in inherent regulatory inconsistencies which leads to difficulty in defining appropriate actions. Currently, there is a lack of definitive treatment standards and no disposal facility designated for mixed waste. Recent inventories indicate approximately 250,000 cubic meters of mixed waste with the potential to generate 900,000 cubic meters more by 1997. DOE needs to enhance its efforts to improve public understanding of the nature of the mixed waste problem, associated hazards and risks, and viability of treatment technologies.

Buried Waste ID

The amount of buried waste located throughout the DOE complex as of 1990 is estimated at approximately 2.1 million cubic meters with an additional 5 to 10 times this volume estimated to be contaminated soils. This waste is predominantly located at Hanford, Savannah River Site, Idaho National Engineering Laboratory (INEL), Los Alamos National Laboratory, Oak Ridge National Laboratory, and Rocky Flats Plant. The wastes at these various DOE sites have been buried or stored in trenches, pits, buildings, storage pads, or other specific structures.

Approximately half of all DOE buried waste was disposed of before 1970. Disposal regulations at that time permitted the commingling of various types of

waste [i.e., transuranic (TRU) low-level radioactive, and hazardous]. As a result, much of the buried waste throughout the DOE complex is presently believed to be contaminated with hazardous and radioactive materials.

Buried waste activities include demonstrating and evaluating a suite of advanced technologies for the effective remediation of mixed and/or transuranic buried waste. Methods for mapping and characterization, retrieval, pretreatment and treatment, and disposal of buried waste are being examined.

CONTACTS

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U.S. Department of Energy
Waste Management DT&E Division, EM-552
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-7965

Ken Merrill, IDC
EG&G Idaho
P.O. Box 1625
Idaho Falls, ID 83415-3930
(208) 526-0797

Scott Hinschberger, TPO
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402
(208) 526-8288

Minimum Additive Waste Stabilization (MAWS) Special Project

The Minimum Additive Waste Stabilization (MAWS) Program involves the development and on-site demonstration of an integrated, multiple-technology system for the treatment of blends of disposal costs. The field demonstration will be conducted at the Fernald Environmental Management Project (FEMP).

The MAWS system integrates three primary technologies - vitrification, soil washing, and water treatment - in order to address a variety of waste streams. The system is centered around directing all contaminant streams to a final stabilized glass waste form. Vitrification was selected as the stabilization technology due to the superior leach resistance of the waste form and the very large volume reduction compared to many alternative technologies (e.g. a ten-fold reduction compared to cementing) which significantly reduces life-cycle remediation costs.

From a vitrification perspective, waste streams can be broadly classified on a spectrum of silica-rich to flux-rich; these extremes having opposite effects on melt temperature and viscosity. Due to the very large volume of uranium-contaminated soils at FEMP, the total waste mix will be dominated by the silica-rich components; this is a common situation at many remediation sites. Treatment of the soils alone would typically require addition of fluxing agents which are both an additional expense and diminish the volume reduction. In the MAWS blended-waste-stream approach, the pit sludges play the role of the required fluxing agents. Furthermore, the uranium-contaminated soils undergo a volume reduction step by treatment in a soil washing system; the contaminant-enriched minor fraction is then used as feed for the vitrification process. The soil washing system is supported by an ion exchange system with a regeneration cycle designed to direct collected uranium to the vitrification system.

The MAWS concept is innovative in that the available waste streams are viewed as resources for the process that are to be fully exploited in order to minimize the need for purchased additives, and a portfolio approach is adopted to maximize the economic benefits of blending the optimum proportions of multiple waste streams and alternative technologies.

CONTACTS

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Environmental Restoration R&D Division, EM-541
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585
(301) 903-7440

Jan Berry, Point of Contact
Oak Ridge National Laboratory
P.O. Box 2008
Bethel Valley Road
Oak Ridge, Tenn 37831-6044
(615) 574-6907

Decontamination, Decommissioning and Recycle IP

This program develops characterization, decontamination, dismantlement, material disposition, and secondary waste treatment methods designed to reduce worker exposure, cost of the program, and generation of secondary waste. These methods for the decontamination and decommissioning of contaminated facilities are developed or improved by both industry and government laboratories, resulting in improved performance over current baseline methods. Other support is provided in the areas of robotics/automation, regulatory compliance and transportation.

CONTACTS

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Environmental Restoration and Waste Management Technology Development
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Johnny Moore, TPO
U.S. Department of Energy
Oak Ridge Operations Office
P.O. Box E
Oak Ridge, TN 37831
(615) 576-3536

R. Keith Kibbe, IDC
Martin Marietta Energy Systems, Inc.
P.O. Box 2003
Oak Ridge, TN 37831-7325
(615) 576-0101

Waste Forms Special Project

The objective of this program is to provide final waste form technologies for those waste types for which best demonstrated available technologies do not currently exist. Emphasis will be placed on spent nuclear fuel, special high-level wastes which are not amenable to vitrification in a borosilicate glass, and remote-handled transuranic wastes. Technologies are also needed to assess long-term performance and regulatory compliance of these waste forms. This program also includes technologies for engineered barriers for permanent storage of low-level waste forms, and for interim storage of spent nuclear fuel, high-level waste, remote-handled transuranic waste forms.

