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Office of Research and Development
Washington, DC 20460

# The Superfund Innovative Technology Evaluation (SITE) Program

## Annual Report to Congress
## FY 1998

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## Notice

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## Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the nation's land, air, and water resources. Under a mandate of national environmental laws, the EPA strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet these mandates, EPA's research program, through its National Risk Management Research Laboratory (NRMRL) and National Exposure Research Laboratory (NERL), provides data and technical support for solving environmental problems, and is building a science knowledge base necessary to wisely manage our ecological resources, understand how pollutants affect our health, and prevent or reduce future environmental risks.

NRMRL is the EPA's center for investigating technological and management approaches for reducing risks from threats to human health and the environment. NRMRL's research program focuses on methods for preventing and controlling pollution to air, land, water, and subsurface resources; protecting water quality in public water systems; remediating contaminated sites and groundwater; and preventing and controlling indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

NERL is EPA's center for investigating technical and management approaches for identifying and quantifying risks to human health and the environment. Goals of NERL's research program are to (1) develop and evaluate methods and technologies for characterizing and monitoring air, soil, and water; (2) support regulatory and policy decisions; and (3) provide the science support needed to ensure effective implementation of environmental regulations and strategies.

This publication has been produced as part of EPA's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

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## Executive Summary

The Superfund Innovative Technology Evaluation (SITE) Program has successfully promoted the development, commercialization and implementation of innovative hazardous waste treatment technologies for more than 13 years. SITE offers a mechanism for conducting joint technology demonstration and evaluation projects at hazardous waste sites involving the private sector, EPA, and other federal and state agencies. The program provides environmental decision-makers with relevant data on new, viable remediation technologies that may have performance or cost advantages compared to conventional treatment technologies. Since the initiation of the SITE Program in 1986, cleanup of contaminated sites through the use of innovative technologies has resulted in a total inflated cost savings of over 1.9 billion dollars.

During fiscal year (FY) 96, the SITE Program reviewed its approach to doing business and determined that operational shifts in the program were necessary to identify and assist in the development of the most sought-after technology types and treatment methods. Building on the strengths of the existing program, such as demonstration design, quality assurance, and technology transfer, the SITE Program shifted from a technology-driven focus to a remediation problem focus, driven by the needs of the hazardous waste remediation community. The SITE Program has the following four operating functions: (1) program planning, (2) matching priority sites with innovative cleanup solutions, (3) technology field demonstrations, and (4) information dissemination. The SITE Program's vision of the program is to remain the premiere organization in enhancing the credibility and implementation of effective innovative remediation options.

The SITE Program continues to earn increased recognition as a leader in advancing innovative technology development and commercialization. The program is participating with 122 technology vendors. Through FY 98, the SITE Program has successfully demonstrated 101 technologies, six of which were completed during FY 98. Emphasis formerly placed on technologies requiring the removal of soil or groundwater (ex situ) is gravitating to in situ technologies that treat contamination in place. The SITE Program recognized this change and has emphasized the development of in situ technologies. Of the 24 ongoing or planned demonstrations, 16 are in situ, while only eight are ex situ. SITE's Monitoring and Measurement Technologies (MMT) Program has completed 36 projects to date, with 2 more in the planning stages.

To ensure that the program continues to meet the needs of the remediation community, the SITE Program established a remediation stakeholder group. This group, which is composed of such agencies as the Department of Defense and the Department of Energy, reviews innovative technology applications and develops an environmental emphasis area list, which ensures that the most pressing issues are prioritized and addressed. For instance, from discussions with various governmental and private groups, SITE's Monitoring and Measurement Technologies (MMT) Program identified a need for more effective methods to evaluate soil contamination. In response to this need, the MMT Program conducted demonstrations of four soil sampling technologies and two soil gas sampling technologies in FY 97. The MMT Program is now addressing a similarly difficult problem in evaluating the

performance of sediment sampling technologies in FY 99. Through such relationships with other interested parties, the SITE Program continually pursues opportunities to conduct cooperative technology demonstrations, thereby reducing expenditures and further promoting innovative technologies. These factors assist the SITE Program in attaining its primary goal – the expedited cleanup of the nation's most contaminated sites.


# SITE Program Description

## Introduction

The Environmental Protection Agency's (EPA) Superfund Innovative Technology Evaluation (SITE) Program has successfully promoted the development, commercialization, and implementation of innovative hazardous waste site remediation and characterization technologies for more than 10 years. The SITE Program is composed of a Demonstration Program, a Monitoring and Measurement Technology (MMT) Program, an Emerging Technology Program (ETP), and information transfer. SITE offers a mechanism for conducting joint technology demonstration and evaluation projects at hazardous waste sites through the involvement of the private sector, EPA, and other federal and state agencies. Commercialization of innovative technologies is assisted by providing potential users with high quality, unbiased performance and cost data. SITE also promotes commercial application of innovative technologies through an extensive technology transfer program.

## Program Principles

To reduce expenditures and to remain at the forefront of innovative technology development, the SITE Program reviewed its approach to doing business in fiscal year (FY) 1996. The review indicated that operational shifts in the program were necessary to identify and assist in the development of the most sought-after technology types and treatment methods. Building on the strengths of the existing program, such as demonstration design, quality assurance, and technology transfer, the SITE Program shifted in FY 97 from a technology-driven focus to a remediation problem focus, driven by the needs of the hazardous waste remediation community. EPA's vision of the SITE Program is to remain the premiere organization in enhancing the credibility and implementation of effective innovative remediation options.

In FY 98, the program continued to focus on cost-effective solutions to remediation problems. The success of the program's focus is illustrated in the strong response to solicitations for technologies, and the great interest in resource leveraging with the SITE Program from federal and state agencies, such as the Department of Defense (DOD), Department of Energy (DOE), and State Environmental Protection Agencies.

The SITE Program is defined by the following four operating principles: (1) program planning, (2) matching priority sites with innovative cleanup solutions, (3) technology field demonstrations, and (4) information dissemination.

### *Program Planning*

To ensure that the SITE Program continues to focus on validating the most sought-after remediation technologies, overall program direction and strategies are now evaluated each year based on input from the user community and other private- and public-sector stakeholders. As part of the overall program planning process, the SITE Program is developing and will implement a quality management plan based on American National Standard Institute, Specifications and Guidelines for Quality Assistance for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E4).

### *Matching Priority Sites with Innovative Cleanup*

***Solutions***

The SITE Program formerly identified innovative technologies, and then searched for an appropriate demonstration site. The SITE Program now solicits and prioritizes sites, and then seeks appropriate technologies for demonstration at these sites. Matching a site with a technology is a flexible process, and a site owner has the option of evaluating one or more technologies. If no specific technology or vendor is identified by a chosen site, technologies and vendors are matched to sites by the SITE Program and other interested parties, which may include state and federal regulators and other public representatives.

An important aspect of technology selection is that more than one technology may be introduced for review and demonstration. This aspect allows for matching the most appropriate and feasible technology to a particular site. General technology needs of the user community are identified by soliciting input from working groups, forums, personal communication, and hazardous waste publications. With this continuous input, the SITE Program will continue to focus on the needs of the remediation community and the more pressing problems at contaminated sites.

***Technology Field Demonstrations***

Field demonstrations are conducted to provide quality data to evaluate technology performance. The resulting data and reports are intended for use by the site owners and state and federal decision-makers in evaluating remediation options and for adding credibility to technology vendors promoting their processes.

SITE Program technology demonstrations are increasingly conducted in partnership with other EPA offices, other federal agencies, states, private industry, and universities. These partnerships not only reduce the overall costs of demonstrations to EPA, but accelerate remediation of some of the most problematic sites at federal and state facilities. One example of these partnerships is a cooperative agreement with the Ohio EPA at the Crooksville/Roseville Pottery site. This site is contaminated with lead from waste disposal practices associated with pottery production operations. Concurrent SITE demonstrations were performed at the site to assess the ability of two technologies to reduce bioavailable lead, and therefore the associated health risks at the site.

***Information Dissemination***

As part of its improvement process, the SITE Program recognized the need for expediting the progression of demonstration data from the program to the user community. The expansion of its electronic information sources was identified by the SITE Program as the most effective means for accomplishing this task. As a result, the amount of information on innovative technologies available through electronic sources is growing at a rapid pace, with the World Wide Web as the primary conduit.

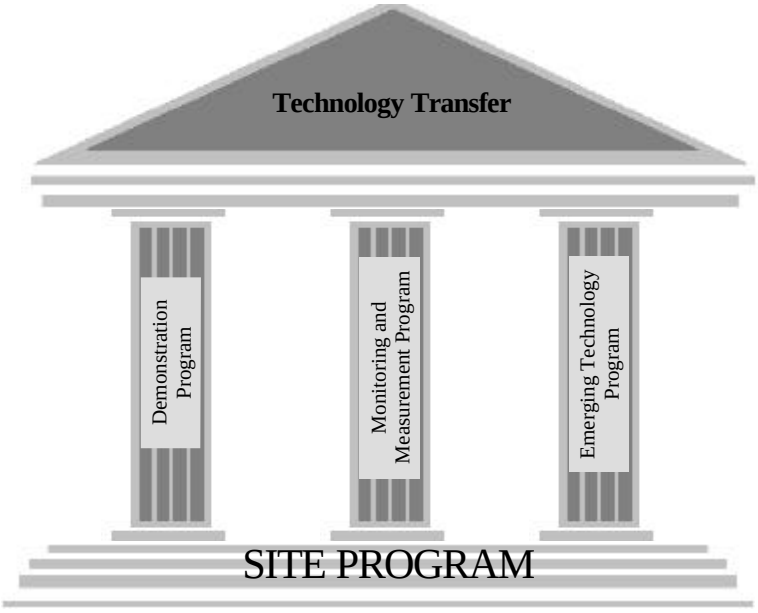
The development of technical documents within the SITE Program is a dynamic process, with a continual drive towards presenting data in its most usable form. A primary product of this effort is the summarization of information on a variety of technologies or applications for a specific area of interest. This information allows the user community to compare the technical capabilities of these technologies, expected cost for the application, and the compliance of the technology with regulatory guidelines.

Meetings and conferences continue to be an important factor in the dissemination of technical information generated by the SITE Program and were utilized to their full potential during FY 98. These forums offer face-to-face discussion among the user community, technology developers, and the SITE Program, which serves to generate ideas for future development and use of innovative technologies.

**Program Implementation**

SITE is a partnership between the public and private sectors, where the costs and responsibilities are shared by EPA, hazardous waste site owners, and technology developers. EPA enters into cooperative-type arrangements with site owners and technology developers, under which innovative technologies are demonstrated at selected hazardous waste sites. EPA evaluates the new technologies based on the demonstration results, and compiles and publishes engineering, performance, and cost data intended to aid in decisions regarding the use of the technologies at similar hazardous waste sites. The program generates credible and unbiased technology cost and performance data needed by remedial project managers, consultants, and other environmental decision makers. EPA promotes easy access to this information, allowing project managers to make timely decisions in selecting cleanup remedies.

Historically, one of the greatest factors inhibiting the use of innovative cleanup technologies has been the lack of adequate and credible cost and performance data during technology development at or near the commercial scale. Understandably, many site owners are unwilling to risk the use of innovative technologies without assurance of the technology's success. By addressing this need, SITE has aided in the first-time field use of many technologies, often resulting in wide acceptance of a particular technology. Providing credible, unbiased cost and performance data remains the foundation of SITE.




**Program Design**

The SITE Program is comprised of the following key elements:

***✓ Demonstration Program***
Evaluates and verifies cost and performance of promising innovative technologies at selected hazardous waste sites to provide reliable performance, cost, and applicability information for site cleanup decision-making

***✓ Monitoring and Measurement Technology Program***
Evaluates technologies that detect, monitor, and measure hazardous and toxic substances to provide more cost-effective methods for producing real-time data during site characterization and remediation

***✓ Emerging Technology Program***
Fosters the research and development of innovative technologies for remediation of hazardous waste sites

***✓ Information Transfer Activities***
Disseminates technical information, including engineering, performance, and cost data, to assist in removing barriers for use of innovative and alternative technologies

***Demonstration Program***

In the Demonstration Program, innovative cleanup technologies are field tested on hazardous waste materials. SITE demonstrations are conducted at hazardous waste sites, such as those on the National Priorities List (NPL); Brownfields at non-NPL sites; or under simulated hazardous waste site conditions at developer or federal test and evaluation facilities.

Engineering, performance, and cost data are gathered on innovative technologies for review by potential users to evaluate their applicability to similar waste sites or to compare their effectiveness and costs to other alternatives. Data collected during each field demonstration are used to assess the performance of the technology, the potential need for pre- or post-processing of the waste, applicable types of wastes and contaminated media (for example, soil, sludge, water, sediment), potential operating problems, limitations, and approximate capital, operating, and maintenance costs.

***The selection of sites for the program is based on the research needs of EPA, other federal agencies, and the technology user community.***

The SITE Program annually solicits applications for participation in the Demonstration Program from interested private firms and federal and state agencies with responsibility for cleanup operations at hazardous waste sites. Cooperative arrangements or Memoranda of Understanding form the relationship between the SITE Program and the parties responsible for the host site. No contractual agreement is arranged and no funds are given to the site as part of this arrangement. SITE provides in-kind service in the form of technical demonstration, testing, sampling/ analytical services, and report writing.

Host site owners (see Appendix B for sites categorized by state and location) are responsible for providing necessary data related to the hydrogeology and other site conditions, results of feasibility studies, and results of waste analyses. The owner is responsible for all logistical requirements for the demonstration, such as availability of utilities, access to land area at the site large enough for equipment setup, elimination or restriction of geographical or geological hindrances, security provisions, and personnel safety provisions. Technology developers whose systems are demonstrated are responsible for transporting equipment to the selected site, operating their systems, and removing equipment from the site upon completion of the demonstration. EPA is financially and technically responsible for project planning, sampling and analysis, quality assurance and quality control, preparing evaluation reports, and disseminating cost and performance information to environmental managers. EPA also prepares evaluation reports, bulletins, project summaries, and videotapes to document demonstration activities. These reports and videotapes evaluate available information on the technology and analyze its overall applicability to other site characteristics, waste types, and waste matrices. Reports also include testing procedures and the quality assurance and quality control standards.

As of September 30, 1998, the Demonstration Program included 127 accepted, ongoing, and completed demonstrations. These technologies are presented alphabetically in Appendix A, according to the state in which the developer's business is located.

### *Monitoring and Measurement Technology Program*

The MMT Program provides developers of innovative hazardous waste measurement and monitoring technologies with an opportunity to demonstrate a technology's performance under actual field conditions. Following the demonstration, EPA compiles the results and prepares a report summarizing the findings. Report distribution may enhance market acceptance or define new applications for the technology.

The purpose of the MMT Program is to accelerate the acceptance and use of effective innovative measurement and monitoring technologies in the field. These technologies include new or modified technologies that can detect, monitor, and measure hazardous and toxic substances in the subsurface, soil, sediment, waste materials, and surface waters. Technologies include chemical sensors for in situ (in place) measurements, groundwater sampling devices, soil and core sampling devices, soil gas or fluid

samplers, laboratory and field-portable analytical equipment, and other systems that support field sampling or data acquisition and analysis.

MMT Program technologies can be used to accurately assess the degree of contamination at a site, provide data to evaluate potential effects on human health and the environment, supply data to assist in selecting the most appropriate cleanup action, and monitor the effectiveness of a remediation technology. The selection process places high priority on technologies that provide more cost-effective, faster, and safer methods than conventional technologies for producing real-time or near-real-time data. Innovative technologies are demonstrated under field conditions and results are compiled, evaluated, published, and disseminated by the Office of Research and Development (ORD). The primary objectives of this portion of the SITE program are to:

- Test field analytical technologies that enhance monitoring and site characterization capabilities
- Identify the performance attributes of new technologies to address field characterization and monitoring problems in a more cost-effective and efficient manner
- Prepare protocols, guidelines, and methods that enhance the acceptance of these technologies for routine use

Evaluations or demonstrations have now been completed for 36 technologies in the MMT Program. The MMT Program is administered by ORD'S National Exposure Research Laboratory at the Environmental Sciences Division in Las Vegas, Nevada. Technologies demonstrated under the MMT Program are listed in Appendix A.

***Emerging Technology Program***

The ETP fosters the research and development of innovative technologies for remediation of Superfund and other hazardous waste sites. Technologies enter the program at the bench- or pilot-scale stage of development. EPA provides developers the opportunity to advance a technology from bench- and pilot-scale testing to demonstration.

The SITE ETP was discontinued in 1996 due to reductions in funding to the Superfund research and development budget. The SITE Program continues to honor commitments to technology developers currently in the ETP but no new technologies were admitted into the program after 1995. Technologies were solicited yearly for the ETP through requests for proposals. Selected candidates were invited to submit a Cooperative Agreement application that underwent full technical review. Applications were considered for a Cooperative Agreement with a duration of up to 2 years, with funding of $150,000 per year with a $300,000 maximum. Second year funding depended on significant progress during the first year. Upon completion of the ETP, technologies were considered for the SITE Demonstration Program. Many technology vendors chose to fully commercialize their technologies after participating in the ETP.

***Information Transfer Activities***

Information transfer activities ensure that valuable information about innovative technologies from the Demonstration and MMT Programs is disseminated through various communication mechanisms, such as technical networking, publications, and electronic distribution. The most important products are the published technical reports for each field demonstration. All such activities promote the awareness and use of innovative technologies for assessment and remediation at Superfund sites. The primary goal of information transfer is to promote communication among environmental stakeholders requiring up-to-date technical information.

Mechanisms for providing information on technology demonstrations and the SITE Program include the following:

- Program-specific brochures and exhibits
- Conferences, workshops, and technical

working groups

- Publications and videotapes (see Appendix C)
- Electronic media, including the Internet and electronic bulletin boards
- Technical assistance to regions, states, and remediation contractors
- Technology seminars

Printed and electronic documents are accessible through the World Wide Web at the Environmental Technologies Verification (ETV) Web site (*http://www.epa.gov/ORD/SITE*) and a site supported by the EPA Office of Solid Waste and Emergency Response's Technology Innovation Office (TIO) (*http://clu-in.org*).

Several technology databases summarize information about innovative treatment technologies and associated vendors. These databases may serve as tools in identifying potential technology demonstration candidates or serve as directories for technology vendors. Examples of these databases include, but are not limited to, Remediation and Characterization Innovative Technologies (REACHIT) online system (*http://epareachit.org*), and the Bioremediation in the Field Search System (BFSS). Descriptions of the databases and publication ordering information are provided in Appendix D.

## SITE Program Accomplishments and Vendor Benefits

### Promotion of Innovative Technologies

SITE is recognized as one of EPA's principal programs to advance innovative site monitoring, characterization, and cleanup technologies, with the potential to treat hazardous wastes more efficiently, less expensively, and more safely than many existing methods. SITE's mission is to promote the development and application of innovative technologies that reduce or eliminate risks to human health and the environment due to contamination. The goal of the program is to interact with the technology user community, understand its needs, integrate those needs with EPA's research mission, and expeditiously address those needs. Identifying and responding to the technology needs of the remediation community is the driving force behind today's SITE Program.

***SITE is a Recognized Leader in Advancing Innovative Techology***

Over the past 13 years, SITE has earned increased recognition as a leader in advancing innovative technology development and commercialization and has participated cooperatively with more than 122 technology developers. Through FY 98, the SITE Program has successfully demonstrated 101 technologies, six of which were completed during FY 98. These demonstrations have provided a tremendous amount of information on the performance, costs, and applicability of innovative cleanup technologies, which greatly assists managers of environmental remediation projects in developing appropriate and effective cleanup solutions.

The types and numbers of innovative technologies selected for remediation at Superfund sites increased significantly after the passage of the Superfund Amendments and Reauthorization Act (SARA). While rarely used during the early 1980s, innovative technologies comprised approximately one-quarter of the total number of technologies selected for Superfund remediation projects between FY 86 and FY 87. Since then, the number has continued to rise, indicating increased credibility and confidence in a number of innovative treatment technologies. Figure 1 shows that more innovative versus conventional technologies were selected in Records of Decisions (RODs—official records documenting selection of Superfund site cleanup methods) signed during FY 93 through FY 97. Although SITE is only one contributing factor in increasing innovative technology selection, the program has played a significant role in this activity.

### Historical Program Cost Savings and Vendor Contracting

Since its establishment in 1986, the SITE Program has assisted in the development and use of innovative technologies, resulting in substantial cost savings for cleaning up contaminated sites. The SITE Program has assisted vendors in advancing innovative technologies from the development phase to full-scale application, and has promoted greater acceptance of these technologies. The following subsections provide examples of the financial success of the SITE Program.

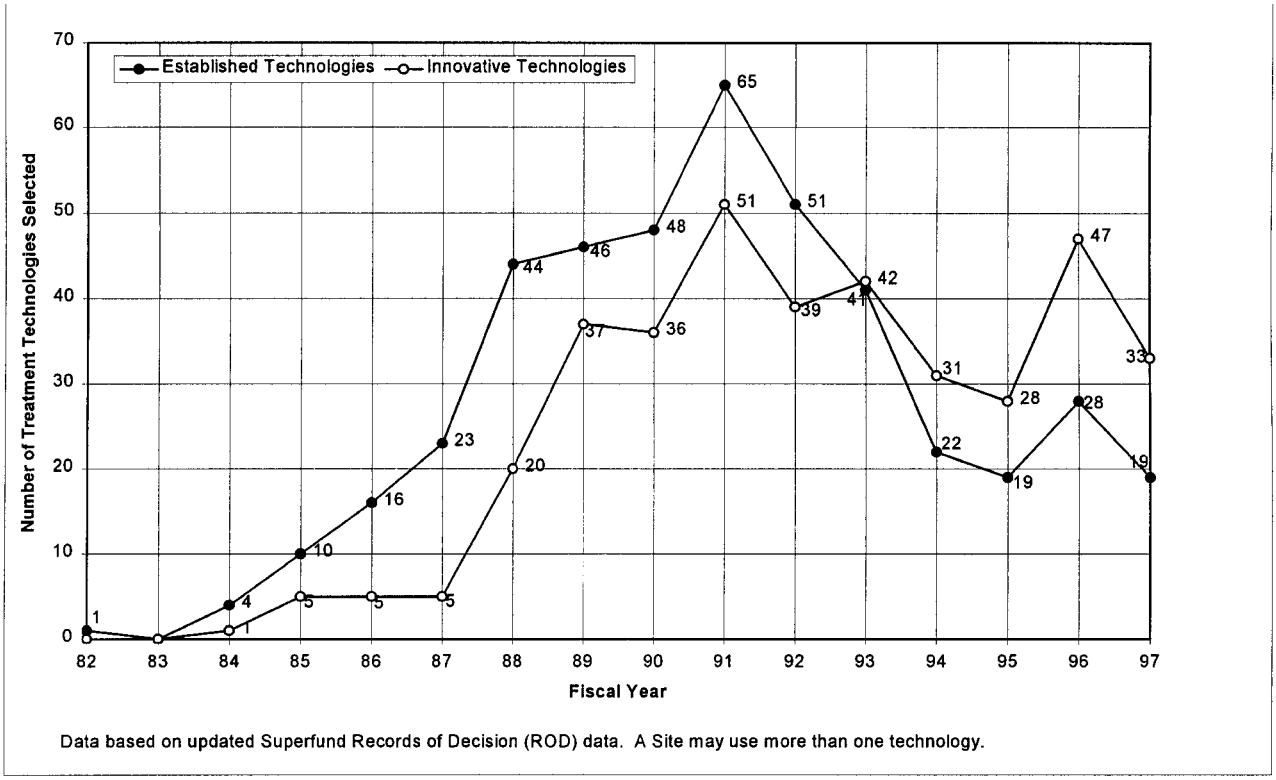



**Figure 1.** Treatment technologies for source control chosen in RODS
(Adapted from: U.S. EPA, Office of Solid Waste and Emergency Response, Innovative Treatment Technologies Annual Status Report, Eighth Edition, EPA/542/r-96/010, November 1997, and U.S. EPA, Office of Solid Waste and Emergency Response, Innovative Treatment Technologies Annual Status Report, Ninth Edition, S42-R-99-001, April 1999)

***SITE Program Accomplishments***

Figure 1 displays the number of innovative and established treatment technologies selected in RODs by year. This figure shows that interest in innovative technologies as a sound remediation action increased in the early 1990s. Since 1993, the use of innovative technologies has outpaced that of established technologies, resulting in dramatic cost savings.

During 1996 and 1999, the SITE Program collected information from signed RODs (dated 1993-1997) in all 10 EPA Regions that selected an innovative technology as the remedy. These technologies include thermal desorption, bioremediation, and in situ soil flushing. The data compiled by the SITE Program allowed environmental managers to compare innovative technologies to conventional technologies, especially with respect to cost. This time period was selected for evaluation because more innovative technologies than conventional technologies were selected in RODs signed in each of these years. Documentation was obtained from updated data on a total of 142 RODs that selected innovative technologies for part or all of the remediation. EPA guidance recommends that ROD estimates assess remedial alternatives with an accuracy of +50 percent to -30 percent. Of the 142 RODs that selected innovative technologies, 71 had sufficient information to make a cost comparison between the selected technology and a conventional technology. Cost savings realized by using innovative technologies for the 71 RODs was estimated at $2.1 billion in end of year 1998 dollars, with an average percent savings per site of over 70 percent. Only 11 of the 71 RODs reported that the innovative technology was more expensive than or equal to the established

technology.

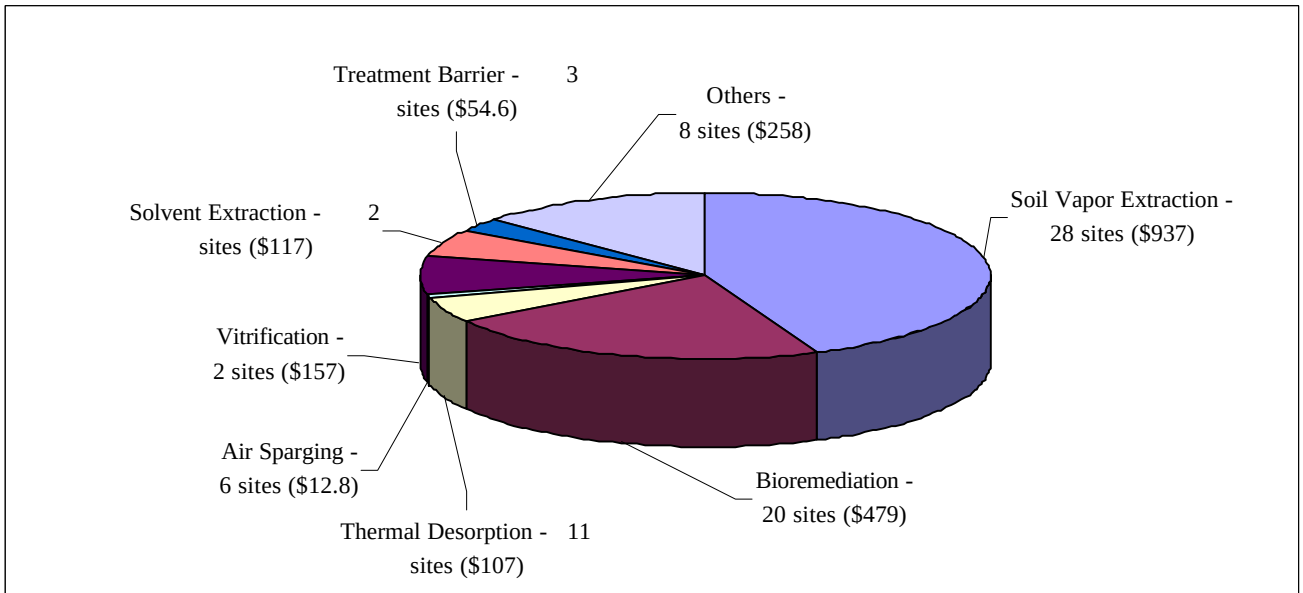
To estimate SITE Program net benefits, the FY 93-FY 97 RODs and the SITE Program budget were inflated to the end of 1998 using Consumer Price Index (CPI) inflation figures. The total inflated cost savings for RODs from 1993-1997 was $2.1 billion, and the total inflated SITE Program budget from 1986-1998 was $170 million. This comparison represents an estimated inflated cost savings of over $1.9 billion for various site cleanups.

Figure 2 shows a breakdown of savings by technology type. Soil vapor extraction (SVE) showed the highest savings of over $937 million, followed by $479 million for bioremediation. SVE was one of the initial technologies accepted into the SITE Program (in the late 1980s), and large savings would therefore be expected from this technology. Solvent extraction, vitrification, and thermal desorption each accounted for over $100 million in savings.

***Historical Vendor Benefits***

Technology vendors are a central part of the SITE Program, providing services for sites requiring clean-up solutions. Vendors experience various benefits by participating in the SITE Program, namely increased market share and recognition. Increased acceptance of innovative technologies is demonstrated by the level of commercial activity experienced by SITE Program vendors. For example, 1998 vendor information indicated that vendors completed SITE demonstration projects reported a total of 1,582 commercial remediation contracts, and 1,161 treatability studies (Figure 3).

As part of a SITE Program evaluation in 1998, 46 vendors provided information regarding company revenues. Following participation in the SITE Program, 64 percent of vendors were awarded commercial remediation jobs using technologies demonstrated in the SITE Program. Ten percent of the vendors were awarded more than 10 contracts each. For 1998, 38 percent of the SITE vendors reported one or more international contracts, more than doubling the 17 percent from 1994 data. SITE vendors identified 33 countries where jobs were contracted (Figure 4). Figure 5 provides a historical perspective of growth in the number of contracts awarded to




Savings estimates based on comparison of innovative to conventional technologies for FY 93 - 97 RODs. In cases where multiple innovative technologies were used, savings were shared equally among the technologies if no specific cost breakdown was available.

**Figure 2** Cost savings estimated from RODs analysis by technology type (millions of end-of-year 1998 dolllars)

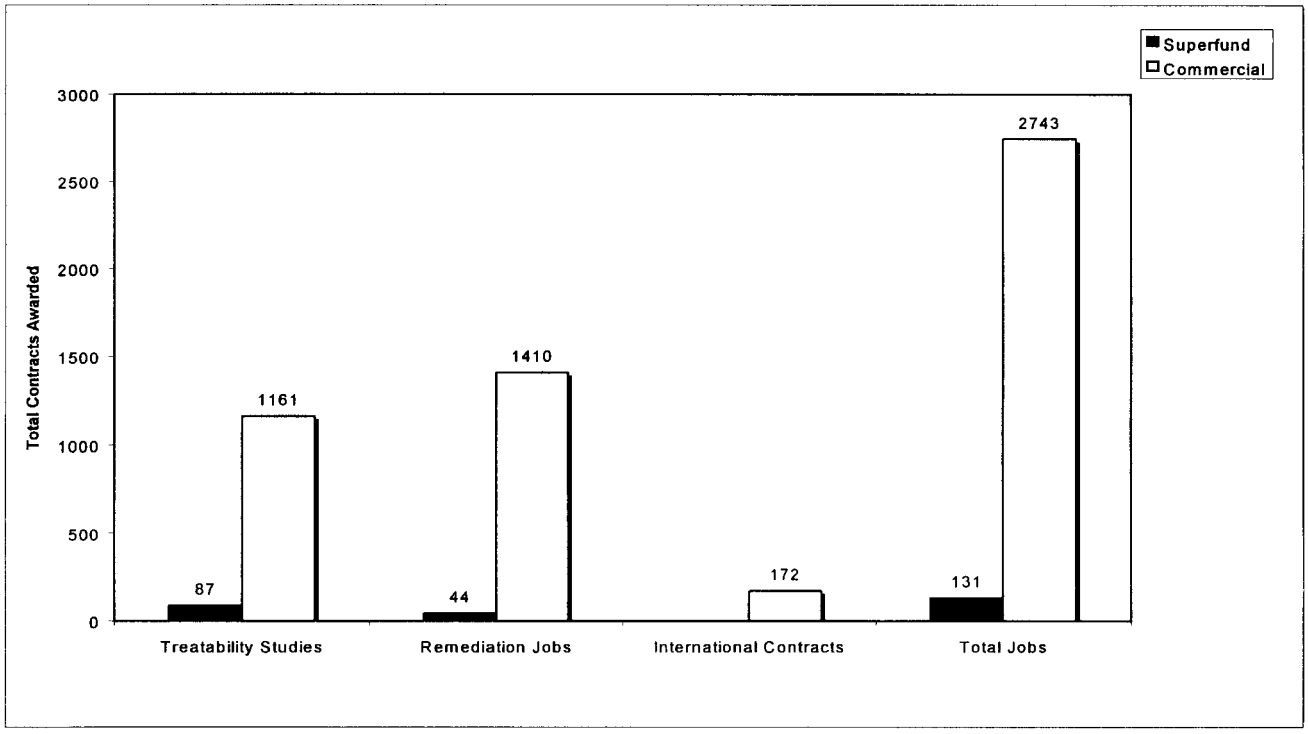



**Figure 3.** Number of contracts awarded to SITE vendors following program participation (Source: 1998 vendor information)

SITE vendors since 1990.

**Figure 4.** Countries where SITE technologies have been applied for remediation.
(Shaded countries are those where SITE vendors have applied an innovative technology)

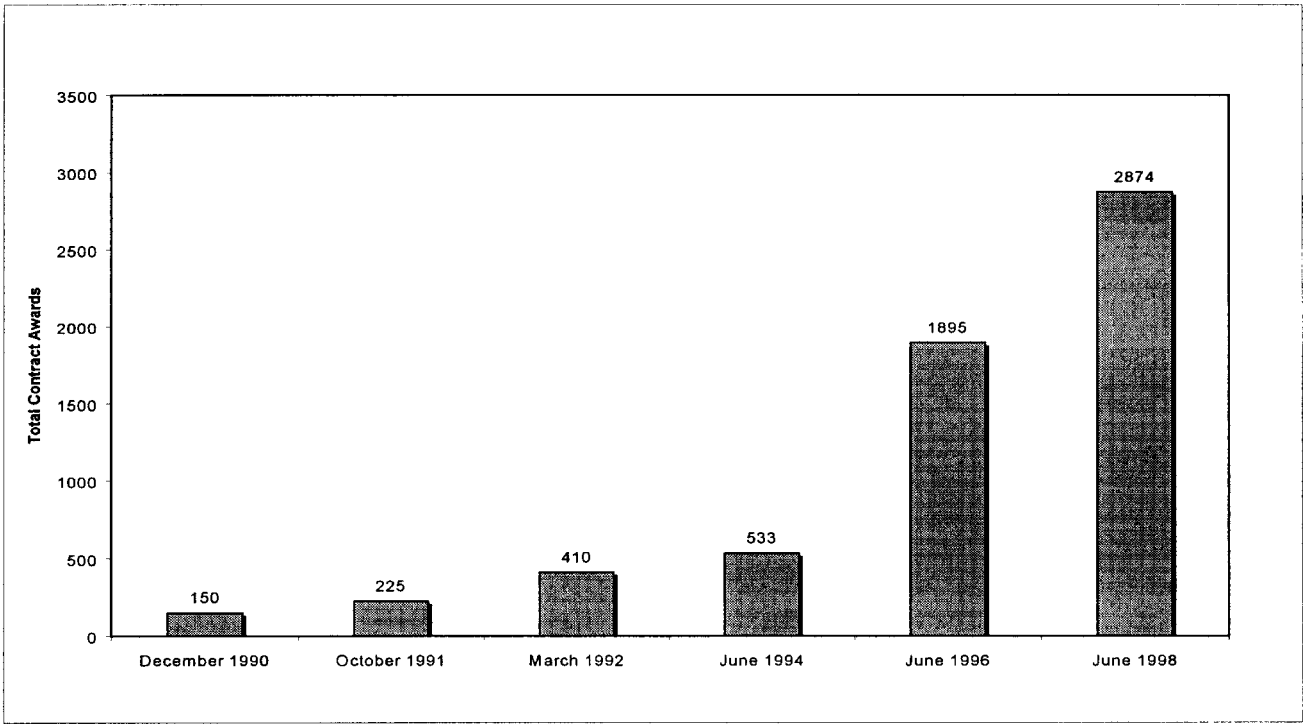



**Figure 5.** Number of remediation contracts awarded to SITE vendors after program participation (Source: 1998 vendor information)

The 1998 vendor information has been broken down by technology type to ascertain which technologies demonstrated the greatest commercial success. Figure 6 shows the share by technology type of the 1,626 remediation contracts awarded to vendors. *It is clear from this chart that soil vapor extraction and bioremediation technologies have had the most commercial success. This trend from the vendor information is consistent with the RODs analysis results which are shown in Figure 2.*

Figure 7 displays the distribution of the 1,248 treatability studies that were awarded to SITE vendors. This graph shows that solidification/stabilization technologies (35%), and soil vapor extraction (25%), have received the largest number of studies. In contrast to the remediation contracts, treatability studies were more evenly distributed among technology types.

Information was obtained in 1998 from 16 vendors in the MMT Program. This information clearly demonstrated the benefits that vendors receive from the program, indicating that 50 percent of the vendors sold more than 25 units since their demonstration in the SITE Program. Over 60 percent of the vendors indicated that vendors' technologies were used on international remediation projects. In total, the MMT vendors reported selling over 2,400 units on over 900 jobs, including 48 international jobs.

Overall, vendor information shows that SITE vendors in the Demonstration and MMT Programs are receiving remediation or characterization work for the demonstrated technologies. There is also a clear connection between the commercial success of particular remediation technology types (that is, SVE and bioremediation) as measured from vendor information, and the cost savings determined from the RODs analysis. An example of the application of an innovative technology at a Superfund site follows.

**Longhorn Army Ammunition Plant (LHAAP) Burning Ground #3 Superfund Site**

The LHAAP site was used for treatment, storage, and disposal of combustible solvent wastes with associated activities including open burning, incineration, and evaporation. The primary contaminants at the site were trichloroethylene (TCE) and methylene chloride. Initial site studies indicated that 50,000 cubic yards (cy) of soil would need to be treated. Thermal desorption (TD), a SITE Program technology, and incineration were the technologies most suited to remediation. Initial cost analyses from the 1996 ROD estimated a unit cost of $204 per cy for TD, and $524 per cy for incineration. TD was chosen to remediatethe site based on its cost effectiveness, and its ability to meet required treatment goals.

As additional characterization data became available, the scope of the project was reduced, and only 32,293 cy of contaminated soil was treated. The TD unit operated from February until December 1997, and achieved the treatment objectives for concentration reductions of organic compounds. Total project costs for the remediation were $4,886,978, which works out to $151 per cy. The unit treatment cost is a 26 percent savings over the initial TD cost estimated in the ROD, and a 71 percent savings over the estimated cost for incineration. These unit cost savings are particularly remarkable in light of the fact that a smaller volume of waste material was treated at the site due to a change in scope.

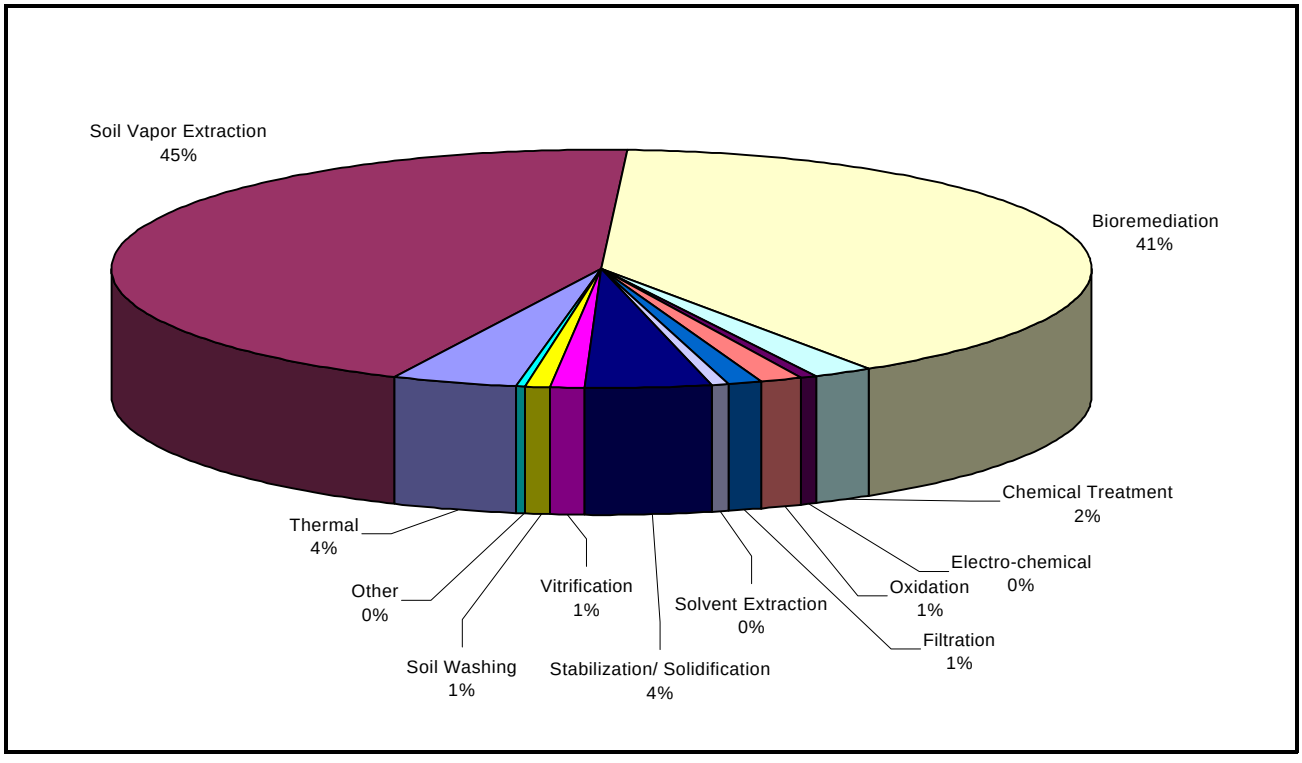



**Figure 6.** Share of 1,626 remediation jobs awarded to SITE Demonstration vendors by technology type based on 1998 vendor information.