CONTACT

Paul Hart, HQ-PM
U.S. Department of Energy
Waste Management Operations R&D Division, EM-542
Environmental Restoration and Waste Management Technology Development
Washington, DC 20585-0002
(301) 903-7456

Mixed Waste IP

The Mixed Waste Integrated Program (MWIP) was established to provide a national focus to DOE's R&D on low-level mixed waste (LLMW). LLMW is the most prevalent waste in the DOE inventory; the current volume is estimated at

107,000 cubic meters. An additional large volume of mixed waste is expected to be generated through restoration and decontamination and decommissioning activities. The technology for processing mixed wastes is currently quite limited and little treatment capacity for LLMW now exists. Hence, an integrated program was developed to conduct technology development aimed at filling key gaps in current technology and developing alternatives. MWIP also serves to coordinate amongst the R&D efforts related to mixed waste throughout DOE.

The need to establish processes for MW treatment has been driven by RCRA Land Disposal Restriction (LDR) requirements. The enactment of the Federal Facilities Compliance Act (FFCA) in 1992 is likely to result in a state-by-state and site-by-site approach to waste management. The FFCA provides a three year waiver for most mixed wastes, after which "sovereign immunity" is waived, and requires plans for the development of treatment technologies and capacities. These provisions will lead to an increased involvement of regional, state and local agencies in the technology development process.

The initial MWIP program was organized in the following technical program areas: Front End Handling, Chemical/Physical Treatment, Waste Destruction and Stabilization, Secondary and Off-gas Treatment, and Final Waste Forms. Technical Area Status Reports are being completed to survey the technologies and systems available to treat LLMW and associated technology R&D needs. In addition, MWIP has supported research in several key programs with the goal of developing candidate systems for treating specific waste streams.

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Supercritical Water Oxidation Special Project

DOE's Office of Technology Development (EM-50) established a national program with the overall objective of developing Supercritical Water Oxidation as a viable treatment technology for mixed waste. To achieve this objective, EM-50 designated the Idaho National Engineering Laboratory as the point of

coordination for all Supercritical Water Oxidation related activities being conducted by DOE, other Federal agencies, industry, and academia to bring a sharp focus to the overall development and implementation of this area for DOE hazardous and mixed waste.

Supercritical Water Oxidation technology brings organic waste, water, and oxygen together at a temperature and pressure above the critical point of water (374°C, 22.1 MPa). Above this point, water becomes a single phase fluid with a density near that of a liquid and the transport properties of a gas. Here, water serves as an effective solvent for organic compounds. Organics are quickly oxidized to carbon dioxide and water with destruction efficiencies of over 99.99 percent.

This technology has several technical issues that must be overcome before DOE mixed waste objectives can be achieved. These issues include problems with materials of construction, control and removal of precipitating and sticky solids, and radionuclide chemistry in supercritical water. The program is looking to the DOE complex, U.S. Department of Defense, and private industry to find solutions to these issues.

The Supercritical Water Oxidation Program is divided into two main elements to evaluate the technology for mixed waste applications. These include: (1) Research and Development, and (2) Demonstration. The research and development focuses on finding solutions for the technical issues, such as corrosion and sticky solids. In addition, this element provides for collaboration with other agencies such as the U. S. Department of Defense, National Aeronautics and Space Administration, U. S. Environmental Protection Agency, industry, universities, and other Federal and state agencies to reduce duplication, enhance acceptance and progress, and leverage resources.

The second element, SCWOD, includes the design, construction, and operation of a SCWO mixed waste pilot plant capable of 300-500 gallons per day of water throughput. This plant will be used for demonstrating the SCWO technology's ability to safely and effectively treat applicable DOE mixed radioactive waste.

The technology, as it presently exists, is not considered sufficiently mature to proceed directly to the treatment of radioactive waste. The direct scale-up from bench scale to radioactive waste pilot plant is considered to be high risk and costly. Much of the technology development required for demonstration can be performed on a considerably less expensive nonradioactive pilot plant.

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Migration of Contaminants

Uncontained hazardous and radioactive contaminants exist throughout the DOE weapons complex. Information on the magnitude and extent of the migration is sketchy. Improvements in characterization and data interpretation methods, containment systems, and in situ treatment could result in better risk reduction at lower cost. This problem is common to industry as well, thus presenting an opportunity to leverage the benefits of DOE expenditures in research and development.

VOCs in Non-Arid Soils ID

This technology program develops, demonstrates and compares technologies for in situ remediation actions to remove VOCs from soils and groundwater. It provides a test bed for field demonstration of air-stripping techniques combining horizontal wells, vapor extraction, and bioremediation. The program also aims to demonstrate new technologies for monitoring, including geophysical tomography and sensors for tracing in situ groundwater flow.

This integrated demonstration is being conducted at the Savannah River Site (SRS) due to the presence of a pre-existing line source that contributed contamination to both soil and groundwater, on-going environmental remediation efforts at the site, and full cooperation from the concerned environmental regulatory agencies.

Conventional means for removal of volatile contaminants from soils and groundwater include pumping the groundwater to the surface followed by air stripping with above-ground equipment, vacuum extraction of volatile subsurface contamination, or site excavation for physical removal of the contaminated materials.

The technology emphasis for this integrated demonstration is in situ remediation because it has tremendous advantages over above-ground treatment. It has the potential to be more effective in less time at a reduced cost and also has the benefit of minimizing worker exposure. Three in situ remediation systems have been or will soon be demonstrated: (1) in situ air stripping or air sparging, (2) in situ bioremediation, and (3) in situ heating. DOE will investigate other proposed techniques.