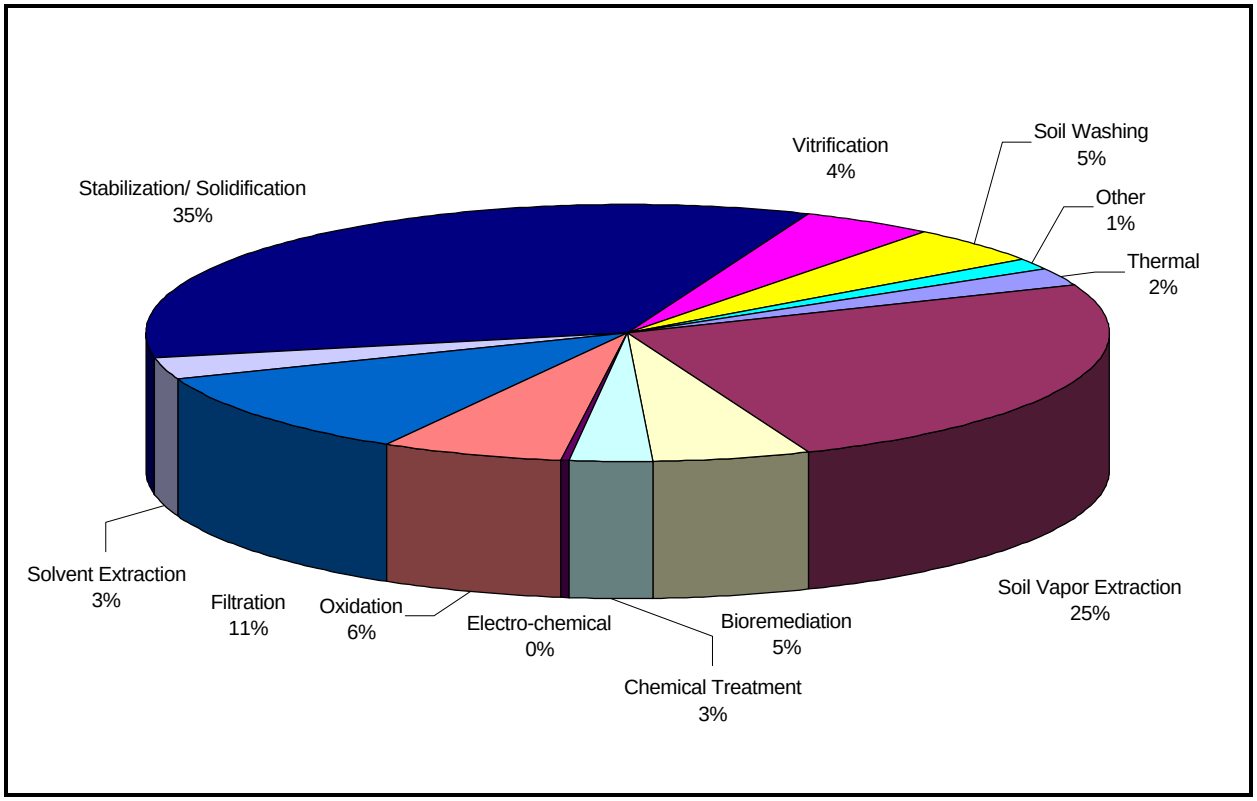



**Figure 7**. Share of 1,248 treatability studies awarded to SITE Demonstration vendors by technology type based on 1998 vendor information

# Innovative Technology Highlights

**SITE Program Case Studies**

This section presents case studies of innovative remediation technologies for vendors that have participated in the SITE Program through either the Demonstration Program (Case Studies 1 through 4) or the MMT Program (Case Study 5).

The case studies provide brief descriptions on the use and status of various technologies and, where available, general information on the cost of applying each technology. These case studies represent the SITE Program's approach to promoting innovative technologies by identifying user needs. In response to user needs, the Demonstration Program assessed the performance of an electrokinetic technology for DNAPL contamination, a phytoremediation technology for lead contamination, bioremediation of spent ore wastes, and a barrier to isolate radioactive wastes (Case Studies 1 - 4). The environmental community is also in need of low-cost, accurate methods for soil and soil gas sampling. The MMT Program has addressed this issue by evaluating the performance of six soil and soil gas samplers at two sites with differing soil types (Case Study 5).

The technologies presented in these case studies are typical of the SITE Program and represent SITE's remediation problem focus, driven by the needs of the hazardous waste community. These technologies represent real or potential solutions to actual cleanup problems faced by the environmental community.

***Case Study 1: Lasagna™ In Situ Soil Remediation (Monsanto Company, DOE, and EPA National Risk Management Research Lab)***

The Lasagna™ process combines electrokinetics with treatment layers that are installed directly into the contaminated soil to form an integrated, in situ remedial process. The process uses an outer layer of charged electrodes, which create an in situ electric field to move contaminants through the treatment layers. The design of treatment layers depends on the type of contamination present at the site. Past designs have used granular activated carbon and iron filing treatment layers to treat chlorinated solvents.

The Lasagna™ process can remove contaminants from soil in the following ways:

- Creating treatment zones in close proximity to one another, and converting them into sorption/degradation zones by adding sorbents, catalysts, microbes, oxidants, and buffers.
- Using electrokinetics to transport contaminants from the soil into the treatment zones for sorption/degradation.

***Waste Applicability***

The process is designed to treat organic and inorganic contaminants and mixed wastes in groundwater and soil. A vertical treatment zone is typically used for shallow contamination, within 50 feet of the ground surface. A horizontal configuration, using hydraulic fracturing or related methods, is capable of treating deeper contamination.

***Status***

The vertical configuration of the Lasagna™ process was accepted into the SITE Demonstration Program in 1995 as part of the White House Rapid Commercialization Initiative. Under the SITE Program, with additional funding from the DOE, it was tested for 120 days in May 1995 on soil contaminated with TCE at DOE's Paducah Gaseous Diffusion Plant (PGDP) in

Kentucky. Sampling and analysis of pre- and post-treatment soils indicated a 98 percent removal of TCE from clayey soil, from initial contamination levels around 100 parts per million (ppm).

A second test of the vertical configuration was initiated at PGDP to treat TCE-contaminated soil to a depth of 45 feet below ground surface. Complications encountered during the operation included significantly higher than expected TCE concentrations, and complex hydrogeology. The overall TCE removal efficiency was in the range of 95 percent for 1 pore volume of water flow to over 99 percent for 2.6 pore volumes between the treatment zones. *Based on the success of this test, DOE has recommended using the process to clean up the rest of the site.*

## *Case Study 2: Phytoextraction (Phytotech)*

Phytotech uses specially selected and engineered plants to treat soil and water contaminated with toxic metals such as lead and cadmium, as well as radionuclides. The treatment of soils or sediments with this technology is referred to as phytoextraction.

Phytoextraction offers an efficient, cost-effective, and environmentally friendly way to clean up heavy metal contamination. Plants are grown in situ on contaminated soil and harvested after toxic metals accumulate in the plant tissues. The degree of accumulation varies with several factors, but can be as high as 2

percent of the plants' aboveground dry weight, leaving clean soil in place with metal concentrations that are less than regulatory cleanup levels. After accumulation in the plant tissues, the contaminant metal must be disposed of, but the amount of disposable biomass is a small fraction of the amount of soil treated. For example, excavating and landfilling a 10-acre site contaminated with 400 parts per million (ppm) lead to a depth of 1 foot requires handling roughly 20,000 tons of lead-contaminated soil. Phytoextraction of the same site would require disposal of around 500 tons of biomass - about 1/40 of the soil cleaned. In the example cited, six to eight crops would typically be needed, with three or four crops per growing season.

***Waste Applicability***

Phytotech's phytoextraction technology can be used to clean soil or sediments contaminated with lead, cadmium, chromium, cesium, strontium and uranium. Phytoremediation of other metals such as arsenic, zinc, copper, and thorium is in the research stage.

***Status***

Under the SITE Program, Phytotech has demonstrated its technology at a former battery manufacturing facility in Trenton, New Jersey. Two crops were planted and harvested in late summer 1998 to remediate lead contamination in soil at the site.

Phytotech has conducted several field demonstrations of its rhizofiltration technology for the removal of (1) cesium/strontium at Chernobyl, and (2) uranium from contaminated groundwater at a DOE site in Ashtabula, Ohio. At Chernobyl, sunflowers were shown to extract 95 percent of the radionuclides from a small pond within 10 days. At the Ashtabula site, Phytotech ran a 9-month pilot demonstration during which incoming water containing as much as 450 parts per billion (ppb) of uranium was treated to 5 ppb or less of uranium.

## *Case Study 3: Spent Ore Bioremediation (Pintail Systems, Inc.)*

This Pintail Systems technology uses microbial detoxification of cyanide in heap leach processes to reduce cyanide levels in spent ore and process solutions. The biotreatment populations of natural soil bacteria are grown to elevated concentrations, and are then applied to spent ore by drip or spray irrigation. Process solutions are treated with bacteria concentrates in continuous or batch applications. This method may also enhance metal remineralization, reducing acid mine drainage and enhancing precious metal recovery to offset treatment costs.

Biotreatment of cyanide in spent ore and ore processing solutions begins by identifying bacteria that will grow in the waste source and that use the cyanide for normal cell building reactions. Native isolates are ideally adapted to the spent ore environment, the available nutrient pool, and potential toxic components of the heap environment. The cyanide-detoxifying bacteria are typically a small fraction of the overall population of cyanide-tolerant species. For this reason, native bacteria isolates are extracted from the ore and tested for cyanide detoxification potential as individual species. Any organisms demonstrating detoxification potential in flask cyanide decomposition tests are preserved and submitted for bioaugmentation. Bioaugmentation of the cyanide detoxification population eliminates nonworking species of bacteria and enhances the natural detoxification potential by growth in waste infusions and chemically defined media.

The working population of treatment bacteria is grown in spent ore infusion broths and process solutions to adapt to field operating conditions. The cyanide in the spent ore serves as the primary carbon or nitrogen source for bacteria nutrition. Other required trace nutrients are provided in the chemically defined broths. The bacterial consortium is then tested on spent ore in a 6-inch-by-10-foot column in the field or in the laboratory. The column simulates leach pile conditions, so that detoxification rates, process completion, and effluent quality can be verified. Following column tests, a field test may be conducted to verify column results.

The spent ore is remediated by first setting up a stage culturing system to establish working populations of cyanide-degrading bacteria at the mine site. Bacterial solutions are then applied directly to the heap using the same system originally designed to deliver cyanide solutions to the heap leach pads. Cyanide concentrations and leachable metals are then measured in heap leach solutions. This method of cyanide degradation in spent ore leach pads degrades cyanide more quickly than methods which treat only rinse solutions from the pad.

### *Waste Applicability*

The spent ore bioremediation process can be applied to treat cyanide contamination, spent ore heaps, waste rock dumps, mine tailings, and process water from gold and silver mining operations.

### *Status*

The technology was accepted into the SITE Demonstration Program in 1994. A demonstration was successfully conducted at Battle Mountain, Nevada to test the effectiveness of the bioremediation process to detoxify cyanide wastes. In addition, PSI has completed two full-scale cyanide detoxification projects.

## *Case Study 4: Cryogenic Barrier (Arctic Foundations, Inc.)*

Long-term containment and immobilization of hazardous wastes using ground freezing technology is a relatively new field, even though ground freezing has been used as a temporary construction aid for several years. Ground freezing is ideally suited to control waterborne pollutants, since changing water from a liquid to a solid has an obvious immobilizing

effect. The challenge for conventional ground freezing technologies is to be technically and economically viable in the long-term.

Arctic Foundations, Inc. (AFI), has developed a ground freezing technology that can be used as a long-term solution for containing and immobilizing hazardous wastes. A frozen barrier is created by reducing the ground temperature around the waste to the appropriate freezing temperature and subsequently freezing the intervening waste. The ground freezing process is naturally suited to controlling hazardous waste because in-ground moisture is transformed from serving as a potential waste mobilizing agent to serving as a protective agent.

A typical containment system consists of multiple thermoprobes, an active (powered) condenser, an interconnecting piping system, a two-phase working fluid, and a control system. The thermoprobes (AFI's heat removal devices) and piping are inserted into the soil at strategic locations around and sometimes underneath the waste source, depending on the presence or absence of a confining layer. Two-phase working fluid circulates through the piping and reduces the temperature of the surrounding soil, creating a frozen barrier around the waste source. The thermoprobes may be installed in any position and spacing to create a frozen barrier wall of almost any shape and size.

***Waste Applicability***

The cryogenic barrier can provide subsurface containment for a variety of sites and wastes, including the following: underground storage tanks; nuclear waste sites; plume control; burial trenches, pits, and ponds; in situ waste treatment areas; chemically contaminated sites; and spent fuel storage ponds. The barrier is adaptable to most geometries; drilling technology presents the only constraint to applying the technology at waste sites.

***Status***

The SITE demonstration of the freeze barrier was conducted over a 5-month period in 1998 at the Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. The demonstration was conducted to evaluate the barrier's ability to contain radionuclides from the ORNL Waste Area Homogeneous Reactor Experiment pond.

The system's effectiveness was evaluated through the performance of a groundwater dye tracing investigation. Phase I of the demonstration included a background study conducted to determine the presence of natural fluorescence and existing dyes in groundwater at the site. The purpose of the background study was to select a dye that was non-detectable in the background, for use during the dye tracing investigation. During Phase II, the dye was injected into a standpipe located within the confines of the frozen barrier. Water samples and charcoal packets were then collected at predetermined sampling points outside the barrier wall to determine the presence or absence of dye in groundwater, springs, or seeps. The freeze barrier wall was effective in impeding groundwater recharge into the containment area, with the exception of a breach in the northwest corner of the pond due to the presence of a subsurface pipe that was left in place after the pond closed.

## *Case Study 5: Subsurface Soil and Soil Gas Samplers*

The MMT Program conducted field tests of four soil and two soil gas sampling technologies in May and June 1997. The sampling technologies were demonstrated at two sites: the Small Business Administration (SBA) site in Albert City, Iowa, and the Chemical Sales Company (CSC) site in Denver, Colorado. These sites were chosen because of the wide range of volatile organic compounds (VOC) concentrations detected at the sites and because each has a distinct soil type. The SBA site is composed primarily of clayey soil, and the CSC site is composed primarily of medium- to fine-grained sandy soil.

The purpose of the field tests was to assess the performance of each technology as

compared to a standard subsurface sampling method (hollow-stem auger drilling and split-spoon sampling for the soil samplers, and active soil gas sampling for the gas samplers).

Four soil sampling technologies were demonstrated at the two test sites: JMC Environmentalist's Subsoil Probe; Simulprobe® Core Barrel Sampler; Geoprobe® Large-Bore Soil Sampler; and the AMS™ Dual Tube Liner Sampler. Two soil gas sampling technologies were demonstrated: EMFLUX® Soil Gas Investigation System; and Gore-Sorber® Screening Survey Passive Soil Gas Sampling System. Each of these technologies, and the results of the demonstration, are described below.

***JMC Environmentalist's Subsoil Probe (ESP)***

JMC Environmentalist's Subsoil Probe consists of a sampling tube assembly, the ESP body, and a jack used to assist in sample retrieval. The sampler can be advanced using manual or direct-push methods. The sampler has been used to collect samples of sandy and clayey soil contaminated with high concentrations of VOCs. The sampler can also collect samples for polychlorinated biphenyls, polynuclear aromatic hydrocarbons, pesticides, and metals analyses.

Demonstration results indicate that the ESP sampler had higher sample recoveries in both the clayey soil present at the SBA site and in the sandy soil present at the CSC site than the standard sampling methods. VOC concentrations in samples collected with the ESP sampler from the SBA site significantly differed from concentrations in samples collected using the standard methods; however, this difference was not observed for samples collected from the CSC site. Sample integrity using the ESP sampler was preserved in highly contaminated soil. The sampler's reliability and throughput were generally better than those of the standard methods. Costs for the ESP sampler were much lower than costs related to the standard sampling methods.

***Simulprobe® Core Barrel Sampler***

The SimulProbe® Technologies, Inc. (SimulProbe®), core barrel sampler consists of a split core barrel similar to a split-spoon sampler, a drive shoe, and a core barrel head. The sampler is constructed of steel, and is capable of recovering a discrete sample 1.25 inches in diameter and 27 inches long.

The SimulProbe® core barrel sampler can be used to collect unconsolidated, subsurface soil samples at depths that depend on the capability of the advancement platform. The sampler can be advanced into the subsurface using a direct-push platform, drill rig, or manual methods.

Demonstration results indicate that the core barrel sampler had higher sample recoveries and yielded samples with higher VOC concentrations in the clayey soil present at the SBA site than the standard methods. Conversely, the sampler had lower recoveries and yielded samples with lower VOC concentrations than the standard methods in the sandy soil present at the CSC site. Sample integrity using the core barrel sampler was not preserved in highly contaminated soil, and the use of sample liners was found to be required to preserve sample integrity. The core barrel sampler's reliability and throughput were not as good as those of the standard methods; however, the developer claims that the sampler used during the demonstrations was incorrectly manufactured. Costs for the core barrel sampler were lower than costs related to the standard sampling method.

***Geoprobe® Large-Bore Soil Sampler (LBS)***

The LBS Sampler is a single tube-type, solid barrel, closed-piston sampler. It is designed to be driven by the Geoprobe percussion probing machine to collect discrete interval soil samples but can be used for continuous coring if needed. This direct-push sampler is for use in unconsolidated soils. It is capable of recovering a soil core 22 inches long by 1-1/16 inches in diameter. The LBS sampler can be used to collect soil samples for both organic and inorganic analytes.

The LBS sampler demonstration results indicate that the it can provide useful, cost-effective samples for environmental problem solving. In some cases, however, VOC data collected using the LBS Sampler may be

statistically different from VOC data collected using the reference sampling method. The integrity of a lined sample chamber may not be preserved when the sampler is advanced through highly contaminated zones in clayey soils.

***Art's Manufacturing and Supply - AMS™ Dual Tube Liner Sampler (DTL)***

The AMS™ sampler consists of two steel tubes of differing diameters designed so that the two tubes fit within one another. The direct-push drill rig used to mount the dual tube liner sampler must be a 0.75-ton or heavier pickup truck supplied by the buyer or a custom-made truck assembled by AMS. The DTL sampler can be used to collect unconsolidated, subsurface soil samples at depths that depend on the capability of the direct-push advancement platform. The sampler has been used to collect samples of sandy and clayey soil contaminated with high concentrations of VOCs.

Demonstration results indicate that the DTL sampler had higher sample recoveries in the clayey soil present at the SBA site than the standard methods. Conversely, the sampler had lower recoveries than the standard methods in the sandy soil present at the CSC site. VOC concentrations in samples collected with the dual tube liner sampler did not significantly differ statistically from concentrations in samples collected using the standard methods. Sample integrity using the DTL sampler was preserved in highly contaminated soil. The sampler's reliability and throughput were generally as good as those of the standard methods. Costs for the dual tube liner sampler were lower than costs related to the standard sampling methods.

***EMFLUX® Soil Gas Investigation System***

Quadrel's EMFLUX® System is a passive, near-surface investigative technology capable of identifying buried VOCs and semi-volatile organic compounds (SVOC) at concentrations in the low parts per billion range. The EMFLUX® System has been employed with great effectiveness in detecting a broad range of VOCs and SVOCs in soil, groundwater, and air. The technology has also been successful in identifying and mapping methane, non-methane landfill gases, mercury, certain types of high explosives, and chemical surety materials.

The demonstration results indicate that the EMFLUX® system can provide useful, cost-effective data in clayey and sandy soils. The sampler identified target VOCs and may be able to detect lower concentrations of VOCs in soil gas than the reference method. The results of the demonstration did not indicate consistent proportional comparability between the EMFLUX® data and the reference method's data. The EMFLUX® system is operational and has been used on 350 major projects in 46 U.S. states, Guam, Canada, Great Britain, South America, Poland, and the Czech Republic.

***Gore-Sorber® Screening Survey Passive Soil Gas Sampling System***

The GORE-SORBER® Screening Survey employs the use of patented passive soil vapor sampling devices (GORE-SORBER® Modules), which are made of an inert, microporous, expanded polytetrafluoroethylene membrane. The membrane restricts transfer of soil and liquid, but allows the soil gases to move across the membrane for collection onto engineered sorbents. These sorbents are designed to minimize the effects of water vapor and to detect a broad range of VOCs and SVOCs. GORE-SORBER® Screening Surveys have been used successfully at sites for determining subsurface areas impacted by VOCs and SVOCs. Organic compounds commonly detected include halogenated solvents, straight- and branched-chain aliphatics, aromatics, and polycyclic aromatic hydrocarbons.

The SITE demonstration showed that the GORE-SORBER® Screening Survey is more sensitive than active soil gas sampling, and therefore more accurate in terms of detecting and reporting low concentrations of some compounds. The technology demonstration also revealed that this survey is more accurate when the soil conditions would otherwise restrict the use of active soil gas methods, for example, where the soil is very dense or nearly saturated.

Additionally, this sorbent based method provides a more robust system for sample collection and analysis for those projects that have more stringent data quality objectives.