Innovative sensors, samplers and real-time analytical measurements have been developed, demonstrated, and evaluated to monitor the effectiveness of the activities at the demonstration site. These technologies have broad applications for innumerable environmental restoration problems. Technologies in this category include both vadose-zone and groundwater multilevel samplers (SEAMIST, arrayed sampler, membrane sampler, etc.), fiber optic sensors, groundwater flow sensors (thermal and microphotographic), real-time field analytical equipment, and seismic and resistivity crosshole geophysical tomography.

The mobile cone penetrometer, capable of rapidly penetrating the ground for collection of real-time geological, geophysical, and geochemical data, has been demonstrated as a cost-effective subsurface characterization tool. The cone penetrometer can deploy many different state-of-the-art line sampling and instrument devices, such as a basic screening detector for soil resistivity and a fiber-optic fluorometric sensor that detects petroleum hydrocarbons (SCAPS).

A number of innovative characterization technologies have been successfully transferred to SRS Environmental Restoration and have been utilized at other SRS waste sites. Licensing of the in situ air stripping horizontal well technology to commercial vendors is another example of technology transfer. At least fourteen licenses for this technology have been granted or filed. Licenses for Sandia National Laboratory's fluid flow sensors and Lawrence Livermore National Laboratory's Tri Chloro Ethylene sensor have also been granted. The cone penetrometer fluorescence sensor has also recently been patented. The use of horizontal wells for environmental applications has flourished over the last year. DOE's involvement in promoting this innovative technology has been instrumental in its implementation.

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VOCs in Arid Soils ID

This program develops and compares technologies that are used to characterize, remove, or monitor VOCs and associated contaminants in soils and groundwater at arid sites. Work has been focused on demonstrating technologies for all phases of remediation, including: site characterization and monitoring; drilling; retrieval of contaminants; above-ground treatment of contaminants; in-ground treatment of contaminants; and interim containment technologies. Technologies for secondary waste stream treatment and site closure will also be tested.

The initial host site is DOE's Hanford facility in southeastern Washington state. The primary VOC contaminant is carbon tetrachloride, in association with heavy metals and radionuclides. An estimated 580-920 metric tons of carbon tetrachloride were disposed of between 1955 and 1973, resulting in extensive soil and groundwater contamination.

The VOC-arid integrated demonstration schedule has been divided into three phases of implementation. The phased approach provides for: (1) rapid transfer of technologies to user programs once demonstrated, (2) logical progression in the complexity of demonstrations based on improved understanding of the VOC problem; and 3) leveraging of the host site EM activities to reduce the overall cost of the demonstrations. Demonstration efforts are underway in the areas of subsurface characterization including drilling and access improvements, off-gas and borehole monitoring of vadose zone VOC concentrations to aid in soil vapor extraction (SVE) performance evaluation, and treatment of VOC-contaminated off-gas. These current demonstration efforts constitute Phase I of the ID and, because of the ongoing activities, can result in immediate transfer of successful technologies to the users.

In Phase II, demonstration of techniques to enhance and control (e.g., contain or direct) the transport of VOC vadose zone contaminants is a primary goal

because a significant percentage of the VOC contamination resident at the Hanford host site and other DOE sites is still held up in unsaturated soils. Emphasis will be placed on: demonstrating enhanced techniques for VOC removal and control in vadose zone soils; and improved methods for accessing the subsurface to reduce the cost of characterization and improve the likelihood for success of in situ treatment technologies. Monitoring technologies for VOCs will be developed and demonstrated throughout Phase I to ensure availability for Phase II remediation technology demonstrations.

Phase II will also expand the focus of the demonstrations to groundwater contamination which is consistent with the general strategy of the environmental restoration program. Other EM organizations are moving forward with a proposed plan for groundwater treatment in FY 1993 and 1994; therefore, there will again be a direct transfer route for demonstrated technologies to environmental restoration. With the initiation of a new activity and opportunities for leveraged work activities, the Arid ID is moving more aggressively to support technologies in FY 1993 and 1994 for the enhanced removal and treatment of groundwater contaminants.

Pump and treat is an unacceptable, baseline approach for extracting groundwater VOCs. Unfortunately, it is currently the only available method. Unlike vadose zone remediation using SVE, groundwater remediation is an extremely expensive option with the current baseline. Investments in groundwater remediation will have significant cost benefits. Technologies for in situ treatment of groundwater, and to a lesser extent, more cost-effective treatment of extracted groundwater, will be developed and demonstrated. Characterization and monitoring technologies will continue to be developed to ensure that the necessary tools are available as the focus shifts from bulk contaminant (VOC) removal from soil to enhanced techniques for VOC residuals removal and groundwater treatment.

Phase III of the VOC-Arid ID will begin to address issues related to co-contaminants within the VOC plume. Specifically, emphasis will be placed on developing and demonstrating technologies for containing, mobilizing for recovery, and/or immobilizing metals and radionuclides in both soil and groundwater. Phase III will build on the base characterization and VOC treatment programs conducted during the first two phases of the program to focus efforts on high priority areas. Efforts will primarily focus on in situ treatment or enhanced recovery techniques for americium and plutonium in soils, and uranium and chromium in groundwater. These contaminants represent common VOC co-contaminants at DOE sites, and are significant problems at the host site.

The VOC-Arid Integrated Demonstration is demonstrating technologies for all phases of remediation. These include:

- drilling
- site characterization and monitoring
- retrieval of contaminants
- above-ground treatment of contaminants
- in-ground treatment of contaminants

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Uranium in Soils ID

An optimized system to clean up uranium and other radionuclides from surface soils is required. The remediation of radionuclide-contaminated soils is difficult and expensive using traditional excavation, transportation, and radiological waste disposal methods because of the large volume of media to be cleaned. The approach of this ID is to establish the optimal techniques (e.g., real-time field characterization and monitoring, physical size separation, chemical treatment, etc.), as well as system performance for each technique, on the basis of efficiency, cost, risk, and applicability range. In addition, community and regulatory acceptance for remediation of large surface areas must be taken into account. Initial focus is on ex situ technologies with inception of real time analysis techniques, treatability studies, precise excavation techniques, and secondary waste testing.