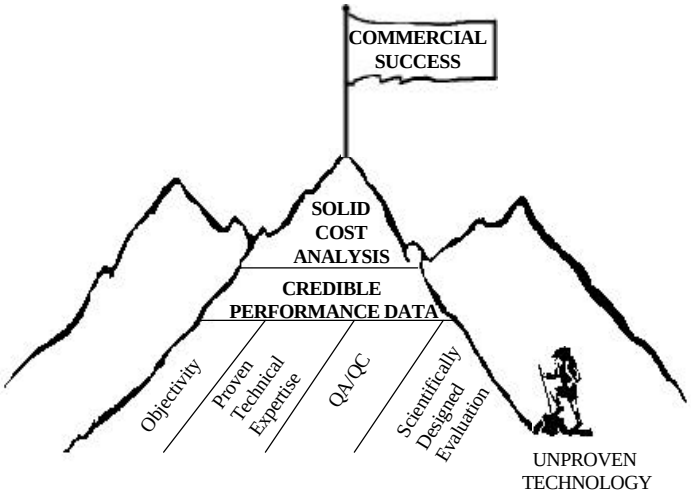
## FY 98 Progress and Accomplishments

**Demonstration Program**

The objective of the Demonstration Program is to conduct field demonstrations and high-quality performance verifications of viable remediation technologies at sites that pose high risks to human health and/or the environment, are common throughout a region or the nation, or where existing remediation methods are inadequate or too costly. The SITE Program solicits applications annually from those responsible for cleanup operations at hazardous waste sites. Respondents and these individuals may suggest one or more technologies. A panel of SITE Program scientists, engineers, and associated environmental experts reviews the applications to identify those technologies that best represent solutions for the most pressing environmental problems. The resulting data and reports are intended for use by decision-makers in selecting remediation options and for increasing credibility in innovative applications.

The need for credible and reliable data for innovative technologies remains significant. For example, of the 80 RODs signed in 1994 that selected established technologies as the best alternative, 16 (or 20 percent) considered an innovative technology as an alternative for remediation of the site. The majority of the RODs indicated that innovative technologies were not chosen due to a lack of verified performance and implementability. The SITE Program serves to fill this need for credible evaluations so that more effective, cost-efficient methods can be used on remediation problems.

During the first 10 years of the SITE Program, an emphasis was placed on innovative technologies for permanent treatment that usually required the removal of soil or groundwater.




Most field demonstrations during this period in the program's history involved ex situ physical/chemical and thermal technologies that could be field tested in a matter of days or weeks. The need for innovative, in situ technologies that provide more cost-effective approaches, provide less secondary waste, and are less intrusive will continue to increase. The SITE Program has recognized this need and has emphasized the development of in situ technologies. As shown in Figure 7, 66 completed SITE projects have been ex situ and 35 in situ. Of the 24 ongoing or planned demonstrations, 16 are in situ, while only eight are ex situ.

Field demonstration and evaluation of in situ technologies may require several months or years of data collection. Based on the SITE Program's increased emphasis on in situ technologies, the number of ongoing demonstrations will likely increase, with fewer moving from ongoing to completed status each year than in the past. It is estimated that six field demonstrations will be completed each year.

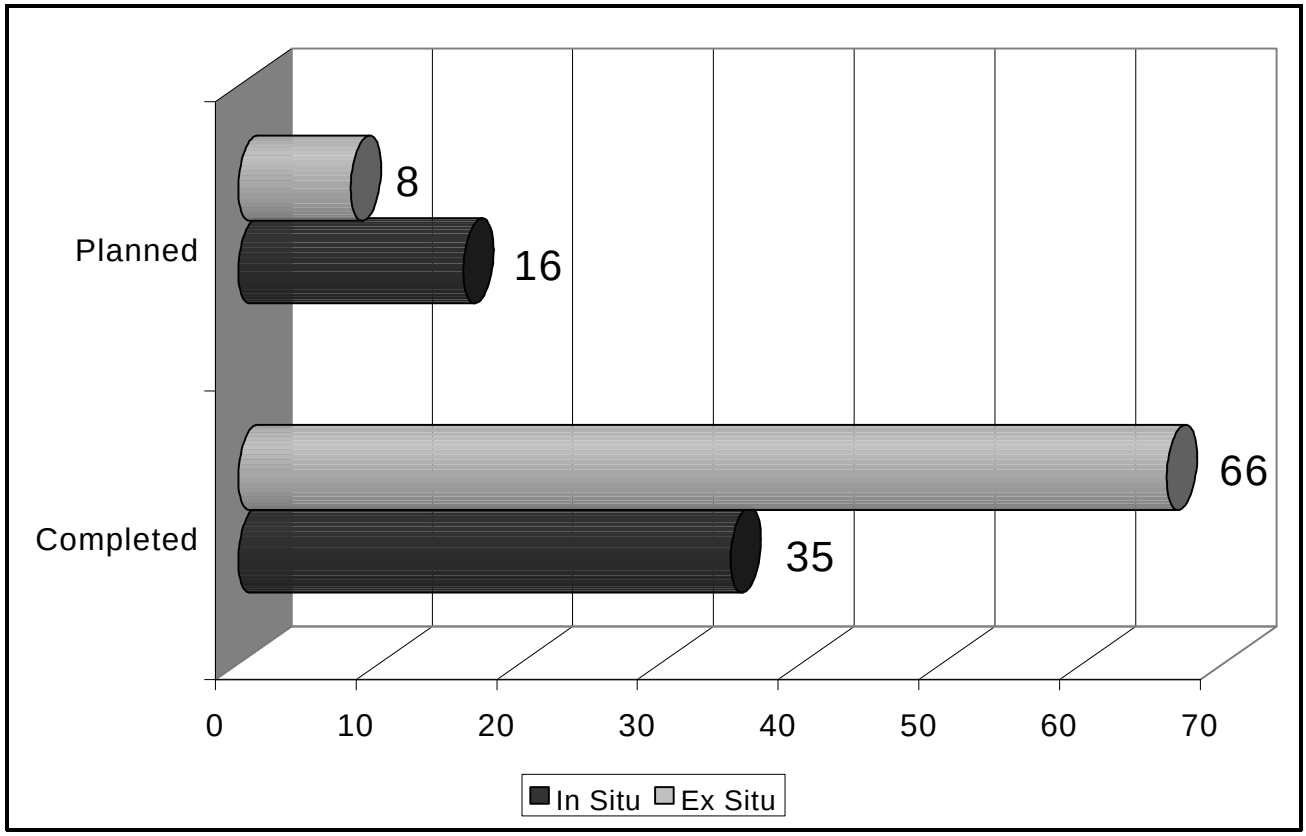



**Figure 8.** Distribution of in situ and ex situ SITE demonstration projects.

During FY 98, six new innovative technologies were evaluated in the field. Completed demonstration projects are listed in Table 1, and ongoing projects are provided in Table 2. All completed and ongoing projects in the Demonstration Program, ETP, and MMT Program are listed in Appendices A and B.

**Emerging Technology Program**

Nine solicitations were issued from November 1987 (E01 Solicitation) to July 1995 (E09 Solicitation). A total of 77 technology development projects were initiated under the ETP, and 66 projects have been completed. Eighteen of the ETP projects are in the SITE Demonstration Program. The completed ETP projects for FY 98 are listed in Table 3.

**Monitoring and Measurement Technologies Program**

The MMT Program has leveraged its resources with EPA's Environmental Technology Verification Program. These two programs, known collectively as the Consortium for Site Characterization Technologies, have developed a partnership with the DOE. Resources from the SITE Program are used solely for those technologies addressing hazardous waste. This partnership will help to address the demands on the MMT Program and reduce the backlog of applications submitted by developers of innovative technologies.

To further advance the MMT Program, a stakeholder group was formed to assist in outreach activities and in the selection of technologies. An advocates program involving the EPA Regional offices was also established to assist in the MMT demonstration process and to ensure that the products of the demonstrations address EPA issues.

***Technology Verification Process***

The technology verification process is designed to generate high-quality data that can be used by EPA to verify technology performance. Four key steps are inherent in the process:

- Needs identification and technology selection
- Demonstration planning and implementation
- Report preparation
- Information distribution

**Table 1.** SITE Demonstration Projects Completed in FY 98

| Developer Location | Developer | Technology | Site Location |
|---|---|---|---|
| AK | Arctic Foundations, Inc. | The Cryogenic Barrier creates a frozen barrier wall to contain and immobilize hazardous waste. The demonstration evaluated the barrier's ability to contain radionuclides from the Oak Ridge National Laboratory Waste Area Grouping 9 Homogenous Reactor Experiment pond. | Oak Ridge, TN |
| OH | ASC\EMR Wright Patterson | Phytoremediation of groundwater involves planting deep-rooted, water-loving vegetation to reduce contaminant concentrations in the saturated zone. The U.S. Air Force has initiated a field demonstration designed to evaluate the effectiveness of eastern cottonwood trees in remediating shallow groundwater contaminated with TCE. | Ft. Worth, TX |
| CO | Colorado Department of Health and Environment | The constructed wetlands-based treatment technology uses natural geochemical and microbiological processes inherent in an artificial wetland ecosystem to accumulate and remove metals from influent waters. The demonstration evaluated process effectiveness, toxicity reduction, and biogeochemical processes at the Burleigh Tunnel near Silver Plume, Colorado. | Silver Plume, CO |
| CO | Pintail Systems, Inc. | This technology uses microbial detoxification of cyanide in heap leach processes to reduce cyanide levels in spent ore and process solutions. The biotreatment populations of natural soil bacteria are grown to elevated concentrations, which are applied to spent ore by drip or spray irrigation. | Battle Mountain, NV |
| CO | Rocky Mountain Remediation Services | The ENVIROBOND™ solution strongly binds heavy metals in a metal-ligand compound to prevent leaching. It can be applied to reduce metal availability in contaminated soils and other wastes. | Crooksville/ Roseville, OH |
| TX | Star Organics | The Soil Rescue solution consists of organic acids that are sprayed onto and then tilled into the contaminated media. The organic acids act as a chelating agent to bond to metals, thereby reduce their leachability. | Crooksville/ Roseville, OH |

**Table 2.** SITE Demonstration Ongoing Projects

| Developer Location | Developer | Technology | Site Location |
|---|---|---|---|
| CA | Eco Mat, Inc. | This technology uses denitryfing bacteria to convert nitrogen compounds to harmless byproducts. The process uses common bacteria that live on a sponge-like medium inside a reactor. The reactor circulates these materials with contaminated water to enhance biodegradation rates. | Bendena, KS |
| LA | Electrokinetics, Inc. | Electrokinetic's soil processes extract or remediate heavy metal and organic contaminants in soils. Electrodes are placed in situ, and a current is applied to mobilize ions and remove contamination. | Fort Polk, LA |
| Ontario, Canada | EnviroMetal, Technologies, Inc. | The In Situ Reactive Barrier uses zero-valent iron to reduce oxidized metals and to induce reductive dechlorination of chlorinated VOCs. In addition, this technology can immobilize some metals by reduction and sorption. | Rocky Flats, CO |
| CA | Geokinetics International, Inc. | This technology applies AC current to the soil matrix in order to produce heat. This process reduces LNAPL viscosity, causes DNAPL to float to the top of the saturated zone, reduces the size of the smear zone, and can increase the biological activity in the heated zone. | Pearl Harbor, HI |
| VA | ITT Industries | The Enhanced Bioremediation Technology, also called co-metabolic degradation, is designed to stimulate the naturally occurring microbial degradation of organic compounds. | Roanoke, VA |
| MA | KSE, Inc. | This technology removes chlorinated and nonchlorinated VOCs in dilute concentrations from air streams by adsorption and photochemical reactions. | N. Smithfield, RI |
| PA | MACTEC-SBP Environmental, Inc. | The NoVOCs™ in-well stripping technology combines air-lift pumping with in-well vapor stripping to remove VOCs from groundwater. | San Diego, CA |
| UT | Phytokinetics, Inc. | This demonstration assesses the ability of plants to reduce the concentrations of petroleum hydrocarbons in near-surface soils and the saturated zone, and to modify the groundwater gradient. The ability of alfalfa and fescue to remediate petroleum hydrocarbons in soil will be evaluated while poplar and juniper trees will be investigated for their ability to treat the saturated groundwater zone. | Ogden, UT |
| NJ | Phytotech, Inc. | The phytoremediation biotechnology uses specially selected and engineered plants to treat soil and sediment contaminated with toxic metals such as lead and cadmium, as well as radionuclides. The technology is being demonstrated at a former metal-plating facility. | Trenton, NJ |
| CO | Pintail Systems, Inc. | The technology involves growing and augmenting indigenous bacteria in culture to reduce the leaching of lead at contaminated sites. The cultures are grown in a laboratory setting, and applied in situ to biostabilize lead contamination in soil. | Crooksville, OH; Aurora, CO |

**Table 2.** SITE Demonstration Ongoing Projects (continued)

| Developer Location | Developer | Technology | Site Location |
|---|---|---|---|
| CO | Pintail Systems, Inc. | Isolated indigenous organisms capable of remineralizing arsenic are grown and augmented in lab cultures. These organisms are being used to remineralize arsenic at the Argonaut Mine site | Jackson, CA; Aurora, CO |
| ID | Process Technologies, Inc. | The Photolytic Destruction Technology is a method of photochemically oxidizing gaseous organic compounds within a reaction chamber. The technology uses ultraviolet light to break apart chemical bonds of VOC molecules. | Sacramento, CA |
| IN | Sevenson Environmental Services, Inc. | The MAECTITE® chemical treatment process can be applied to soils, waste and other materials containing lead and other heavy metals. The technology uses reagents and processing equipment to stimulate the nucleation of crystals by chemical bonding. | Sparta, WI |
| OH | U.S. EPA, NRMRL | Alternate Cover Assessment Program (ACAP) - The ACAP is a cooperative partnership of industry, government, and research institutions that will evaluate evapotranspiration and break cover systems. The program is expected to provide cost-effective alternative cover designs, and assist in the development of designs at other sites. | 10 sites around the nation |

Needs Identification and Technology Selection

The first aspect of the technology verification process is to determine the most important technology needs of EPA and the regulated community. EPA, the Department of Defense, DOE, industry, and state agencies are asked to identify technology needs and interest in a technology area. Once a technology need is established, a search is conducted to identify suitable technologies that will address the need. The technology search and identification process consists of reviewing responses to *Commerce Business Daily* announcements, searches of industry and trade publications, attendance at related conferences, and leads from technology developers. MMTs are evaluated against the following criteria:

- Meets regulatory or user needs
- May be used in the field or in a mobile laboratory
- Applicable to a wide variety of environmentally impacted sites
- High potential for resolving problems for which current methods are unsatisfactory
- Costs are competitive with current methods
- Performance is better than current methods in areas such as data quality, sample preparation, or analytical turnaround time
- Uses techniques that are easier and safer than current methods
- Is a commercially available, field-ready technology

Demonstration Planning and Implementation

After a technology has been selected, EPA, the support contractor, and the technology developer agree to responsibilities for conducting the demonstration and evaluating the technology. The following issues are addressed at this time:

- Identifying demonstration sites that will provide the appropriate physical or chemical attributes, in the desired environmental media
- Identifying and defining the roles of demonstration participants, observers, and reviewers

- Determining logistical and support requirements (such as field equipment, power and water sources, mobile laboratory, or communications network)
- Arranging analytical and sampling support
- Preparing and implementing a demonstration plan that addresses the experimental design, sampling design, quality assurance/quality control (QA/QC), health and safety considerations, scheduling of field and laboratory operations, data analysis procedures, and reporting requirements

**Table 3.** SITE Emerging Technology Projects Completed in FY 98

| Developer Location | Developer | Technology Description | Treatment Category |
|---|---|---|---|
| MA | ABB Environmental Services, Inc. | A two-step anaerobic/aerobic biodegradation sequence allows degradation of PCE and TCE to lesser chlorinated DCE and vinyl chloride in the anaerobic stage. The aerobic stage then degrades DCE and vinyl chloride. | Biological |
| LA | Electrokinetics, Inc. | This process applies a low level DC electrical potential to cause physical-chemical and hydrological changes in the waste and the conductive medium. This augments uniform transport of process additives, and therefore enhances biodegradation. | Physical |
| OH | IT Corporation | This process removes heavy metals from contaminated soils and sludges by forming a soluble chelate. Metals can then be separated from the sludge and recovered. | Physical |
| OH | IT Corporation (formerly OHM Remediation Services) | This technology enhances in situ bioremediation by the subsurface injection of oxygen microbubbles in a water solution containing low concentrations of surfactant. The microbubbles provide an electron acceptor for indigenous microorganisms to enhance biodegradation rates. | Biological |
| UT | Phytokinetics, Inc. | Phytoremediation can be used to enhance biological degradation of a variety of organic contaminants in the near surface zone. | Biological |
| CO | Pintail Systems, Inc. | Bioremediation processes can be used for in situ biomineralization of heavy metals in soils, sludges, and sediments. Microorganisms can be used to cause metal hydroxides, oxides, and carbonates to precipitate, and stabilize in a less leachable form. | Biological |
| TN | Thermo Nutech, Inc. | The automated Segmented Gate System uses a conveyor to transport radioactively contaminated soil under an array of radiation detectors. Contaminated material is diverted to a disposal area, while clean material can be reclaimed, thereby reducing cleanup costs. | Physical |

Report Preparation

Innovative technologies are evaluated independently and, when possible, against reference technologies. The field technologies are operated by the developers in the presence of independent technology observers. Technology observers are provided by EPA or a third party group. Demonstration data are used to evaluate the capabilities, limitations, and field applications of each technology. Following the demonstration, all raw and reduced data used to evaluate each technology are compiled into a technology evaluation report, which is mandated by EPA as a record of the demonstration. A data summary and performance evaluation of each technology are published in an Environmental Technology Verification Report (ETVR).

***Demonstrations in FY 98***

During FY 98, ETVRs were completed for four soil and two soil gas sampling technologies. In FY97, the demonstrations were conducted for these technologies. The technologies were demonstrated in Albert City, Iowa and Commerce City, Colorado. Individual ETVRs have been prepared for each technology. A brief description of the technologies and the field demonstrations is given in the Innovative Technology Highlights section of this report.

***Ongoing Demonstrations***

The MMT Program has identified sediment sampling technologies for a demonstration to be conducted during FY 99. Because sediment sample collection and analysis play an important role in ecological risk assessment studies, as well as wetland protection, the science and practice of sediment sampling is of considerable interest to EPA Regional and Program Offices. This MMT project will test two innovative sediment sampling devices that may prove to be more efficient or cost-effective than current technologies (see Table 4). The performance of each technology will be compared to commonly used, conventional procedures. The demonstration will also collect information describing the ease of operation, cost and other relevant performance characteristics of these devices. The demonstration results will assist EPA and others in the understanding and use of alternate sediment sampling technologies and will enhance the commercial development of these devices.

**Table 4.** SITE MMT Program Demonstrations Ongoing in FY 98

| Developer Location | Developer | Technology | Site Location |
|---|---|---|---|
| ID | Aquatic Research Instruments | The ability of the ARI's Russian Peat Borer to collect and return sediment samples will be tested under a variety of field conditions. | MA, WI |
| WI | Art's Manufacturing and Supply | The AMS Split Core Sampler will be tested under a variety of field conditions to evaluate its ability to collect and return sediment samples. | MA, WI |

# Future Direction

## Introduction

During FY 98, the SITE Demonstration Program began its second year operating under a market driven approach. This approach continues to emphasize the importance of first selecting a site and secondly evaluating one or more appropriate innovative technologies. The selection of these sites and technologies is important in meeting the needs of those responsible for selecting and implementing hazardous waste cleanup.

Three sites were selected under the first host site solicitation. A wide range of representation ensures that the most pressing issues are prioritized and addressed. These sites were selected by a review group comprised of representatives from the following organizations:

- **DOD Environmental Security and Technology Certification Program (ESTCP)**
- **DOE Office of Science and Technology**
- **EPA Office of Solid Waste and Emergency Response**
- **EPA Regional Offices**
- **Interstate Technology and Regulatory**

One of the selected sites completed an evaluation of two technologies during FY 98. The two additional sites are continuing evaluation of technologies through FY 99.

In response to stakeholders demand, the MMT Program initiated a series of demonstrations designed to evaluate innovative sampling technologies. In FY 98, four soil and two soil gas sampling technologies were evaluated. In FY 99, a field demonstration of sediment sampling technologies will be conducted. These projects are designed to address ongoing difficulties in obtaining representative samples at defined depths using less expensive and less complex equipment.

## Technology Areas of Primary Interest

The areas of primary interest remain an important part of appropriate site selection. Stakeholder groups, like those used in selecting the sites and technologies, identify these areas with technical staff within ORD. This helps ensure that the most pressing needs are met.

In FY 98 the SITE Program continued to emphasize the need for technologies capable of in-situ remediation of dense non-aqueous phase liquids (DNAPLs) in difficult geological formations. This continues to be a theme through the remediation community as a whole. This also parallels the theme set in the 1997 National Research Council (NRC) report titled Innovation in Groundwater and Soil Cleanup (www.NAP.EDV/readingroom ISBN #0309-06358-2). As the complexity of the geological formation increases so does the need for innovative technologies to treat or detect DNAPL. Metals in soils, treatment of recalcitrant compounds and the general need for in situ treatment remain high on the priority list.