Research and testing is being conducted to characterize and remediate radionuclides present in conglomerates of organic, inorganic and radioactive wastes which require chemical extraction. Research is also being conducted to improve radioactive detection system accuracy in characterization activities and enhance chemical decontamination methods which permit cleaned soil to be used for vegetation.

Analysis of Fernald soil samples is aimed at characterizing the chemical and physical properties of both the soils and uranium wastes. Physical characterization of the soils and uranium wastes is being conducted at Oak Ridge National Laboratory. These tests are defining the basic chemistry and mineralogy of the soils, size fractionation of the soils, uranium/soil fractionation characteristics, and physical characterization of the particulate and occluded uranium waste. Chemical characterization of the uranium waste is being performed at Los Alamos National Laboratory. These tests are addressing questions concerning the speciation (oxidation state, chemical structure, mode of binding) of uranium and uranium/organic mixtures in the Fernald soils. In addition to these tests, Argonne National Laboratory is conducting studies to determine if the chemical and physical forms of uranium in the soil matrix can be characterized by analytical transmission electron microscopy (i.e. transmission electron microscopy with x-ray diffraction and electron energy-loss spectroscopy capabilities).

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Dynamic Underground Stripping

This project is developing and demonstrating a system for thermal remediation and underground imaging techniques for rapid cleanup of localized underground spills. Technologies being investigated include: steam injection, direct electrical heating, passive seismic monitoring, and tomographic geophysical imaging.

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Resource Recovery Project IP

The Resource Recovery Project (RRP) is demonstrating, testing and evaluating technologies, at pilot scale, for recovery of both surface and ground water from dilute heavy metal aqueous solutions. The project will emphasize recovery of valuable mineral resources, including heavy and/or precious metals, as well as industrial minerals. Economic analyses of each technology and the resources recovered are being used to project resource recovery and/or remediation costs for similar DOE and industrial sites using similar technologies. The project is focusing on resource conservation and end use applications of the recovered resources by maximizing resource utilization and minimizing non-useable byproducts. Resource utilization will address industrial, commercial, municipal/governmental, agricultural and recreational uses of the water, metals and other resources.

The primary goal of the RRP is to develop data through demonstrations that will allow DOE and other project managers, engineers, and scientists to screen and select "off-the-shelf" technologies for the recovery of ground and surface waters containing dilute heavy metals. The data generated will address the

effectiveness, implementability, limitations, and costs of the technologies demonstrated. The information developed will allow for the timely, confident, and cost-effective selection of appropriate reclamation technologies at various sites throughout the DOE complex. Through technology transfer, the information generated can also be applied to non-DOE sites.

The Resource Recovery Project is also attempting to minimize non-useable byproducts of water treatment, e.g., waste sludge, by identifying potential end use applications of all treatment byproducts. Resource utilization activities are also identifying potential opportunities for "value-adding" of recovered minerals to further enhance the utilization potential of the treatment byproducts.

The Berkeley Pit, an inactive open pit copper mine, in Butte, Montana, has been selected as the RRP test bed. The Berkeley Pit and surrounding groundwater systems were de-watered by active mining operations for over 100 years. In April, 1982, the de-watering pumps located approximately 3,900 feet below surface were shut off. Groundwater and surface waters are now recharging. The Berkeley Pit is acting as a collection point, or "sink," for the recharging waters. Currently, the Berkeley Pit alone is estimated to contain over 20 Billion gallons of acidic, highly mineralized water. The Pit is filling at a rate of approximately 5 million gallons per day. The U.S. Environmental Protection Agency (EPA) has estimated that the Pit will contain as much as 56 Billion gallons of contaminated water at its maximum water level.

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Containment of Existing Landfills

DOE has numerous landfills constructed and used in the manner consistent with the time of construction. These landfills now pose significant remediation problems. Some landfills require interim containment prior to final remediation to prevent accelerated migration of contaminants. Some material was buried in "retrievable" storage thus requiring safe retrieval systems. Development of

in situ methods for both containment and treatment are under investigation. Public understanding of the risk associated with these problems requires action.

Mixed Waste Landfill ID

Characterization, stabilization, and cleanup technologies are being examined for remediating soils contaminated with heavy metals in complex mixtures with organic, inorganic, and radioactive waste. Few technologies are currently available that address these issues.

Investigations will include systems designed to characterize metal and mixed waste contaminants and their migration beneath landfills in arid environments. The emphasis is on minimally intrusive technologies and downhole geochemical/geological sensors that are cheaper and faster than conventional methods. Major goals include: cost savings; promoting and nurturing industrial/university partnerships; and field demonstrating innovative technologies.

Other investigations will involve remediation technology. Waste disposed of in landfills can be segregated based on their mobility. High mobility wastes are typically VOC's and large volume aqueous or liquid streams. Moderately mobile wastes can include leachable anions/cations. By far the largest volumes of waste disposed of in landfills fall into the realm of low mobility wastes. These wastes are either bound, adsorbed, or low water solubility contaminants.

The Mixed Waste Landfill Integrated Demonstration makes two assumptions:

- Existing landfills can remain in place. This infers that there is no mandate to perform wholesale excavation.

- Environmental problems are caused by migration of contaminants out of the waste disposal zone.

Using these assumptions, this program will examine three remediation subsystems: extraction, transformation, and containment. Extraction is applied to those wastes that are the most mobile in the system. These contaminants are typically those of most concern to the regulatory community. Their removal is facilitated by in situ type systems, not excavation mechanisms. Transformation is based on the alteration of the form of the waste in the soil to reduce its mobility. Containment is then selected to enhance the soil isolation of the remaining constituents that are the least mobile.

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Characterization, Monitoring and Sensor Technology IP

The Characterization, Monitoring and Sensor Technology (CMST) Integrated Program supports the development of technologies to characterize contaminated sites, assay stored waste, and monitor waste streams with new on-line, real-time chemical sensors. Program technical areas include:

- Technologies for site characterization (i.e., for contaminant identification, location, and measurement in soils and for geophysical, subsurface mapping);
- Characterization data analysis, integration and visualization;
- Nondestructive assay of container contents; and,
- Monitoring of waste streams and airborne contaminants.

For environmental restoration, the system for characterization data collection includes: historical data analysis, remote sensing from satellites and historical data analysis, remote sensing from satellites and airborne platforms (cost-effective large area coverage), noninvasive ground-based sensor technologies, and higher cost-intrusive but necessary sample collection and analyses.

The program emphasis is on remote and minimally intrusive characterization, in situ measurements, and field deployable instrumentation. R&D funding for specific technologies is based upon: the priority of the need addressed; the

projected advancement over baseline technology; and overall cost savings to DOE, evidenced by a low cost/benefit ratio. Short-term goals of the program are to match and adapt available technologies to immediate environmental restoration and waste management needs at DOE sites. In the long-term, this program endeavors to stimulate, coordinate, and sponsor relevant R&D within DOE, and to promote, publicize, and transfer established and emerging CMST throughout the Federal Government, universities, and private sector.

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In Situ Remediation IP

The In Situ Remediation Technologies Integrated Program focuses research and development (R&D) on in-place containment technologies for hazardous, radioactive and mixed wastes in soils, groundwater, and storage tanks. These technologies address environmental and waste management problems such as buried waste, contaminated soils, contaminated groundwater, containerized hazardous and radioactive wastes, and underground detonation sites.

Investigations of these technologies will focus on their ability to minimize adverse health effects on workers and the public by reducing contact exposure, as well as reducing cleanup costs by eliminating the need for waste excavation, transport, and disposal. In addition, the technologies will allow the remediation of relatively inaccessible areas, such as the deep subsurface and areas beneath structures.

The three major In Situ Remediation program areas include: treatment, containment, and subsurface manipulation. The objectives of the treatment and containment R&D work are described below.

Treatment technologies will be evaluated for in situ destruction, enhanced in situ removal and extraction, and in situ immobilization. Supplementary process monitoring and control technologies will also be developed. In situ destruction R&D will lead to demonstration of biological, chemical, and thermal

technologies that destroy contaminants without harming the environment. Technologies may include in situ bioremediation, in situ chemical oxidation, and in situ electrochemical oxidation. In situ removal and extraction can be enhanced by thermal, chemical, or biological subsurface treatments to extract contaminants for destruction or immobilization above ground.

Containment technologies will be evaluated to isolate or contain contaminants within defined zones prior to and during treatment. The goal is to develop physical systems to prevent contaminant dispersal into the air, surface water, or groundwater. Process monitoring and control techniques will also be developed.

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Decommissioning and Final Disposition

Reduction in nuclear weapons production has resulted in a need to decommission, decontaminate, and dispose of numerous facilities. This affects the commercial nuclear power industry as well. Materials available from these activities include over 600,000 tons of precious metals, nickel, copper, steel, and stainless steel worth millions of dollars. Current regulations lack clear treatment standards and discourage the recovery/recycling/reuse of these resources. Development of effective technologies for the decontamination of these materials and associated improved communication of the risks involved appear necessary to convince regulators and the public of the viability of the recovery/recycle/reuse concept.

DOE/United States Air Force (USAF) Memorandum of Understanding IP

Many of the waste minimization and pollution prevention technology needs of federal agencies are similar. The DOE/USAF Memorandum of Understanding (MOU) Program exists for the purpose of utilizing the combined resources of the DOE and USAF to facilitate technology solutions in the area of waste

minimization, pollution prevention, and recycling. The MOU Program officially began with the execution of an MOU between the DOE Office of Environmental Restoration and Waste Management, Office of Technology Development, and the (then) USAF Civil Engineering Support Agency (AFCESA) at Tyndall AFB, Florida, in the fall of 1990. (The groups in AFCESA participating in the MOU Program have subsequently been reorganized to fall under the USAF Armstrong Laboratory Environmental Quality (AL/EQ) Directorate.) The MOU Program has a full-time interagency coordinator located at Tyndall AFB.

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Robotics

Robotics technology is being investigated to retrieve buried waste, characterize it for immediate processing, and disposal at approved storage sites. This technology is being developed with applications for laboratory automation to remotely handle and analyze radioactive and hazardous materials. Robotics is also being developed for underground storage tank and buried waste characterization and waste handling; decontamination and decommissioning of retired facilities; and waste management operations.

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Supporting Technologies and Infrastructure Programs

DOE EM has a number of technology development program initiatives underway to support and supplement its technology development activities. These

program initiatives fall within four categories: RDDT&E, supporting technologies and infrastructure, technology integration and environmental education development, and emergency management/transportation. Descriptions and points of contact for each program are provided in the following paragraphs.