Sediments is another area where the remediation community would benefit from new processes, approaches or less expensive methods for treatment. In situ treatment, sampling and containment are technology areas of interest. An increase of projects in these areas is expected in the future. Table 5 outlines the areas of interest of the SITE Program, and Table 6 describes the demonstrations that are planned for FY 99.

| **Table 5.** SITE Future Emphasis Areas 1999 - 2002 | | | |
|---|---|---|---|
| GROUNDWATER | SOILS | SEDIMENTS | CONTAINMENT |
| Organics / Inorganics | Metals | Pesticides | Alternative Caps (e.g., evapotranspiration covers) |
| DNAPLs - fractured bedrock / Karst | Pesticides | Chlorinated Aromatics | Walls / Bottoms |
| Oxygenated Compounds | Chlorinated Compounds | Metals | New Materials / Delivery Systems |
| Chlorinated Compounds | Aromatics | Sediment Sampling Technologies (MMT) | |
| Aromatics | Creosote | New Materials / Processes | |
| Creosote | Phenols | | |
| Phenols | Total Petroleum Hydrocarbons Measurement Technologies (MMT) | | |
| New Materials / Processes | New Materials / Processes | | |

| **Table 6**. SITE Program Projects FY 99 | | | |
|---|---|---|---|
| Site Name/ Location | Technology | Project Description | Proposed Schedule |
| Aladdin Plating Clarks Summit, PA | Electokinetics | Site contains hexavalent chromium contaminated groundwater. | Treatability studies FY 98, Technology demonstration FY 99 |
| Beede Waste Oil/Cash Energy Plainstow, NH | In situ bioremedation under consideration | Surface soils contaminated with chlorinated VOCs, lead, PAHs and PCBs. | Treatability tests FY 98 |
| Cape Canaveral Cocoa Beach, FL | 2 in situ thermal and 1 in situ oxidative technology | Groundwater and soils contaminated with TCE. | Multiple technology selection FY 98, Technology demonstration FY 99-00 |
| Loring AFB Aroostook County, Maine | 4 in situ technologies under consideration by the site. | Groundwater contaminated with VOCs, BTEX and total petroleum hydrocarbons. | Selection of technology FY 99 |
| Shrader Automotive Facility, Saltire Ind. Dickson, TN | Technology to be selected by site and SITE Program | TCE and its degradation products in groundwater with a Karst geological setting. | Selection of vendor(s) in FY 99 |
| Two sites in EPA Regions 1 and 5 | 2 technologies to evaluate: ARI Russian Peat Borer, and AMS Split Core Sampler | Sediment sampling technologies will be tested at two sites. | Technology demonstrations in FY 99 |

**MMT Program Areas of Interest**

Emerging field analytical areas which will be included in the MMT Program include in situ monitoring technologies, especially for ground water. The MMT Program is interested in testing non-invasive techniques for site characterization, including a variety of geophysical techniques which claim to be able to map a DNAPL plume without the need for drilling wells. Evaluation of these technologies will be very complex and will likely be conducted at controlled spill facilities.

Because of the importance of effective water quality monitoring to human and environmental health, the MMT Program is planning a demonstration in FY 00 to evaluate the performance of water quality monitoring equipment. This demonstration will evaluate a number of new and portable devices that have been proposed to measure various chemical indicators more accurately and inexpensively.

There are a number of biological tests for toxicity in soils and water that are relevant to ecological risk assessment, and that may be useful in waste and drinking water treatment facilities. A demonstration is planned for FY 01 in order to evaluate the effectiveness of new biological assessment techniques that may be highly sensitive and inexpensive test methods.

Since the program has matured, a number of developers in the area of X-ray fluorescence and gas chromatography / mass spectromety have made significant improvements in their technology and will be candidates for abbreviated demonstrations which will evaluate the improvements.

**Partnerships for Success**

***Federal to Federal Interface***

Federal to federal interface is an important aspect to enhancing the benefits of technology demonstrations. It allows for leveraging resources, expedited cost and performance information exchange and cross fertilization of technical expertise between agencies. In common environmental areas of interest this type of joint research is of great benefit to all parties involved. One example of this type of approach is the Interagency DNAPL Consortium (IDC).

***Federal Interface: Cape Canaveral Air Station SITE Demonstration***

The IDC at the Cape Canaveral site is comprised of EPA, DOE, DOD, and NASA. The objective of the group is to conduct side-by-side demonstrations of 3 innovative technologies for DNAPL remediation and monitoring. The demonstration will be conducted at Cape Canaveral Air Station Launch Complex 34. The SITE Program will provide the independent cost and performance evaluation. The Air Force and DOE are combining resources to contract the technology vendors to complete demonstrations. NASA is providing the site and in-kind services for the completion of the demonstrations. NASA plans to use successful demonstration results as a basis for selecting the appropriate technology for remediating Launch Complex 34.

The geological formation at the NASA Cape Canaveral site is in what is considered a less difficult to treat formation (Figure 8). In FY 00-01, the IDC is interested in performing work at more difficult to treat geological formations such as heterogeneous saturated and unsaturated zones, fractured bedrock and complex clays. It is expected that different types of technologies may be needed to treat varying complex formations. These joint projects could potentially identify several innovative options or approaches to solving environmental problems where currently there are no solutions.

***Federal to State Interface***

Where there are common environmental areas of interest, it is equally important to have federal to state interactions as it is federal to federal cooperation. The ITRC provide a mechanism to interact with multiple state regulatory agencies and state specific verification

More Difficult More Needs

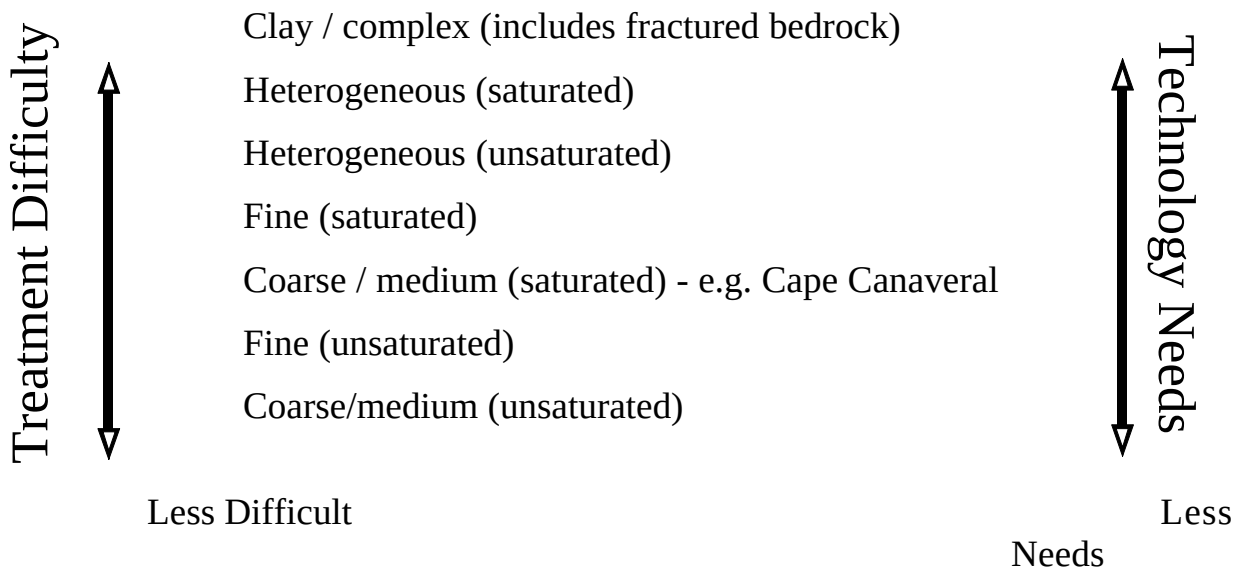



**Figure 9.** DNAPL Testing Site Roadmap: Media (Based on NRC Report, 1997)

programs. Like cooperation with other federal agencies, direct interaction with multiple state agencies provides many benefits. State regulatory agencies are also faced with hazardous waste clean-up, and regulations may vary between states. Interaction among multiple states on SITE projects can result in multiple technical issues being addressed in one field demonstration. This reduces duplication of field demonstrations to answer one or more state specific regulatory questions.

The ITRC currently has several workgroups that crosscut the SITE Program's environmental priority areas of interest. The various groups are as follows: 1) Passive Barrier Workgroup, 2) DNAPL Workgroup, 3) Phytoremediation Workgroup. These groups are invited to participate in SITE Program demonstrations projects. Groups choose to participate at a level required by the objectives of the workgroup. Involvement of the workgroups allows for better planning and exchange of technical requirement early in the project planning.

***State Interface: Rocky Flats SITE Demonstration***

One example of multistate participation is the passive barrier technology demonstration at the DOE Rocky Flats facility. The passive barrier workgroup attended a technical visitors day hosted by DOE and EPA. The group lead by DOE discussed construction, design and technology implementation. EPA led the discussion on the approach for testing and evaluating the demonstration. The ITRC team also participated in a field tour where they witnessed sampling procedures related to the performance demonstration.

Another important workgroup within the ITRC is the verification team. This team worked with 11 different verification programs including SITE in evaluating and documenting technical and cost parameters that are important to the different states. The document will be a useful tool in determining and meeting the technical information needs of the state regulatory agencies. The report includes a variety of elements to be included in verification program reports. The states participating in the ITRC were encouraged

by the willingness of the programs to accommodate states' needs. This type of cooperation will enhance states' confidence in the results of verification and allow them to make more informed decisions regarding use of innovative remediation technologies.

**Information Transfer**

Information transfer is accomplished through a number of mechanisms. While the internet information distribution is an effective mechanism, published documentation, meetings, and conferences remain an essential part of technical information dissemination. Coordination with existing remediation workgroups and programs is also essential. The SITE Program continues to work cooperatively with DOD's ESTCP Program, the Environmental Council of States (ECOS) sponsored ITRC, and as stated previously plans a much stronger technical relationship with the DOE's Office of Science and Technology.

Internet service allows for quick and easily accessible information, and saves time and costs in publication. In FY 98, SITE converted all earlier publications to electronic format and has made those documents accessible through the SITE homepage. General program information is available as well as quarterly reports, most recent documents, program highlights and the technology profiles of the vendors participating in the program. As a result of the homepage, the number of documents printed has been reduced by 75%. According to Web Server Statistics, the monthly average number of hits for electronic information solicited from the SITE homepage over the last year was 514. Numerous requests come from outside the US, reflecting an increased global interest in the SITE Program.

The program will continue pursuing and supporting the development of document summaries in areas where data exists on a variety of technologies or applications. The information is useful in providing the user community with comparative technical information and costs within an area. Documentation will continue for some time since many of the technologies are in situ and highly complex. In situ technology evaluations are tested over varying lengths of time, with a minimum time of 3-6 months. Most are evaluated for one year. In the case of phytoremediation, growing seasons span 2-3 years. The summaries will need updating as the technologies mature and information becomes available.

**http://www.epa.gov/ORD/SITE**

# Appendix A

## SITE PROJECTS
## (Alphabetically by Developer State)

## SITE PROJECTS - BY DEVELOPER STATE

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Alabama | CMS Research Corporation Birmingham, AL | Portable Gas Chromatograph | H. Ashley Page 205-773-6911 | Monitoring and Measurement Technologies | Completed 1992 |
| Alaska | Brice Environmental Service Corp. (BESCORP) Fairbanks, AK | Soil Washing Plant | Craig Jones 907-452-2512 | Demonstration | Completed September 1992 |
| Arizona | Arizona State University Tempe, AZ | Photocatalytic Oxidation and Air Stripping | Gregory Raupp 606-965-2828 Elliot Berman 352-867-1320 | Emerging Technology | Ongoing |
| | STC Omega (formerly Silicate Technology Corporation) Scottsdale, AZ | Solidification and Stabilization Treatment | Stephen Pelger Scott Larsen 602-948-7100 | Demonstration | Completed November 1990 |
| California | Analytical and Remedial Technology, Inc., Milpitas, CA | Automated Sampling and Analytical Platform | Gary Hopkins 408-263-8931 | Monitoring and Measurement Technologies | Completed May 1991 |
| | Berkeley Environmental Restoration Center (formerly Udell Technologies, Inc.) Emeryville, CA | In situ Enhanced Extraction | Kent Udell 510-642-2928 Steve Collins 510-643-1300 | Demonstration | Completed 1993 |
| | Binax Corp., Antox Division Sunnyville, CA | Imunoassay for PCB in Soil | Richard Lankow 408-752-1353 | Monitoring and Measurement Technologies | Completed 1992 |
| | COGNIS, Inc. Santa Rosa, CA | Biological/ Chemical Treatment | Steve Rock U.S. EPA 513-569-7149 | Emerging Technology | Completed 1995 |
| | Eco Mat, Inc. Hayward, CA | Biological Denitrification | Kim Halley 510-783-5885 | Demonstration | Ongoing |
| | Energy and Environmental Research Corporation Irvine, CA | Hybrid Fluidized Bed System | Richard Koppang 714-859-8851 | Emerging Technology | Completed 1992 |
| | | Reactor Filter System | Neil Widmer 714-859-8851 | Emerging Technology | Completed 1995 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Environmental Biotechnologies Montara, CA | Microbial Composting | Dougleas Munnecke 415-596-1020 | Emerging Technology<br><br>Demonstration | Ongoing<br><br>Ongoing |
| California | EPOC Water, Inc. Fresno, CA | Precipitation, Microfiltration, Sludge Dewatering | Rodney Squires 209-291-8144 | Demonstration | Completed August 1993 |
| | General Atomics (formerly Ogden Environmental Services) San Diego, CA | Circulating Bed Combuster | Jeffrey Broido 619-455-4495 | Demonstration | Completed September 1989 |
| | | Acoustic Barrier Separator | Anthony Gattuso 619-455-2910 | Emerging Technology | Completed 1995 |
| | Geokinetics | Electrokinetics | Steven H. Schwartzkopf 415-424-3176 | Demonstration | Ongoing |
| | Geokinetics & Duke Engineering | Electrokinetic Heating & Surfactant Flushing | Thomas Holdsworth U.S. EPA 513-569-7675 | Demonstration | Ongoing treatability testing underway |
| | GIS\Solutions, Inc. Concord, CA | GIS\Key Environmental Data Management Software | John Saguto 415-827-5400 | Demonstration | Completed August 1993 |
| | Groundwater Technology Government Services, Inc. Concord, CA | Biological Composting | Ronald Hicks 510-671-2387 | Emerging Technology | Completed 1995 |
| | Hughes Environmental Systems, Inc. Manhattan Beach, CA | Steam Enhanced Recovery Process | Paul De Percin U.S. EPA 513-569-7797 | Demonstration | Completed September 1993 |
| | Lockheed Martin Missiles & Space Co., Inc. Palo Alto, CA | Electrokinetic Remediation | Steven H. Schwartzkopf 415-424-3176 | Demonstration | Ongoing |
| | Magnum Water Technology El Segundo, CA | CAV-OX Process | Dale Cox 310-322-4143 Jack Simser 310-640-7000 | Demonstration | Completed March 1993 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Membrane Technology and Research, Inc. Menlo Park, CA | VaporSep Membrane Process | Marc Jacobs Doug Gottschlich 415-328-2228 | Emerging Technology | Completed 1991 |
| California | NOVATERRA, Inc. (formerly Toxic Treatments USA, Inc.) Los Angeles, CA | In-situ and Air Stripping | Philip LaMori 213-969-9788 | Demonstration | Completed September 1989 |
| | Praxis Environmental Services Burlingame, CA | In-situ Steam Enhanced Extraction | Lloyd Stewart 650-548-9288 Major Paul B. Devon 850-283-6288 | Demonstration | Ongoing |
| | Pulse Sciences, San Leandro, CA | X-Ray Treatment (Aqueous) | Vernon Bailey 510-632-5100 ext. 227 | Emerging Technology | Completed 1994 |
| | | X-Ray Treatment (Soils) | Vernon Bailey 510-632-5100 ext. 227 | Emerging Technology | Ongoing |
| | Radian Corporation (formerly AWD Technologies, Inc.) Walnut Creek, CA | Integrated Vapor Extraction and Steam Vacuum Stripping | David Bluestein 510-988-1125 | Demonstration | Completed September 1990 |
| | Retech, Inc. Ukiah, CA | Plasma Arc Vitrification | Ronald Womack Leroy B. Leland 707-462-6522 | Demonstration | Completed July 1991 |
| | Rochem Separation Systems, Inc. Torrance, CA | Rochem Disc Tube Module System | David LaMonica 310-370-3160 | Demonstration | Completed August 1994 |
| | Roy F. Weston Sherman Oaks, CA | Air Sparging Process | Jeff Bannon 818-971-4900 Eric Klingel 704-599-4818 | Demonstration | Completed 1994 |
| | Simulprobe Technologies, Inc. | Core Barrel Soil Sampler | Richard Laton 415-883-8787 | Monitoring and Measurement Technologies | Completed |
| | SIVE Services Dixon, CA | Steam Injection and Vacuum Extraction | Douglas Dieter 916-678-8358 | Demonstration | Ongoing |
| | SRI Instruments Torrance, CA | Portable Gas Chromatograph | Douglas Gavilanes 310-214-5092 | Monitoring and Measurement Technologies | Completed January 1992 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Terra-Kleen Response Group, Inc. Del Mar, CA | Solvent Extraction | Alan Cash 619-558-8762 | Demonstration | (1) Completed 1994<br>(2) Ongoing |
| | Texaco, Inc. S. El Monte, CA | Entrained-Bed Gasification | John Wintor 310-908-7387 | Demonstration | Completed July 1994 |
| California | Thermatrix, Inc. (Formerly Purus, Inc.) San Jose, CA | Photolytic Oxidation | Steve McAdams 408-453-0490 | Emerging Technology | Completed 1992 |
| | U.S. EPA Region IX San Francisco, CA | Excavation and Foam Suppression of Volatiles | Jack Hubbard U.S. EPA 513-569-7507 | Demonstration | Completed July 1990 |
| | U.S. Filter (formerly Ultrox) Huntington, CA | Ultraviolet Radiation and Oxidation | William Himebaugh 714-545-5557 | Demonstration | Completed March 1989 |
| | Xon Tech, Inc. Van Nuys, CA | Xon Tech Sector Sampler | Matt Young 818-787-7380 | Monitoring and Measurement Technologies | Completed 1991 |
| Colorado | CF Systems Corporation Arvada, CO | Solvent Extraction | L.V. Benningfield 303-420-1550 | Demonstration | Completed December 1988 |
| | | Batch Organics Extraction Unit | L.V. Benningfield 303-420-1550 | Demonstration | Ongoing |
| | Colorado Dept. of Health Denver, CO | Wetland-Based Treatment for Mineral Mine Drainage | Jim Lewis 303-692-3390 | Demonstration | Ongoing |
| | Colorado School of Mines, Golden, CO and Colorado Department of Health Denver, CO | Wetlands-Based Treatment | Thomas Wildeman 303-273-3642<br>James Lewis 303-692-3390 | Emerging Technology<br>Demonstration | Completed<br>Ongoing |
| | Cure International Inc. (Formerly General Environmental Corporation) Englewood, CO | CURE Electrocoagulation | Carl Dalrymple 303-761-6960 Dan Eide 561-575-3500 | Demonstration | Completed 1995 |
| | Pintail Systems, Inc. Aurora, CO | Biodegradation of Cyanide | Caren Caldwell 303-367-8443 | Demonstration | Completed 1998 |
| | | Biostabilization of Lead | Leslie Thompson 303-367-8443 | Demonstration | Ongoing |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | | Biological Stabilization of Arsenic in Soils | Leslie Thompson 303-367-8443 | Demonstration | Ongoing |
| Colorado | Smith Environmental Technologies Corporation (formerly Canonie Environmental Services Corp.) Englewood, CO | Low Temperature Thermal Aeration | Joseph Hutton 303-790-1747 | Demonstration | Completed September 1992 |
| | | Anaerobic Thermal Processor | Joseph Hutton 303-790-1747 | Demonstration | Completed May 1991 and June 1992 |
| | Walsh Environmental Scientists and Engineers (ECOVA) Boulder, CO | Bioslurry Reactor (technology developed by ECOVA Corp.) | William Mahaffey 303-670-2875 303-443-3282 | Demonstration | Completed September 1991 |
| Connecticut | Dexsil Corporation Hamden, CT 4 demonstrations | Environmental Test Kits (PCB) Chlor-N-Soil L2000 PCB/Chloride Analyzer | Jack Mahon 203-288-3509 | Monitoring and Measurement Technologies | Completed August 1993 |
| Delaware | E.I. DuPont de Nemours and Co. and Oberlin Filter Co. Newark, DE and Waukesha, WI | Membrane Microfiltration | Ernest Mayer 302-774-2277 | Demonstration | Completed April-May 1990 |
| | Hewlitt- Packard (formarly MTI Analytical Instruments) Wilmington, DE | Portable Gas Chromatograph | Hewlitt-Packard 800-227-9770 Bob Belair 302-633-8487 | Monitoring and Measurement Technologies | Completed 1992 |
| | Strategic Disgnostics Inc. (Formarly Ensys, Inc.) Newark, DE | Immunoassay for PCP | Tim Lawruk 800-544-8881 302-456-6782 | Monitoring and Measurement Technologies | Completed September 1993 |
| Florida | Funderburk and Associates Apollo Beach, FL | Dechlorination and Immobilization | Ray Funderburk 800-723-8847 | Demonstration | Completed October 1997 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | High Voltage Environmental Applications, Inc./Florida International University and University of Miami<br>Miami, FL | High-Energy Electron Irradiation (Aqueous) | William Cooper<br>305-593-5330 | Emerging Technology<br><br>Demonstration | Completed 1993<br><br>Completed 1994 |
| Florida | High Voltage Environmental Applications, Inc.<br>Miami, FL | High Energy Electronic Beam (Solids) | William Cooper<br>305-593-5330 | Emerging Technology | Ongoing |
| | PCP, Inc.<br>West Palm Beach, FL | Ion Mobility Spectrometry | Martin Cohen<br>407-683-0507 | Monitoring and Measurement Technologies | Completed 1991 |
| Georgia | American Combustion, Inc.<br>Norcross, GA | PYRETRON Thermal Destruction | Gregory Gitman<br>404-564-4180 | Demonstration | Completed January 1988 |
| | ETG., Inc.<br>Norcross, GA | Long-Path Fourier Transform Infrared Spectrometer | Orman Simpson<br>404-242-0977 | Monitoring and Measurement Technologies | Completed January 1992 |
| | Sonotech, Inc.<br>Atlanta, GA | Frequency Tunable Pulse Combustion System | Ben Zinn<br>404-894-3033 | Demonstration | Completed 1995 |
| | Williams Environmental Services, Inc. (Formerly Harmon Environmental Services, Inc.)<br>Stone Mountain, GA | Soil Washing | S. Jackson Hubbard<br>(U.S. EPA)<br>513-569-7507 | Emerging Technology | Exited 1992 |
| Idaho | Aquatic Research Instruments | Russian Peat Borer | Will Young<br>208-768-2222 | Monitoring and Measurement Technologies | Ongoing |
| | Art's Manufacturing and Supply | AMS™ Dual-Tube Liner Soil Sampler | Brian Anderson<br>800-635-7330 | Monitoring and Measurement Technologies | Completed |
| | | AMS™ Split Core Sampler | Brian Anderson<br>800-635-7330 | Monitoring and Measurement Technologies | Ongoing |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | J.R. Simplot Co.<br>Pocatello, ID | Anaerobic Biological Process | Russell Kaake<br>208-235-5620 | Emerging Technology | Completed 1993 |
| | | Anaerobic Biological Process | Tom Yergovich<br>208-238-2850 | Demonstration | Completed February 1994 |
| | Morrison Knudsen Corp./STG Technologies<br>Boise, ID | Grouting Technique | Kathryn Levihn<br>Rick Raymondi<br>208-386-6115 | Demonstration | Completed |
| Idaho | Process Technologies, Inc.<br>Boise, ID | Photolytic Destruction of SVE off-gases | Michael Swan<br>208-385-0900 | Demonstration | Ongoing |
| Illinois | Institute of Gas Technology | Chemical and Biological Treatment | Robert Kelley<br>847-768-0722 | Emerging Technology | Completed 1993 |
| | | Fluid Extraction-Biological Degradation Process | Albert Paterek<br>847-768-0720 | Emerging Technology | Completed 1992 |
| | | Fluidized-Bed Cyclonic Agglomerating Incinerator | Mike Mensinger<br>847-768-0602<br>Amir Rehmat<br>847-768-0588 | Emerging Technology | Completed |
| | | Superficial Extraction/Liquid Phase Oxidation of Waste | Mike Mensinger<br>847-768-0602 | Emerging Technology | Ongoing |
| | OHM Remediation Services (formerly RUST Remedial Services, Inc.)<br>Lombard, IL | X-TRAX Thermal Desorption | Chetan Trivedi<br>630-261-3958 | Demonstration | Completed May 1992 |
| | Recycling Sciences, Inc.<br>Chicago, IL | Desorption and Vapor Extraction System | William Meenan<br>312-663-4269 | Demonstration | Ongoing |
| Indiana | Bio-Rem, Inc.<br>Butler, IN | Augmented In-situ Subsurface Bioremediation Process | David Mann<br>219-868-5823<br>800-428-4626 | Demonstration | Completed December 1993 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Sevenson Environmental Services, Inc. Munster, IN | MAECTITE® Treatment Process | Chuck McPheeters 219-836-0116 | Demonstration | Ongoing |
| | Geoprobe Salina, KS | Soil, Water, Vapor Sampling Cone Penetrometer | Wes McCall Tom Omli 800-436-7762 | Monitoring and Measuring Technologies | Completed 1995 |
| | Trinity Environmental Technologies, Inc. Mound Valley, KS | Ultrasonically Assisted Detoxification of Hazardous Materials | Duane Koszalka 316-328-3222 | Emerging Technology | Completed 1992 |
| Iowa | Clements Associates, Inc. | JMC Environmentalist's Subsoil Probe | Jim Clements 515-792-8285 | Monitoring and Measurements Technologies | Completed |
| Kansas | Geoprobe Systems | Large Bore Soil Sampler | Wesley McCall Tom Omli 800-436-7762 | Monitoring and Measurements Technologies | Completed |
| Kentucky | Microsensor System, Inc. Bowling Green, KY | Portable Gas Chromatograph | Norman Davis 502-752-1353 | Monitoring and Measurement Technologies | Completed 1995 |
| Louisiana | Advanced Remediation Mixing, Inc. (Formerly Chemfix Technologies, Inc.) Kenner, LA | Solidification and Stabilization | David Donaldson 504-831-3600 | Demonstration | Completed March 1989 |
| | Electrokinetics, Inc. Baton Rouge, LA | Electrokinetic Remediation | Elif Acar 504-753-8004 | Emerging Technology<br>Demonstration | Completed March 1989<br>Ongoing |
| | | Electro-Klean Electrokinetic Soil Remediation | Elif Acar 504-753-8004 | Emerging Technology | Ongoing |
| | SBP Technologies, Inc. Baton Rouge, LA | Membrane Separation and Bioremediation | Clayton Page 504-755-7711 | Demonstration | Completed 1995 |
| Maryland | Quadrel Services, Inc. | Emflux® Soil-Gas Survey System | Bruce Tucker Paul Henning 301-874-5510 | Monitoring and Measurement Technologies | Completed |
| | W. L. Gore and Associates, Inc. | Gore-Scrubber® Passive Soil Gas Sampler | Ray Fenstermacher 410-392-7600 | Monitoring and Measurement Technologies | Completed |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Massachusetts | ABB Environmental Services, Inc. Wakefield, MA | Anaerobic/ Aerobic Sequential Bioremediation | Willard Murray 617-245-6606 | Emerging Technology | Ongoing |
| | Harding Lawson Associates (formally ABB Environmental Services, Inc.) Wakefield, MA | Two-Zone Plume Interception In-situ Treatment Strategy | Jaret Johnson Willard Murray 617-245-6606 | Emerging Technology | Completed |
| | Bruker Instruments Billerica, MA | Bruker Mobile Environmental Monitor | Dr. Brian Abraham 508-667-9580 | Monitoring and Measurement Technologies | Completed |
| Massachusetts | HNU Systems, Inc. Newtown, MA | Portable Gas Chromatograph | Jack Driscoll 800-724-6690 617-964-6690 | Monitoring and Measurement Technologies | Completed January 1992 |
| | HNU Systems, Inc. Newtown, MA | Portable X-Ray Fluorescence Spectrometer | Jack Driscoll 800-724-6690 617-964-6690 | Monitoring and Measurement Technologies | Completed 1995 |
| | KSE, Inc. Amherst, MA | Air II Photocatalytic Technology for Air Streams | James Kittrell 413-549-5506 | Demonstration | Ongoing |
| | Maxymillian Technologies, Inc. (formerly Clean Berkshires) Lanesboro, MA | High Temperature Thermal Process | Neal Maxymillian 617-557-6077 | Demonstration | Completed December 1993 |
| | Millipore Corporation Bedford, MA | EnviroGard PCB Immunoassay Test Kit | Alan Weiss 617-275-9200 | Monitoring and Measurement Technologies | Completed January 1992 |
| | | Immunoassay for PCP (Soil, Water) | Alan Weiss 617-275-9200 | Monitoring and Measurement Technologies | Completed 1993 |
| | Niton Corporation Bedford, MA | Portable X-Ray Fluorescence Spectrometer | Don Sackett 781-275-9275 | Monitoring and Measurement Technologies | Completed 1995 |
| | Ohmicron Corporation Newton, MA | Immunoassay for PCP in Soil | Mary Hayes 215-860-5115 | Monitoring and Measurement Technologies | Completed 1993 |
| | PSI Technology Co. Andover, MA | Immobilize and Decontaminate Metals in Aggregate Solids | Joseph Morency 508-689-0003 | Emerging Technology | Completed 1993 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | UV Technologies, Inc. (formerly Energy and Environmental Engineering, Inc.) East Cambridge, MA | Laser-Induced Photochemical Oxidative Destruction | John Roll<br>James Porter<br>617-666-5500 | Emerging Technology | Completed 1993 |
| Minnesota | BioTrol, Inc. Eden Prairie, MN | Methanotropic Bioreactor System | Durell Dobbins<br>612-942-8032 | Emerging Technology | Completed 1992 |
| | BioTrol, Inc. Eden Prairie, MN | Biological Aqueous Treatment System | Durell Dobbins<br>612-942-8032 | Demonstration | Completed July-September 1989 |