RDDT&E Program Initiative--Innovative Technology

The mission of the Innovative Technologies (IT) Program is to identify and provide development support for two types of technologies:

- Technologies that show promise to address specific EM needs, but require proof-of-concept experimentation

- Already proven technologies in other fields that show promise of being adapted to specific EM needs.

The IT Program provides seed money to DOE field sites, other government agencies, industry, and universities to accelerate research of promising technologies in these two categories, and promptly moves successful projects to the Integrated Program (IP) or Integrated Demonstration (ID) level. The approach of targeted and accelerated research will result in timely advances in the state-of-the-art in environmental restoration and waste management technologies so that developed technologies can be used to accomplish the overall EM mission with greater expediency and success.

The IT Program is based on the premise that conventional methods for many environmental restoration and waste management problems are marginal in effectiveness, time consuming, costly, and may not reduce the possibility of future problems. Through a combination of external and internal mandates, IT is charged with finding technologies that are presently beyond the frontiers of science and engineering or that are developed for other purposes but show promise for adaptation DOE needs. Following is a brief list of the internal and external drivers that influence the program.

- EPA is promoting the development and implementation of innovative, cost-effective solutions to environmental restoration and waste management problems.

- EPA, DOD, DOI, and DOE signed a Memorandum of Understanding with the Western Governor's Association (WGA) to establish a cooperative approach for development of necessary environmental technology,

- EPA, states, and DOE have entered into Federal Facilities Compliance Agreements (FFCAs) relative to DOE's waste management program.

- R&D communities external to DOE are developing technologies relevant to the EM mission, and are interested in and willing to participate in EM technology development efforts, particularly those that could result in marketable technologies.

- EM's Implementation Plan for environmental restoration and waste management acknowledges that innovative technologies have the potential of significantly reducing waste volumes to be transported, reducing cost of current treatment activities, and reducing risk to workers and to the public.

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Supporting Technologies and Infrastructure Program Initiatives

DOE EM currently has three supporting technologies and infrastructure program initiatives underway. These program initiatives focus on analytical laboratory management, robotics technology development, and decision support.

Analytical Laboratory Management

The analytical laboratory management program ensures the availability of analytical data for efficient waste management characterization, effective cleanup, and demonstration of regulatory compliance. It also ensures that standard regulator-approved procedures are in place, and that analytical data appropriate to user needs are generated and maintained.

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Robotics Technology Development

This program develops robotics technology to retrieve buried waste, characterize it for immediate processing, and disposal at approved storage sites.

This technology is being developed with applications for laboratory automation to remotely handle and analyze radioactive and hazardous materials. Robotics technology is also being developed for underground storage tank and buried waste characterization and waste handling; decontamination and decommissioning of retired facilities; and waste management operations.

The key element in convincing customers and regulators that advanced robotics systems are preferable to existing alternatives is the full-scale, full-complexity of system prototypes operating in an environment closely simulating real-world problems. The Robotics Technology Development program applies this concept by developing computer-controlled, sensor-based robotics systems for technology demonstration.

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Decision Support

Decision support identifies management tools to assess, analyze, and evaluate DOE EM technology development cost, schedule, and technical decisions. It also provides a framework for decision-making, decision support systems and data bases, and risk assessment. Other areas of program focus are performance assessment, cost/benefit analyses, risk and communication.

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Technology Integration and Environmental Education Development Program Initiatives

DOE EM has three technology integration and environmental education development program initiatives currently underway. They are Technology Integration, International Technology Exchange program, and the Environmental Education Development program.

Technology Integration

Technology Integration works with industry, especially small business, universities, and other government agencies to build public-private sector partnerships and to nurture a user-friendly modus operandi for doing business with DOE. It does this by matching interested parties, streamlining procedures and developing new policies for doing business with DOE, and assures stakeholders participation in the decision making process.

The Technology Integration Division (EM-521) is comprised of three major program elements: industrial integration, small business assistance, and public participation. Collectively, these program areas are pursuing various initiatives and program activities to meet customer needs by bringing technology and capabilities into DOE from outside organizations; moving successfully demonstrated technology across DOE to sites with comparable environmental management technology needs; and transferring successful technologies out of DOE to industry and other agencies seeking to resolve similar environmental problems.

In particular, Technology Integration is providing crosscutting support to the research, development, demonstration, test, and evaluation (RDDT&E) mission of EM-50. Such support efforts are central to the development and transfer of innovative cleanup technologies to EM-50's principal customers, namely EM-30, -40, and -60. In addition, Technology Integration is working with external organizations (including firms from private industry, small businesses, and public stakeholders) to promote "win-win," public-private partnerships in support of EM environmental cleanup activities.

In efforts to enhance industrial interactions with small, medium, and large businesses, Technology Integration is actively: promoting business and research opportunities within the DOE environmental cleanup market; developing policies and procedures for using Cooperative Research and Development Agreements (CRADAs) and other cooperative mechanisms; providing private-sector partners with access to licensable technologies and other forms of DOE-developed intellectual property; and offering technical assistance and access to EM sites and facilities for outside organizations to benefit from EM capabilities, expertise, and "lessons learned." In addition, Technology Integration is providing decision-making opportunities for stakeholders, bolstering public awareness of DOE cleanup actions and increasing regulators confidence for supporting innovative environmental technology options.

Industrial Integration Program

The principal thrust of the Industrial Integration program is to provide scientific and technical information on innovative technologies to EM-30, -40, -50 and -60 representatives; to facilitate industry access to DOE sites to market their technologies for DOE use; and to ensure technology transfer to outside organizations.

Major highlights and scheduled activities presently include: developing electronic information system capabilities to enhance program manager access to current cost, schedule, performance and related data; disseminating a technology catalogue of innovative technologies under development in EM-50 for external audiences; developing and maintaining a database of JWS/CRADAs involving public- and private-sector partners participating in the EM program; introducing private-sector technologies into Integrated Demonstrations (IDs) and Integrated Programs (IPs); conducting information exchange meetings with industry; operating a *Central Point of Contact* (CPOC) to increase opportunities for industry to market cleanup services and technologies to EM; forming a Technology Integration System Support (TISS) Network to match industry capabilities and technologies to ID and IP needs; designing outreach and communication materials for industry, universities, and other government agencies; facilitating the approval process for all EM-50 CRADAs; coordinating information dissemination on Departmental intellectual property, procurement and other technology transfer issues integral to successful public-private ventures; developing a technology transfer training program for EM-50 Program Managers; and developing technology transfer process models to promote the transfer and commercialization of technology developed within EM.

Small Business Program

Strengthening the role of small businesses in meeting DOE/EM technological needs is the major focus of the Small Business Program. By providing such assistance, Technology Integration can enhance small business participation in DOE environmental cleanups. Specific program thrusts include: coordinating small business technology acquisition activities resulting from the Research Opportunity Announcement and other acquisition vehicles; providing information to small businesses on EM programs, technology needs, and potential business and research opportunities; addressing barriers that hinder small business technology innovation and participation in RDDT&E; promoting technologies advanced via the ROA and other acquisition vehicles and facilitating their transfer into EM, other government agency, and industrial markets; providing technical assistance to small businesses to facilitate the development and adoption of innovative environmental technologies; offering technical staff support to EM Program Managers participating in small business activities; and establishing working relationships with other DOE small business programs

Small Business Innovation Research (SBIR)

EM participates in the DOE SBIR program which is an annual competitive grant program that supports phased research and development on advanced concepts related to energy and the environment. Proposal solicitation occurs each January with Phase I winners receiving up to $75,000 to explore the feasibility of their ideas. In the second phase, $500,000 is available for those ideas with the highest potential to meet the program objectives. For more information on

the SBIR program or to be placed on the solicitation mailing list, contact the SBIR office at (301) 903-5707. Anyone at this number will be able to assist.

Public Participation Program

The Public Participation Program was established to ensure EM-50 activities are consistent with public participation and other statutory and regulatory mandates. Specifically, mechanisms have been established to provide opportunities to involve the public stakeholders in DOE decision-making. The Program is researching, developing, and testing innovative public participation process models and providing public participation training for EM-50 program and project managers.

Technology Integration is developing a public participation plan highlighting the budget, management, and review process, and addressing areas for possible stakeholder involvement. This plan governs technology development activities sponsored by EM-50, and is being coordinated with EM's Office of Policy and Program Information (EM-4). Each ID and IP will use this plan as guidance and develop site specific Public Participation Plans. A national community leaders forum for technology development decision makers has been established to ensure open and regular dialogue, and mechanisms for enhanced communications with the EM Advisory Committee (EMAC), the State and Tribal Government Working Group (STGWG), and Stakeholders Forum are being institutionalized.

Remaining initiatives and program thrusts presently include: providing regulatory training within the technology development framework to state regulators; evaluating the effectiveness of DOE's use of citizen advisory boards, and producing a report summarizing recommendations to EM-4; evaluating and implementing recommendations for citizen advisory boards at an EM site; designing, conducting, and analyzing a national stakeholder and DOE employee survey focused on public participation issues; implementing an effective information dissemination system to distribute information to stakeholders; refining the DOE Headquarters Public Participation Awareness Program that provides guest seminars on related topics; and designing, implementing, and evaluating two public participation training programs for Headquarters and field managers.

CONTACT

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International Technology Exchange

The International Technology Exchange Division facilitates collaboration among governments, industries, and educational institutions to identify international remediation needs and to evaluate international technologies suitable for use in DOE cleanup activities. It brings foreign technologies into the DOE complex and transfers DOE-developed technologies to the international market place. The Division coordinates EM international travel and technology research, and international agreements in cooperation with other Federal agencies and private industry.

CONTACT

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Environmental Education and Development

Environmental Education and Development sponsors initiatives to ensure DOE's current and future workforce has the requisite skills, capabilities, and training to meet DOE's future cleanup needs. These initiatives include academic partnerships with university consortia, internships to develop qualified staff, and scholarships and fellowships for graduate and under-graduate students. The program also sponsors activities to: promote DOE interactions with community colleges; and advance understanding of environmental issues. This area also addresses the issues of workforce planning.

CONTACT

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Emergency Management

Emergency management focuses on planning for, responding to, and mitigating emergency situations during environmental restoration, waste management, or DOE non-weapons transportation activities. Program components include EM facility emergency preparedness, transportation emergency preparedness, and occurrence notification and reporting.

CONTACT

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Transportation Management

Transportation management develops, manages, and coordinates transportation policies and procedures for:

- all DOE materials, including hazardous materials (particularly radioactive), substances and wastes

- shipping activities (i.e., transportation operations and the traffic business)

- develops the systems and technologies (i.e., packaging development and training programs) to ensure that safe, economical, and efficient transportation services, meeting regulatory requirements, are consistently available to DOE in order to fulfill its missions.