| Minnesota | BioTrol, Inc. Eden Prairie, MN | Soil Washing System | Durell Dobbins<br>612-942-8032 | Demonstration | Completed September-October 1989 |
| | Membrane Corporation Minneapolis, MN | Membrane Gas Transfer in Waste Remediation | Charles Gantzer<br>612-378-2160 | Emerging Technology | Ongoing |
| Montana | Montana College of Mineral Science and Technology Butte, MT | Air-Sparged Hydrocyclone | Theodore Jordan<br>406-496-4112<br>406-496-4193 | Emerging Technology | Completed 1994 |
| | | Campbell Centrifugal Jig | Gordon Ziesing<br>406-496-1573<br>406-496-4193 | Emerging Technology | Ongoing |
| Nebraska | Universiity of Nebraska Lincoln, NE | Spray Irrigation | Ray Spalding<br>402-472-7558 | Demonstration | Completed 1996 |
| Nevada | U.S. EPA Las Vegas, NV | Field Analytical Screening Program (FASP) | Howard Fribush<br>703-603-8831<br>Larry Jack<br>702-798-2373 | Demonstration | Completed 1996 |
| New Jersey | ART International, Inc. (formerly Enviro Sciences, Inc.) Denville, NJ | Low-Energy Solvent Extraction Process | Werner Steiner<br>201-627-7601 | Emerging Technology | Completed 1994 |
| | Dehydro-Tech. Corporation Somerville, NJ | Carver-Greenfield Process for Extraction of Oily Waste | Theodore Trowbridge<br>908-904-1606 | Demonstration | Completed August 1991 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Geotech Development Corporation Newark, NJ | Cold Top Vitrification | William Librizzi 201-596-5846 Thomas Tate 610-337-8515 | Demonstration | Ongoing |
| | M.L. ENERGIA, Inc. Princeton, NJ | Reductive Photo-Dechlorination Treatment | Moshe Lavid 609-799-7970 | Emerging Technology | Completed 1995 |
| | M.L. ENERGIA, Inc. Princeton, NJ | Reductive Photo-Thermal Oxidation Processes for Chlorocarbons | Moshe Lavid 609-799-7970 | Emerging Technology | Ongoing |
| New Jersey | New Jersey Institute of Technology, Hazardous Substance Management Research Center Newark, NJ | Pneumatic Fracturing/ Bioremediation | John Schuring 201-596-5849 David Kosson 908-445-4346 | Emerging Technology | Completed 1994 |
| | New Jersey Institute of Technology Newark, NJ | GHEA Associates Process | Itzhak Gottlieb 201-226-4642 | Emerging Technology | Completed 1992 |
| | Phytotech, Inc. Monmouth, NJ | Phytoextraction of metal from soil | Burt Ensley 908-438-0900 | Demonstration | Ongoing |
| | Sentex Sensing Technology, Inc. Ridgefield, NJ | Portable Gas Chromatograph | Amos Linenberg 201-945-3694 | Monitoring and Measurement Technologies | Completed January 1992 |
| New Mexico | Billings and Associates, Inc. Albuquerque, NM | Subsurface Volatilization and Ventilation System | Gale Billings 505-345-1116 Don Brenneman 713-676-5324 | Demonstration | Completed May 1994 |
| | Resource Management and Recovery (formerly Bio-Recovery Systems, Inc.) Las Cruces, NM | AlgaSorb Biological Sorption | Mike Hosea 505-382-9228 | Emerging Technology | Completed 1990 |
| | Sandia National Laboratories Albuquerque, NM | Electrokinetic Extraction in Unsaturated Soils | Eric Lindgren 505-844-3820 Earl Mattson 505-856-3311 | Demonstration | Ongoing |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Thermo Nutech (formerly TMA Eberline) Albuquerque, NM | Segmented Gate System for Radioactive Materials | Jeff Brown 423-481-0683 | Emerging Technology | Ongoing |
| New York | Photovac International, Inc. Deer Park, NY | Portable Gas Chromatograph | Mark Collins 516-254-4199 | Monitoring and Measurement Technologies | Completed January 1992 |
| | SBP Technologies, Inc. White Plains, NY | Bioventing, Air Sparging, Biological Treatment for Ground Water (multi-developer project with State of New York) | Richard Desrosiers 914-694-2280 Nick Kolak 518-457-3372 | Demonstration | Completed 1995 |
| New York | Solucorp Industries West Nyack, NY | Molecular Bonding System | Robert Kuhn 914-623-2333 | Demonstration | Ongoing |
| | RECRA Environmental, Inc. (formerly Electro-Pure Systems, Inc.) Amherst, NY | Alternating Current Electrocoagula-tion Technology | Kenneth Kinecki 800-527-3272 | Emerging Technology | Completed 1992 |
| | State University of New York at Oswego Oswego, NY | Photocatalytic Treatment for Sediments | Ronald Scrudato Jeffrey Shiarenzelli 315-341-3639 | Emerging Technology | Completed 1995 |
| | Xerox Corporation Webster, NY | Ground Water Extraction | Ron Hess 716-422-3694 Phil Mook 916-643-5443 | Demonstration | Completed 1995 |
| Ohio | ASC/EMR Wright Patterson AFB Dayton, OH | Phytoremedia-tion of TCE in Groundwater | Greg Harvey 513-255-7716 | Demonstration | Completed 1998 |
| | Battelle Memorial Institute Columbus, OH | In-situ Electroacoustic Soil Decontamina-tion | Satya Chauhan 614-424-4812 | Emerging Technology | Completed |
| | Ferro Corporation Independence, OH | Waste Vitrification Through Electric Melting | S.K. Muralidhar 216-641-8580 | Emerging Technology | Completed |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | IT Corporation Cincinnati, OH | Chelation/ Electro-deposition of Toxic Metals from Soil | Radha Krishnan 513-782-4700 | Emerging Technology | Ongoing |
| | IT Corporation (formerly OHM Remediation Services Corp.) Findlay, OH | Oxygen Microbubble In-situ Bioremediation | Douglas Jerger 423-690-3211 | Emerging Technology | Completed 1998 |
| | University of Dayton Research Institute Dayton, OH | Photothermal Detoxification Unit (PDU) | Berry Dellinger John Graham 513-229-2846 | Emerging Technology | Completed 1994 |
| | U.S. EPA NRMRL and ETG Environmental Cincinnati, OH | Base-Catalyzed Dechlorination Process | George Huffman 513-569-7431 Yei-Shong Shieh 610-431-9100 | Demonstration | Completed August 1993 |
| Ohio | U.S. EPA Risk Reduction Engineering Laboratory and IT Corporation Cincinnati, OH | Debris Washing System | Michael Taylor Majid Dosani 513-782-4700 | Demonstration | Completed November 1992 |
| | U.S. EPA Risk Reduction Engineering Laboratory and FRX, Inc. Cincinnati, OH | Hydraulic Fracturing | William Slack 513-469-6040 | Demonstration | Completed September 1992 |
| | U.S. EPA NRMRL Cincinnati, OH | Alternate Cover Assessment Program (ACAP) | Steve Rock 513-569-7149 | Demonstration | Ongoing |
| Oklahoma | Geo-Microbial Technologies, Ochelata, OK | Technology for Metals Release and Removal from Wastes | Donald Hitzman 918-535-2281 | Emerging Technology | Ongoing |
| Oregon | Metorex, Inc. Bend, OR | Field Portable X-Ray Fluorescence (FPXRF) | Jim Pasmore 800-229-9209 541-385-6748 | Monitoring and Measuring Technologies | Completed 1995 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Pennsylvania | Aluminum Company of America (formerly Alcoa Separations Technology, Inc.) Pittsburgh, PA | Bioscrubber | Paul Liu 412-826-3711 | Emerging Technology | Completed 1993 |
| | Calgon Carbon Oxidation Technologies (formerly Peroxidation Systems, Inc.) Pittsburgh, PA | Perox-Pur Chemical Oxidation | Bertrand Dussert 412-787-6681 | Demonstration | Completed 1995 |
| | Center for Hazardous Materials Research Pittsburgh, PA | Acid Extraction Treatment System | Stephe Paff 412-826-5321 | Emerging Technology | Completed 1992 |
| | Center for Hazardous Materials Research Pittsburgh, PA | Organics Destruction and Metals Stabilization | B Stephe Paff 412-826-5321 Brian Bosilovich 412-826-5321 | Emerging Technology | Completed 1995 |
| Pennsylvania | Concurrent Technologies (formerly Center for Hazardous Materials Research) Pittsburgh, PA | Lead Smelting | Brian Bosilovich 412-826-5321 | Emerging Technology | Completed 1993 |
| | MacTec-SPB Technologies Company Pittsburgh, PA | In Well Vapor Stripping of Ground Water | Mark McGlathery 800-444-6221 | Demonstration | Ongoing |
| | Geo-Con, Inc. Monroeville, PA 2 Demonstrations | In-situ Solidification/ Stabilization | Linda Ward Robert Hayden 412-856-7700 | Demonstration | Completed April-May 1988 |
| | Lewis Environmental Services, Inc. Pittsburgh, PA | Soil Leaching Process | Tom Lewis III 412-322-8100 | Emerging Technology | Ongoing |
| | Strategic Diagnostics, Inc. Newtown, PA | Immunoassay for PCP | Craig Kostyshyn 215-860-5115 ext. 634 | Monitoring and Measurement Technologies | Completed 1993 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | R.E. Wright Middletown, PA | Bioventing, Air Sparging, Biological Treatment for Ground Water (multi-developer project with state of New York) | Richard Cronce 717-944-5501 | Demonstration | Completed September 1992 |
| | Roy F. Weston, Inc. West Chester, PA | Low Temperature Thermal Treatment System | Mike Cosmos 215-430-7423 | Demonstration | Completed December 1992 |
| | | Steam Regeneration Adsorption System (Ambersorb) | John Thoroughgood 610-701-3728 Deborah Plantz 215-537-4061 | Emerging Technology | Completed 1995 |
| | Vortec Corp Collegeville, PA | Oxidation and Vitrification Process | James Hnat 610-489-2255 | Emerging Technology<br>Demonstration | Completed 1993<br>Ongoing |
| South Carolina | University of South Carolina Columbia, SC | In-situ Mitigation of Acid Water | Frank Caruccio 803-777-4512 | Emerging Technology | Completed 1995 |
| Tennessee | Bergmann USA Gallatin, TN | Soil and Sediment Washing Technology | George Jones 615-230-2217 | Demonstration | Completed 1995 |
| | Brown and Root Environmental/ Illinois Institute of Technology Oak Ridge, TN | Radio Frequency Heating | Clifton Blanchard 423-483-9900 Captain Jeff Stinson 904-283-6254 Harsh Dev 312-567-4257 | Demonstration | Completed 1994 |
| | IT Corporation Knoxville, TN | Batch Steam Distillation and Metal Extraction | Stuart Shealy 423-690-3211 | Emerging Technology | Completed May 1992 |
| | | Eimco Biolift Slurry Reactor as developed by Tekno Associates | Kandi Brown 423-690-3211 | Emerging Technology | Completed 1992 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | | Mixed Waste Treatment Process | Ed Alperin 615-690-3211 | Emerging Technology | Completed 1995 |
| | IT Corporation Knoxville, TN | Photocalytic and Biological Soil Detoxificaiton | Duane Graves 423-690-3211 | Emerging Technology | Completed 1993 |
| | WASTECH, Inc. Oak Ridge, TN | Solidification/ Stabilization | Terrence Lyons U.S. EPA 513-569-7859 | Demonstration | Completed August 1991 |
| Texas | EET, Inc. Bellaire, TX | PCB/Metals Extraction from Porous Surfaces | Tim Tarrillion 713-662-0727 | Demonstration | Ongoing |
| | ENSR Consulting Engineering and Larson Engineering Houston, TX | Bioventing, Air Sparging, Biological Treatment for Ground Water (multi-developer project with the State of New York) | David Ramsden (ENSR) 713-520-6802 N. Sathi-yakumar 716-272-7310 | Demonstration | Completed 1995 |
| Texas | Filter Flow Technology, Inc. League City, TX | Heavy Metals and Radionuclide Sorption Method | Todd Johnson 281-332-3438 | Demonstration | Completed September 1993 |
| | Fugro Geosciences, Inc. Houston, TX | Laser Fluorescence PAH, BTEX Screening Cone Penetrometer | Andrew Taer 713-778-5580 | Monitoring and Measuring Technologies | Completed 1996 |
| | Hanby Environmental Laboratory Wimberly, TX | PCP Test Kit | John Hanby 512-847-1212 | Monitoring and Measurement Technologies | Completed 1993 |
| | Hrubetz Environmental Services, Inc. Dallas, TX | HRUBOUT Process | Barbara Hrubetz Michael Hrubetz 214-363-7833 | Demonstration | Completed February 1993 |
| | Solidtech, Inc. Houston, TX | Solidification and Stabilization | Jack Hubbard U.S. EPA 513-569-7507 | Demonstration | Completed December 1988 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | TN Spectrace<br>Round Rock, TX | Portable X-Ray Fluorescence Spectrometer | Peter Barry<br>512-388-9100 | Monitoring and Measuring Technologies | Completed 1995 |
| | University of Houston<br>Houston, TX | Concentrated Salt Extraction of Lead | Dennis Clifford<br>713-743-4266 | Emerging Technology | Ongoing |
| | Western Product Recovery Group, Inc.<br>Houston, TX | CCBA Physical and Chemical Treatment | Donald Kelly<br>713-493-9321<br>Bert Elkins<br>619-749-8856 | Emerging Technology | Completed 1994 |
| Utah | Phytokinetics, Inc.<br>North Logan, UT | Phytoremedia-tion of Soils | Ari Ferro<br>801-750-0985 | Emerging Technology<br><br>Demonstration | Ongoing<br><br>Ongoing |
| Vermont | Green Mountain Laboratories | Biodegradation of PCBs in Soils | Ronald Lewis<br>513-569-7856 | Demonstration | Ongoing |
| Virginia | BWX Tech., Inc. (Affiliate of Babcock and Wilcox Co. Lynchburg, VA | Cyclone Furnace | Evan Reynolds<br>804-522-6000 | Emerging Technology<br><br>Demonstration | Completed 1992<br><br>Completed November 1991 |
| Virginia | Dynaphore, Inc.<br>Richmond, VA | Removal of Dissolved Heavy Metals via FORAGER Sponge | Norman Rainer<br>804-288-7109 | Demonstration | Completed April 1994 |
| | ITT Industries<br>Roanoke, VA | Enhanced In-Situ Bioremediation of Chlorinated Compounds | Rosann Kryczkowski<br>540-362-7356 | Demonstration | Ongoing |
| Washington | Geosafe Corporation<br>Richland, WA | In-situ Vitrification | James Hansen<br>Matthew Haass<br>509-375-0710 | Demonstration | Completed 1994 |
| | Ionics/ Resources Conservation Co.<br>Bellevue, WA | BEST Solvent Extraction | William Heins<br>206-828-2400 | Demonstration | Completed July 1992 |
| | Remediation Technologies, Inc. (ReTec) Seattle, WA | Methanotrophic Biofilm Reactor | Hans Stroo<br>206-624-9349 | Emerging Technology | Completed 1995 |
| | | Liquid and Soils Biological Treatment | Merv Cooper<br>206-624-9349 | Demonstration | Completed 1994 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Scitec Corporation<br>Richland, WA | Field Portable X-Ray Fluorescence | Steve Santy<br>1-800-466-5323<br>509-783-9850 | Monitoring and Measurement Technologies | Completed<br>1995 |
| | University of Washington<br>Seattle, WA | Asdorptive Filtration | Mark Benjamin<br>206-543-7645 | Emerging Technology | Completed<br>1992 |
| Wisconsin | Svedala Industries (formerly Allis Mineral Systems)<br>Oak Creek, WI | Pyrokiln Thermal Encapsulation Process | Jim Kidd<br>414-798-6341<br>Glenn Heian<br>414-762-1190 | Emerging Technology | Completed<br>1993 |
| | University of Wisconsin,<br>Madison, WI | Photoelectro-catalytic Treatment of Metals and Organics in Water | Marc Anderson<br>608-262-2674<br>Charles Hill, Jr.<br>608-263-4593 | Emerging Technology | Ongoing |
| Wyoming | Western Research Institute<br>Laramie, WY | Contained Recovery of Oily Wastes (CROW) | Lyle Johnson<br>307-721-2281 | Emerging Technology<br><br>Demonstration | Completed<br>1991<br><br>Ongoing |
| Canada | Atomic Energy of Canada, Limited<br>Chalk River, Ontario | Ultrasonic-Acid Leachate Treatment for Mixed Wastes | Shiv Vijayan<br>613-583-3311<br>ext. 3220/6057 | Emerging Technology | Completed |
| Canada | Atomic Energy of Canada, Limited<br>Chalk River, Ontario | Chemical Treatment and Ultrafiltration | Leo Buckley<br>613-584-3311 | Emerging Technology | Completed<br>1993 |
| | Cone Tech Investigations<br>Vancouver, British Colombia | Resistivity, pH, Seismic, Temperature, Cone Penetrometer | Ward Phillips<br>604-327-4311 | Monitoring and Measuring Technologies | Completed<br>1992 |
| | ELI Eco Logic International, Inc.<br>Rockwood, Ontario<br>2 Demonstrations | Thermal Gas Phase Reduction and Thermal Desorption Process | Jim Nash<br>519-856-9591 | Demonstration | Completed<br>December 1992 |
| | EnviroMetal Technologies, Inc.<br>Guelph, Ontario<br>2 Demonstrations | Metal Enhanced Abiotic Degradation | Larry Kwicinski<br>519-824-0432 | Demonstration<br><br>Ex-situ<br><br>In-situ | <br><br>Completed<br>1995<br><br>Ongoing |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Grace Dearborn, Inc.<br>Mississauga, Ontario | Daramend Process | Alan Seech<br>Paul Bucen<br>905-272-7480 | Demonstration | Completed 1994 |
| | Matrix Photocatalytic Limited (formerly Nutech Environmental)<br>London, Ontario, Canada | $TiO_2$ Photocatalytic Treatment of Aqueous Waste Streams | Bob Henderson<br>519-660-8669 | Emerging Technology | Completed 1994 |
| | Matrix Photocatalytic Limited | $TiO_2$ Photocatalytic Air Treatment | Bob Henderson<br>519-660-8669 | Demonstration | Ongoing |
| | Toronto Harbour Comission<br>Toronto, Ontario | Soil Recycling | Teri Richardson<br>U.S. EPA<br>513-569-7949 | Demonstration | Completed May 1992 |
| | Wastewater Technology Centre<br>Burlington, Ontario | Cross-Flow Pervaporation System | Chris Lipski<br>905-639-6320 | Emerging Technology | Completed 1992 |
| | Zenon Environmental Systems, Inc.<br>Burlington, Ontario | Cross-Flow Pervaporation System | Phil Canning<br>Tony Tonelli<br>905-639-6320~ | Demonstration | Completed 1995 |
| | EnviroMetal Technologies, Inc. | In Situ Reactive Barrier | John Vogan<br>519-824-0432 | Demonstration | Ongoing |
| Canada | Zenon Environmental Systems, Inc.<br>Burlington, Ontario | ZenoGem Process | Chris Lipski<br>905-639-6320 | Demonstration | Completed 1995 |
| England/United Kingdom | AEA Technology (formerly Warren Spring Laboratory)<br>Oxfordshire, England | Physical and Chemical Treatment | Steve Barber<br>011-44-1235-463062 | Emerging Technology | Completed 1994 |
| | Graseby Ionics, Limited<br>Waterford Herts, England | Ion Mobility Spectrometry | John Brokenshire<br>011-44-1923-816166<br>Martin Cohen<br>561-683-0507 | Measuring and Monitoring Technologies | Completed Summer and Fall 1990 |
| Italy | Gruppo Italimpresse (developed by Shirco Infrared Systems, Inc.) (formerly ECOVA)<br>Rome, Italy<br>2 Demonstrations | Infrared Thermal Destruction | Laurel Staley<br>U.S. EPA<br>513-569-7863 | Demonstration | Completed November 1987 |