In addition, transportation management supports DOE-wide activities with significant research and development capabilities, as well as an operational automated information and communication systems infrastructure (nation-wide) which collects, stores, and disseminates reliable transportation related information throughout DOE and to other Federal agencies as required.

CONTACT

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Once You've Made Contact

Identifying the right DOE programs and contacts is the first step in doing business with DOE EM. The next step is to find the most effective and efficient financial, acquisition, and business assistance provisions to ensure successful business transactions. Chapter 1 presented the descriptive information regarding these mechanisms and their use. The central point of contact can be used at any stage.

Appendix A Acronyms

CRADA	Cooperative Research and Development Agreement
DOE	U.S. Department of Energy
DT&E	Development, Testing, and Evaluation
EM	Environmental Restoration and Waste Management
EM-1	Office of Environmental Restoration and Waste Management
EM-4	DOE EM Office of Policy and Program Information
EM-10	DOE EM Planning and Resource Management
EM-20	DOE EM Oversight and Self-Assessment
EM-30	DOE EM Waste Management
EM-40	DOE EM Environmental Restoration
EM-50	DOE EM Technology Development
EM-60	DOE EM Office of Facility Transition and Management
HQ-PM	DOE Headquarters, Program Manager
ID	Integrated Demonstration
IDC	Integrated Demonstration Coordinator
IP	Integrated Program
IPC	Integrated Program Coordinator
ORTA	Office of Research and Technology Applications
PRDA	Program Research and Development Announcement
R&D	Research and Development
RDDT&E	Research, Development, Demonstration, Testing, and Evaluation
ROA	Research Opportunity Announcement
SB-TIP	DOE EM Small Business Technology Integration Program
TPO	Technical Program Officer
VOC	Volatile Organic Compound

Appendix B DOE Organizational Descriptions

DOE EM Office of Policy and Program Information (EM-4)

The DOE EM Office of Policy and Program Information serves as a central coordination point for DOE EM public participation and program information activities. EM-4 establishes EM public participation policy and guidance, conducts EM public participation activities, and coordinates EM public participation activities on both an intra- and interagency basis. The goal of public participation is to identify public concerns, needs, and objectives, through two-way communications between DOE and the public as part of the decision making process. This interactive process improves DOE understanding of public concerns, and improves the public's understanding of DOE decisions and subsequent technology development activities.

DOE EM Office of Planning and Resource Management (EM-10)

The DOE EM Office of Planning and Resource Management coordinates and integrates activities across all EM offices and divisions and provides overall direction and management oversight for all areas of EM operation. EM-10's scope of activities includes budget development and financial management, project coordination and control, and human resource management. EM-10 also provides oversight for security, procurement, automated office support and information management systems, and administrative and support services.

DOE EM Office of Oversight and Self-Assessment (EM-20)

DOE EM Office of Oversight and Self-Assessment performs an independent internal oversight function to ensure compliance with environmental and safety laws and regulations and to enhance technical validity and cost effectiveness in EM programs and projects. Through self-assessment, EM-20 ensures that the operations and maintenance procedures and practices of EM field activities comply with DOE orders and accepted industry practices.

DOE EM Office of Waste Management (EM-30)

DOE EM Office of Waste Management is responsible for waste management at all DOE sites. Program activities focus on the treatment, storage, and disposal of DOE-generated wastes such as high-level radioactive wastes, sanitary wastes, and transuranic radioactive wastes. DOE EM-30 activities also encompass the management of low-level radioactive waste; mixed waste, both radioactive and chemically hazardous; and hazardous waste and substances addressed by the *Resource Conservation and Recovery Act* and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.* In addition, EM-30 directs waste reduction and minimization efforts and waste management-related facility corrective actions that are required to bring

active and standby facilities into compliance with applicable federal, state, and local regulations.

DOE EM Office of Environmental Restoration (EM-40)

DOE EM Office of Environmental Restoration manages the cleanup of hazardous waste at 110 DOE sites in 32 states and at one site in Puerto Rico. Activities focus on environmental restoration as well as decontamination and decommissioning. Remedial actions include all aspects of assessment and cleanup of known and suspected inactive release sites. Decontamination as well as decommissioning focuses on the safe caretaking of surplus nuclear facilities until they are decontaminated, entombed, dismantled and removed or until the site is converted.

DOE EM Office of Technology Development (EM-50)

DOE EM Technology Development, as the DOE EM technical RDDT&E service organization, develops and applies innovative environmental technology systems to fulfill specific environmental restoration and waste management needs for DOE sites. DOE EM-30 and EM-40 identify technical needs and requirements and share this information with DOE EM-50, which in turn, identifies the best available technology to fill these requirements. If state-of-the-art technologies are unable to respond to identified needs, the DOE EM-50 develops new and innovative environmental restoration systems for DOE EM-30 and EM-40. Once these technologies have been successfully demonstrated, they are transferred internally to EM-30 and EM-40 and externally to the private sector, universities, and other government programs with similar remediation requirements. EM-50 also supplies analytical laboratory, transportation, emergency management support, education, outreach, and technology integration programs.

DOE EM Office of Facility Transition and Management (EM-60)

DOE EM Office of Facility Transition and Management plans, implements, and manages the process for the orderly transition of facilities from their operational base to EM-30 and EM-40 and for their subsequent disposition. EM-60 establishes and implements a consistent process to safely deactivate and disposition DOE facilities. It also minimizes environmental safety and health risks of facilities to be dispositioned by DOE. In addition, it maximizes facility reuse by the government and/or private sector.

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