## SITE PROJECTS - BY DEVELOPER STATE (Continued)

| State | Developer | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Puerto Rico | Terra Vac, Inc.<br>San Juan, PR | In-situ Vacuum Extraction | James Malot<br>787-725-8750 | Demonstration | Completed<br>April 198 |

# Appendix B

## SITE TECHNOLOGY DEMONSTRATION SITES
## (Alphabetically by Demonstration Site State)

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Alaska | Fairbanks, AK<br>ABE<br>Superfund Site<br>(Region 10) | Soil Washing | Brice Environmental Services Corporation (BESCORP)<br>Fairbanks, AK<br>Craig Jones<br>907-452-2515 | Demonstration | Completed September 1992 |
| Arizona | Phoenix, AZ<br>Pesticide Site<br>(Region 9) | Thermal Desorption | Smith Environmental Services (formerly Canonie)<br>Porter, IN<br>Joe Hutton<br>219-926-8651 | Demonstration | Completed September 1992 |
| | Phoenix, AZ<br>Williams AFB<br>(Region 9) | In-situ Subsurface Bioremediation | Bio-Rem<br>Butler, IN<br>David O. Mann<br>219-868-5823 | Demonstration | Completed December 1993 |
| Arkansas | Jefferson, AR<br>Incineration Research Facility (IRF)<br>(Region 6) | Tunable-Pulse Combustion | Sonotech, Inc.<br>Atlanta, GA<br>Ben Zinn<br>404-894-3033 | Demonstration | Completed 1995 |
| | | Pyreton Burner (Thermal Destruction) | American Combustion Technologies<br>Norcross, GA<br>Gregory Gitman<br>404-564-4180 | Demonstration | Completed January 1988 |
| California | Burbank, CA<br>Lockheed Site<br>(Region 9) | Integrated In-situ Vapor Extraction and Steam Vacuum Stripping Process | Radian Corporation (formerly AWD Technologies, Inc.)<br>Walnut Creek, CA<br>David Bluestein<br>415-227-0822 | Demonstration | Completed 1993 |
| | Edwards AFB, CA<br>(Region 9) | CAV-OX Oxidation Process | Magnum Water Technology<br>El Segundo, CA<br>Dale Cox<br>310-640-7000 | Demonstration | Completed March 1993 |
| | Fresno, CA<br>Selma Site<br>(Region 9) | Silicate Compounds by Solidification/ Stabilizatioin | STC Omega (formerly Silicate Technology Corporation)<br>Scottsdale, AZ<br>Steve Pegler<br>602-948-7100 | Demonstration | Completed November 1990 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| California | Fullerton, CA<br>McColl Superfund Site<br>(Region 9) | Excavation and Foam Suppression of Volatiles | U.S. EPA<br>Region 9<br>San Francisco, CA<br>Jon Blevins<br>415-744-2400 | Demonstration | Completed July 1990 |
| | Huntington Beach, CA<br>Rainbow Disposal<br>(Region 9) | Steam Injection/ Vacuum Extraction (SIVE) | Hughes Environmental<br>Manhattan Beach, CA<br>(No longer a vendor for SIVE)<br>Paul De Percin<br>U.S. EPA<br>513-569-7797 | Demonstration | Completed August 1993 |
| | Jackson, CA<br>Pintail Systems, Inc.<br>(Region 9) | Biological Stabilization of Arsenic in Soils | Pintail Systems, Inc.<br>Aurora, CO<br>Leslie Thompson<br>303-367-8443 | Demonstration | Ongoing |
| | Livermore, CA<br>Lawrence Livermore National Laboratory (LLNL)<br>(Region 9) | Chemical Oxidation Perox-Pure | Vulcan Peroxidation Systems, Inc.<br>Tucson, AZ<br>Chris Giggy<br>602-790-8383 | Demonstration | Completed 1995 |
| | Livermore, CA<br>LLNL<br>(Region 9) | In-situ Enhanced Extraction | Berkley Environmental Restoration<br>(formerly Udell Technologies, Inc.)<br>Kent Udell<br>510-653-9477 | Demonstration | Completed 1993 |
| | March AFB, CA<br>(Region 9) | In-situ Air Stripping | Roy Weston<br>Woodland Hills, CA<br>Jeff Bannon<br>818-971-4900 | Demonstration | Completed 1994 |
| | Port Hueneme, CA<br>Naval Facilities Engineering Service Center<br>(Region 9) | Solvated Electron Treatment of Chlorinated Organics | Commodore Environmental<br>Columbus, OH<br>Neil Dronby<br>614-297-0365 | Demonstration | Completed 1996 |
| | Sacramento, CA<br>McClellan AFB<br>(Region 9) | Photolytic Destruction for SVE Off-gases | Process Technologies, Inc.<br>Boise, ID<br>Michael Swan<br>208-385-0900 | Demonstration | Ongoing |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| California | Sacramento, CA<br>McClellan AFB<br>(Region 9) | Groundwater Extraction | Xerox Two Phase Extraction<br>Ron Hess<br>716-422-3694 | Demonstration | Completed February 1995 |
| | San Diego, CA<br>Naval Air Station North Island (NASNI)<br>(Region 9) | In Well Vapor Stripping of Ground Water | MACTEC Environmental, Inc.<br>Pittsburgh, PA<br>Mark McGlathery<br>800-444-6221 | Demonstration | Ongoing |
| | San Diego, CA<br>NASNI Site 9<br>(Region 9) | Cross-flow Pervaporation System for Removal of VOCs from Groundwater | Zenon Environmental, Inc.<br>Burlington, Ontario, Canada<br>Phil Canning<br>905-639-6320 | Demonstration | Completed 1995 |
| | San Francisco, CA<br>Westin Hotel<br>(Region 9) | GIS/KEY Software for HW Site Data Management | GIS Solutions, Inc.<br>Concord, CA<br>Garry W. Reid<br>510-827-5400 | Demonstration | Completed August 1993 |
| | San Jose, CA<br>Lorentz Barrel and Drum Site<br>(Region 9) | Ultraviolet Ozone Treatment for Liquids | Ultrox International, Inc.<br>Santa Ana, CA<br>David Fletcher<br>562-490-4649 | Demonstration | Completed May 19889 |
| | San Pedro, CA<br>Annex Terminal<br>(Region 9) | In-situ Steam/ Air Stripping | Novaterra, Inc. (formerly Toxic Treatment, Inc.)<br>Torrance, CA<br>Phil La Mori<br>310-328-9433 | Demonstration | Completed September 1989 |
| | Santa Barbara, CA<br>Santa Marie Health Care Services (UST Site)<br>(Region 9) | Soil Washing/ Geological Treatment | BioGenesis Enterprises (formerly BioVersal USA)<br>Fairfax Station, VA<br>Charles Wilde<br>703-250-3442<br>Mohsen Amiran<br>708-827-0024 | Demonstration | Completed November 1992 |
| | South El Monte, CA<br>(Region 9) | Gasification Process | Texaco Syngas, Inc.<br>White Plains, NY<br>John Winter<br>316-251-4000<br>ext. 536 | Demonstration | Completed 1994 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Colorado | Clear Creek, CO<br>Burleigh Tunnel<br>(Region 8) | Wetland-Based Treatment for Mineral Mine Drainage | Colorado Department of Health<br>Denver, CO<br>Jim Lewis<br>303-692-3390 | Demonstration | Ongoing |
| | Denver, CO<br>Rocky Flats<br>(Region 8) | Colloid Polishing Method | Filter Flow Technology<br>League City, TX<br>Tod Johnson<br>713-334-6080 | Demonstration | Completed November 1992 |
| | Denver, CO<br>DOE Rocky Flats<br>(Region 8) | Core Barrel Soil Sampler | Simulprobe Technologies, Inc. | Monitoring and Measurement | Completed |
| | Denver, CO<br>(Region 8) | Dual Tube Liner Soil Sampler | Art's Manufacturing and Supply<br>American Falls, ID<br>Brian Anderson<br>800-635-7330 | Monitoring and Measurement | Completed |
| | Denver, CO<br>(Region 8) | Electrocoa-gulation | General Environmental Inc. (formerly Hydrologics, Inc.)<br>Englewood, CO<br>Carl Dalrymple<br>303-761-6960 | Demonstration | Completed 1995 |
| | Denver, CO<br>(Region 8) | EMFLUX Soil Gas Survey System | Quadrel Services, Inc. | Monitoring and Measurement | Completed |
| | Denver, CO<br>(Region 8) | Gore-Scrubber Passive Soil Gas Sampler | W. L. Gore and Associates, Inc.<br>Elkton, MD<br>Ray Fenstermacher<br>410-506-4780 | Monitoring and Measurement | Completed |
| | Denver, CO<br>(Region 8) | JMC Environmentalist's Subsoil Probe | Clements Associates, Inc. | Monitoring and Measurement | Completed |
| | Denver, CO<br>(Region 8) | Large Bore Soil Sampler | Geoprobe Systems | Monitoring and Measurement | Completed |
| | Rocky Flats, CO<br>(Region 8) | In-situ Reactive Barrier | EnviroMetal Technologies, Inc.<br>John Vogan<br>519-824-0432 | Demonstration | Ongoing |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Florida | Brandon, FL<br>Peak Oil Superfund Site<br>(Region 4) | Infrared Incinerator | Grupo Italimprese (Ecova Europa) (formerly ECOVA)<br>John Cioffi<br>206-883-1900 | Demonstration | Completed August 1987 |
| | Pensacola, FL<br>American Creosote Works<br>(Region 4) | Filtration | SBP Technologies, Inc.<br>Baton Rouge, LA<br>Clayton Page<br>504-753-5255 | Demonstration | Completed 1992 |
| | Pensacola, FL<br>Escanbia Wood Preserving Site<br>(Region 4) | Soil Washing | U.S. EPA Mobile Volume Reduction Unit<br>Cincinnati, OH<br>Richard Griffith<br>908-321-6629 | Demonstration | Completed November 1992 |
| Georgia | Chickamuga, GA and Hopkinsville, GA<br>(Region 4) | Debris Washing System | U.S. EPA<br>NRMRL<br>Cincinnati, OH<br>Donald Sanning<br>513-569-7875<br>Mike Taylor<br>512-782-4700 | Demonstration | Completed August 1990 |
| | Warner Robins, GA<br>Robins AFB<br>(Region 4) | Stabilization of Organics | WASTECH, Inc.<br>Oak Ridge, TN<br>Benjamin Peacock<br>615-483-6515 | Demonstration | Completed August 1991 |
| Hawaii | Pearl Harbor, HI<br>(Region 9) | PCB/Metals Extraction from Porous Surfaces | EET Inc.<br>Bellaire, TX<br>Tim Tarrillion<br>713-662-0727 | Demonstration | Ongoing |
| | Pearl Harbor, HI<br>Naval Facility<br>(Region 9) | Electrokinetics | Geokinetics<br>Steven H. Schwartzkopf<br>415-424-3176 | Demonstration | Ongoing |
| | Pearl Harbor, HI<br>Naval Facility<br>(Region 9) | Electrokinetic Flushing & Surfactant Flushing | Geokinetics and Duke Engineering<br>Thomas Holdsworth<br>U.S. EPA<br>523-569-7675 | Demonstration | Ongoing |
| Illinois | Chicago, IL<br>(Region 4) | Hydraulic Fracturing | U.S. EPA/ NRMRL<br>Cincinnati, OH<br>William Slack<br>513-556-2526 | Demonstration | Completed September 1992 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Illinois | Waukegan Harbor, IL (Region 5) | Thermal Desorption | SoilTech, ATP Systems Inc. Porter, IN Joe Hutton 219-926-8651 | Demonstration | Completed June 1992 |
| Indiana | Gary, IN Indiana Harbour (Region 5) | Solvent Extraction | Ionics/Resources Conservation, Co. Bellevue, WA Bill Hines 206-828-2400 | Demonstration | Completed July 1992 |
| Iowa | Albert City, IA (Region 7) | Core Barrel Soil Sampler | Simulprobe Technologies, Inc. | Monitoring and Measurement | Completed |
| | Albert City, IA (Region 7) | Dual Tube Liner Soil Sampler | Art's Manufacturing and Supply American Falls, ID Brian Anderson 800-635-7330 | Monitoring and Measurement | Completed |
| | Albert City, IA (Region 7) | EMFLUX Soil Gas Survey System | Quadrel Services, Inc. | Monitoring and Measurement | Completed |
| | Albert City, IA (Region 7) | Gore-Scrubber Passive Soil Gas Sampler | W. L. Gore and Associates, Inc. Elkton, MD Ray Fenstermacher 410-506-4780 | Monitoring and Measurement | Completed |
| | Albert City, IA (Region 7) | JMC Environmentalist's Subsoil Probe | Clements Associates, Inc. | Monitoring and Measurement | Completed |
| | Albert City, IA (Region 7) | Large Bore Soil Sampler | Geoprobe Systems | Monitoring and Measurement | Completed |
| Kansas | Bendena, KS (Region 7) | Biological Denitrification | Eco Mat, Inc. Hayward, CA Kim Halley 510-783-5885 | Demonstration | Ongoing |
| Kentucky | Paducah, KY Gaseous Diffustion Plant (Region 4) | In-situ Electroosmosis of TCE in Soil/ Groundwaters "Lasagna" Process | Monsanto/Dupont Thomas Holdsworth 513-569-7675 | Demonstration | Completed 1998 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Louisiana | Fort Polk, LA<br>(Region 6) | Electrokinetic Extraction | Electrokinetics, Inc.<br>Baton Rouge, LA<br>Elif Acar<br>504-388-3992 | Demonstration | Ongoing |
| Massachusetts | Bostion, MA<br>(Region 1) | AMS Split Core Sampler | Art's Manufacturing and Supply<br>Brian Anderson<br>800-635-7330 | Monitoring and Measurement | Ongoing |
| | Bostion, MA<br>(Region 1) | Russian Peat Borer | Aquatic Research Instruments<br>Will Young<br>208-768-2222 | Monitoring and Measurement | Ongoing |
| | New Bedford, MA<br>(Region 1) | Solvent Extraction | CF Systems Corporation<br>Westminister, CO<br>L.V. Benningfield<br>303-420-1550 | Demonstration | Completed December 1988 |
| | North Dartsmouth, MA<br>Resolve Superfund Site<br>(Region 1) | Thermal Desorption | OHM Environmental (formerly Chemical Waste Management Inc.)<br>Geneva, IL<br>Dick Ayen<br>803-846-241 | Demonstration | Completed May 1992 |
| Michigan | Adrian, MI<br>Anderson Development<br>(Region 5) | Thermal Desorption (physical) | Roy F. Weston, Inc.<br>West Chester, PA<br>Michael Cosmos<br>215-430-7423 | Demonstration | Completed December 1992 |
| | Bay City, MI<br>Bay City Municipal Landfill<br>(Region 5) | Thermal Gas Phase Reduction Process and Thermal Desorption | ELI Eco Logic International, Inc.<br>Rockwood, Ontario, Canada<br>Jim Nash<br>519-856-9591 | Demonstration | Completed December 1992 |
| | Buchanan, MI<br>Electro-Voice<br>(Region 5) | Subsurface Volatilization and Ventilation System (SVVS) | Billings & Associates, Inc.<br>Albuquerque, NM<br>Gale Billings<br>505-345-1116 | Demonstration | Completed May 1994 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Detroit, MI (Region 5) | Debris Washing System | U.S. EPA/ NRMRL Cincinnati, OH Donald Sanning 513-569-7444 | Demonstration | Completed August 1990 |
| | Essexville, MI Saginaw Bay Confined Disposal Facility (Region 5) | Sediment Soil Washing | Bergmann, USA Gallatin, TN Richard Traver 615-452-5500 | Demonstration | Completed May 1992 |
| Michigan | Grand Ledge, MI Parsons Chemical Site (Region 5) | In-situ Vitrification | Geosafe Corporation Richland, WA James Hansen 509-375-0710 | Demonstration | Completed 1994 |
| | Rose Township, MI (Region 5) | Infrared Incinerator | Grupo Italimprese (Ecova Europa) (formerly ECOVA) Jon Cioffi 206-883-1900 | Demonstration | Completed 1987 |
| Minnesota | McGillis & Gibbs Superfund Site, MN (Region 5) | Biotreatment of Groundwater | BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032 | Demonstration | Completed September 1989 |
| | McGillis & Gibbs Superfund Site, MN (Region 5) | Soil Washing | BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032 | Demonstration | Completed October 1989 |
| | Minneapolis, MN Private Oil Refining Company (Region 5) | Soil Washing/ Biological Treatment | BioGenesis Enterprises, Inc. (formerly BioVersal USA) Fairfax Station, VA Charles Wilde 703-250-3442 Mohsen Amiran 708-827-0024 | Demonstration | Completed November 1992 |
| | New Brighton, MN Twin Cities Army Ammunition Plant (TCAAP) (Region 5) | Removal of Lead from Soils | COGNIS TARRAMET Goss, MO Lou Magdits 573-626-3476 | Demonstration | Completed 1994 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Minnesota | St. Louis Park, MN (Region 5) | Bioventing (air-injection) | U.S. EPA/NRMRL Cincinnati, OH Paul McCauley 513-569-7444 | Demonstration | Completed Fall 1997 |
| Mississippi | Brookhaven, MS Brookhaven Wood Preserving (Region 4) | Fungus Treatment Technology | U.S. EPA/NRMRL USDA-Forest Products Lab Madison, WI Richard Lamar 608-231-9469 | Demonstration | Completed 1991 |
| Montana | Butte, MT Butte-Silverbow Site (Region 8) | Plasma Heat | Retech, Inc. Ukiah, CA R.C. Eschenback 707-462-6522 | Demonstration | Completed July 1991 |
| | Mike Horse Mine, MT (Region 8) | Grouting Technique | Morrison Knudsen Corporation Boise, ID 208-386-6115 | Demonstration | Completed 1996 |
| | St. Louis, MT Welldon Spring (Region 7) | Anaerobic Biological Destruction of TNT in Soil | J.R. Simplot Company Pocatello, ID Dr. Kaake 208-234-5367 | Demonstration | Completed February 1994 |
| Nebraska | Hastings, NE (Region 7) | Spray Irrigation | University of Nebraska-Lincoln Hasting, NE Roy Spalding 402-783-3931 | Demonstration | Completed July 1996 |
| Nevada | Battle Mountain, NV (Region 9) | Biodegradation of Cyanide | Pintain Systems, Inc. Aurora, CO Caren Caldwell 303-367-8443 | Demonstration | Ongoing |
| New Hampshire | Plaistow, NH (Region 1) | Biodegradation of PCB's in Soils | Green Mountain Laboratories Montpelier, VT Adam Longee 802-223-1468 | Demonstration | Ongoing |
| New Jersey | Edison, NJ EPA (Region 2) | Solvent Extraction Carver-Greenfield Process | Dehydro Tech Corporation East Hanover, NJ Thomas Holcombe 210-887-2182 | Demonstration | Completed August 1991 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Hillsborough, NJ (Region 2) | Pneumatic Fracturing, Extraction and Hot Gas Injection | Accutech, Inc. Keyport NJ & New Jersey Institute of Technology, Newark, NJ Lohn Liskowitz 908-739-6444 | Demonstration | Completed August 1992 |
| | Millville, NJ Nascoilte Site (Region 2) | Bioreactor Integrated with an Ultrafiltration Membrane System | Zenon Environmental, Inc. Burlington, Ontario, Canada Anthony Tonelli 416-639-6320 | Demonstration | Completed 1995 |
| New Jersey | Morganville, NJ Imperial Oil Co., Inc. Site (Region 3) | Solidification | Solidtech, Inc. Houston, TX Bill Stallworth 713-497-8558 | Demonstration | Completed December 1988 |
| | Pedricktown, NJ National Lead Industries (Region 2) | Removal of Dissolved Metals | Dynaphore/ Forager Sponge Richmond, VA Norman Rainer 804-288-7109 | Demonstration | Completed April 1994 |
| | Trenton, NJ (Region 2) | Phytoextraction of Metal from Soil | Phytotech, Inc. Monmouth, NJ Burt Ensley 908-438-0900 | Demonstration | Ongoing |
| | Wayne, NJ (Region 2) | Ex-situ Metal-enhanced Abiotic Degredation | EnviroMetal Technologies, Inc. Guelph, Ontario John Vogan 519-824-0432 | Demonstration | Completed 1995 |
| New Mexico | Albuquerque, NM (Region 6) | Electrokenitic Extraction in Unsaturated Soils | Sandia National Laboratories, Albuquerque, NM Eric Lindgren 505-844-0543 | Demonstration | Ongoing |
| New York | Brant, NY Wide Beach (Region 2) | Thermal Desorption Dechlorination | SoilTech, ATP Systems, Inc. Porter, IN Joe Hutton 219-926-8651 | Demonstration | Completed June 1992 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | Brockport, NY<br>Sweden-3 Chapman Site<br>(Region 2) | Biovault, Bioventing and Groundwater Circulation Biological Treatment Process | NY State Bioremediation and SBP Technologies, Inc.<br>White Plains, NY<br>Clayton Page<br>504-755-7711 | Demonstration | Completed 1995 |
| | Niagara Falls, NY<br>(Region 2) | Cold Top Vitrification | New Jersey Institute of Technology (NJIT)<br>Newark, NJ and Geo Tech Development Corporation, King of Prussia, PA<br>William Librizzi<br>201-596-5846<br>Thomas Tate<br>610-337-8515 | Demonstration | Ongoing |
| New York | Upstate NY<br>(Region 2) | In-situ Metal-enhanced Abiotic Degredation | EnviroMetal Technologies, Inc.<br>Guelph, Ontario<br>John Vogan<br>519-824-0432 | Demonstration | Ongoing |
| | Utica, NY<br>(Region 2) | High Temperature Thermal Processor | Maxymillian Technologies, Inc. (Formerly Clean Berkshires)<br>Lanesboro, MA<br>Jim Maxymillian<br>413-499-3050 | Demonstration | Completed 1994 |
| | Utica, NY<br>Town Gas Site<br>(Region 2) | Slurry Biodegradation | Remediation Technologies Inc. (ReTec) (formerly Mo Tec Inc.)<br>Pitsburgh, PA<br>David Nakles<br>412-380-0140 | Demonstration | Completed 1991 |
| North Carolina | Morrisville, NC<br>Koppers Site<br>(Region 4) | Base-Catalyzed Destruction (Dehalogenation) | U.S. EPA/ NRMRL<br>Cincinnati, OH<br>George Huffman<br>513-569-7341<br>Environmental Inc.<br>Blue Bell, PA<br>Yei-Shong Shieh<br>215-832-0700 | Demonstration | Completed August 1993 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Ohio | Aliance, OH<br>Babcock & Wilcox Alliance Research Center<br>(Region 5) | Cyclone Vitrification | Babcock & Wilcox Alliance Research Center<br>Alliance, OH<br>Lawrence King<br>216-829-7576 | Demonstration | Completed 1991 |
| | Cincinnati, OH<br>EPA T&E Facility<br>(Region 5) | Bioslurry Reactor | ECOVA Corporation<br>Redmond, WA<br>Alan Jones<br>206-883-1900 | Demonstration | Completed 1991 |
| | Crooksville, OH<br>Pintail Systems, Inc.<br>(Region 5) | Biostabilization of Lead | Pintail Systems, Inc.<br>Aurora, CO<br>Leslie Thompson<br>303-367-8443 | Demonstration | Ongoing |
| | Dayton, OH<br>(Region 5) | Hydraulic Fracturing | U.S. EPA/ NRMRL<br>Cincinnati, OH<br>William Slack<br>513-556-2526 | Demonstration | Completed September 1992 |
| Ohio | DOE Fernald Facility, OH<br>(Region 5) | Solvent Extraction | Terra Kleen Corporation (name changed back from Sevenson Extraction Technology, Inc.)<br>Alan Cash<br>619-552-9902 | Demonstration | Completed 1997 |
| Oregon | Clackamas, OR<br>Portable Equipment Co. Site<br>(Region 10) | Chemical Fixation/ Stabilization | Advanced Remediation Mixing, Inc. (formerly Chemfix Technologies, Inc.)<br>Metarie, LA<br>Sam Pizzitola<br>504-461-0466 | Demonstration | Completed March 1989 |
| Pennsylvania | Douglassville, PA<br>(Region 3) | Solidification/ Stabilization | Hazcon and Funderburk & Associates)<br>Fairfield, TX<br>Ray Funderburk<br>813-645-9620 | Demonstration | Completed October 1987 |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Pennsylvania | Palmerton, PA<br>Palmerton Zinc Pile<br>(Region 3) | Membrane Microfiltration | E.I. DuPont DeNemours & Company<br>Newark, DE<br>Oberlin Filter Company<br>Waukesha, WI<br>Ernest Mayer<br>302-366-3652 | Demonstration | Completed May 1990 |
| | Stroudsburg, PA<br>(Region 3) | Contained Recovery of Oil Wastes | Western Research Institute<br>Laramie, WY<br>James Speight<br>307-721-2011 | Demonstration | Completed August 1997 |
| Rhode Island | Central Landfill, RI<br>(Region 1) | Reverse Osmosis: Disc-Tube Module Technology | ROCHEM Separations, Inc.<br>Torrence, CA<br>David LaMonica<br>310-370-3160 | Demonstration | Completed August 1994 |
| | N. Smithfield, RI<br>(Region 1) | AIR II Photocatalytic Technology for Air Streams | KSE, Inc.<br>Amhurst, MA<br>James Kittrell<br>413-549-5506 | Demonstration | Ongoing |
| South Carolina | Savannah River Site, SC<br>(Region 4) | High Energy Irradiation for Destruction of Organics in Aqueous Solutions and Sludge | High Voltage Environmental Application, Inc.<br>Florida and International University Miami, FL<br>William Cooper<br>305-348-3049 | Demonstration | Completed 1994 |
| Tennessee | Oak Ridge, TN<br>(Region 4) | Photocatalytic Aqueous Phase Organics Destruction Matrix | Matrix, Inc.<br>London, ON<br>Robert Henderson<br>519-660-8669 | Demonstration | Completed 1995 |
| | Oak Ridge, TN<br>DOE Oak Ridge Facility<br>(Region 4) | Freeze Barrier | Arctic Foundations<br>Anchorage, AK<br>Ed Yarmak<br>907-562-2741 | Demonstration | Ongoing |
| Texas | Fort Worth, TX<br>Carswell AFB<br>(Region 6) | Phytoremediation of TCE in Groundwater | ASC/EMR<br>Wright Patterson AFB<br>Greg Harvey<br>513-255-7718 | Demonstration | Ongoing |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| | San Antonio, TX<br>Kelly AFB<br>(Region 6) | Hot Air Injection | Hrubetz Evironmental Services, Inc.<br>Dallas, TX<br>Michael or Barbara Hrubetz<br>214-691-8545 | Demonstration | Completed February 1993 |
| | San Antonio, TX<br>Kelly AFB<br>(Region 6) | Radio-frequency Heating | IITRI/NUS<br>IITRI-Chicago, IL and Haliburton/ NUS<br>Oak Ridge, TN<br>Clifford Blanchard<br>615-483-9900 | Demonstration | Completed 1994 |
| | San Antonio, TX<br>Kelly AFB<br>(Region 6) | Radio-frequency Heating | KAI/HNUS<br>Oak Ridge, TN<br>Cliff Blanchard<br>615-483-9900 | Demonstration | Completed 1994 |
| Utah | Hill AFB, UT<br>(Region 8) | Steam Injection/ Vacuum Extraction | Praxis Environmental Services<br>San Francisco, CA<br>Dr. Lloyd Steward<br>415-641-9044 | Demonstration | Ongoing |
| Utah | Ogden, UT<br>Chevron Transfer Facility<br>(Region 8) | Phytoremediation of Petroleum in Soil and Groundwater | Phytokinetics, Inc.<br>Logan, UT<br>Ari Ferro<br>801-750-0985 | Demonstration | Ongoing |
| Virginia | Roanoke, VA<br>ITT Night Vision Facility<br>(Region 3) | Enhanced In-situ Bioremediation of Chlorinated Compounds | ITT Industries<br>Roanoke, VA<br>Rosann Kryczkowski<br>540-362-7356 | Demonstration | Ongoing |
| Washington | Ellensburg, WA<br>(Region 10) | Anaerobic Biological Destruction of Dinoseb in Soil | J. R. Simplot Company<br>Pocatello, ID<br>Dr. Kaake<br>208-234-5367 | Demonstration | Completed July 1993 |
| Wisconsin | Green Bay, WI<br>(Region 5) | AMS Split Core Sampler | Art's Manufacturing and Supply<br>Brian Anderson<br>800-635-7330 | Monitoring and Measurement | Ongoing |
| | Green Bay, WI<br>(Region 5) | Russian Peat Borer | Aquatic Research Instruments<br>Will Young<br>208-768-2222 | Monitoring and Measurement | Ongoing |

## TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

| State | Demonstration Location | Technology | Contact | Program | Status |
|---|---|---|---|---|---|
| Wisconsin | Sparta, WI<br>U.S. DOD<br>Fort McCoy<br>(Region 5) | MAECTITE® Treatment Process | Sevenson Environmental Services, Inc.<br>Munster, IN<br>Chuck McPheeters<br>219-836-0116 | Demonstration | Ongoing |
| Various locations in U.S. | 10 sites around the nation | Alternate Cover Assessment Program (ACAP) | U.S. EPA<br>NRMRL | Demonstration | Ongoing |
| Canada | Toronto, Canada<br>Toronto Port Industrial Division | Treatment Train for Contaminated Soils | Toronto Harbor Commissioners<br>Toronto, Canada<br>Dennis Lang<br>416-863-2047 | Demonstration | Completed May 1992 |
| | Trenton, Ontario<br>Domtar Wood Preserving Site | Bioremediation | GRACE Bioremediation Technologies<br>Mississauga, Ontario, Canada<br>Alan Seech<br>905-272-7480 | Demonstration | Completed 1994 |

# Appendix C

## PUBLICATIONS - INFORMATION TRANSFER PRODUCT DESCRIPTIONS

Documents from the
US EPA National Risk Management Research Laboratory
Land Remediation & Pollution Control Division
Measuring & Monitoring Program
General Publications

- SITE Program: Annual Report to Congress 1995 (EPA/540/R-97/508)
- SITE Profiles, Ninth Edition (EPA/540/R-97/502)
- Survey of Materials Handling Technologies Used at Hazardous Waste Sites (EPA/540/2-91/010) PB91-921283[2]
- Superfund Innovative Technology Evaluation Program: - Innovation Making a Difference (EPA/540/F-94/505)
- Superfund Innovative Technology Evaluation Program: - Technology with an Impact (EPA/540/F-93/500)
- Interim Status Report U.S. and German Bilateral Agreement on Remediation of Hazardous Waste Sites (EPA/540/R-94/500) PB94-164811[2]
- SITE Innovation on the Move (EPA/540/F-97/500)
- Land Remediation & Pollution Control Division; Science and Technology to Treat Contaminated Soils, Sludge & Sediments (EPA/504/F-98/501) PB92-222215[2]
- Technology Evaluation Vol. 11 (EPA/540/R-92/017B) PB92-222223[2]

## Demonstration Project Results

**Accutech Remedial Systems, Inc.--Pneumatic Fracturing Extraction and Hot Gas Injec., Phase 1**
- Technology Evaluation (EPA/540/R-93/509) PB93-216596[2]
- Technology Demo. Summary (EPA/540/SR-93/509)[3]
- Demonstration Bulletin (EPA/540/MR-93/509)[3]
- Applications Analysis (EPA/540/AR-93/509) PB94-117439[2]

**American Combustion, Inc. - Oxygen Enhanced Incineration**
- Technology Evaluation (EPA/540/5-89/008)
- Applications Analysis (EPA/540/A5-89/008)
- Technology Demo. Summary (EPA/540/S5-89/008)[3]
- Demonstration Bulletin (EPA/540/M5-89/008)[3]

**AWD Technologies, Inc. - Integrated Vapor Extraction and Steam Vacuum Stripping**
- Applications Analysis (EPA/540/A5-91/002) PB92-218379[2]
- Demonstration Bulletin (EPA/540/M5-91/002)[3]

**Babcock & Wilcox Co-Cyclone Furnace Vitrification**
- Technology Evaluation Vol. 1 (EPA/540/R-92/017A) PB92-222215[2]
- Technology Evaluation Vol. 11 (EPA/540/R-92/017B) PB92-222223[2]
- Applications Analysis (EPA/540/AR-92/017) PB93-122315[2]
- Technology Demo. Summary (EPA/540/SR-92/017)[3]
- Demonstration Bulletin (EPA/540/MR-92/011)

**Bergman USA - Soil and Sediment Washing System**
- Demonstration Bulletin (EPA/540/MR-92/075)[3]
- Applications Analysis (EPA/540/AR-92/075)

**Biogenesis Enterprises, Inc . - Soil and Sediment Washing Processes**
- Demonstration Bulletin (EPA/540/MR-93/510)
- Innovative Tech. Eval. Report (EPA/540/R-93/510)
- SITE Technology Capsule (EPA/540/SR-93/510)

**Bio-Rem, Inc. - Augmented In-Situ Subsurface Biorem Process**
- Demonstration Bulletin (EPA/540/MR-93/527)[3]

**BioTrol - Biological Aqueous Treatment System**
- Technology Evaluation (EPA/540/5-91/001) PB92-110048[2]
- Applications Analysis (EPA/540/A5-91/001) PB91-227983[2]
- Technology Demo. Summary (EPA/540/S5-91/001)[3]
- Demonstration Bulletin (EPA/540/M5-91/001)[3]

**- Soil Washing System**
- Technology Evaluation Vol. 1 (EPA/540/5-91/003a) PB92-115310[2]
- Technology Evaluation Vol. 11 Part A (EPA/540/5-91/003b) PB92-115328[2]
- Technology Evaluation Vol. 11 Part B (EPA/540/5-91/003c) PB92-115336[2]
- Applications Analysis (EPA/540/A5-91/003)

[1] Order documents free of charge by calling EPA's Center for Environmental Research Information (CERI) at 513-569-7562 or Fax 513-569-8695.

[2] Documents with a PB number are out of stock and must be ordered by that number at cost from:
National Technical Information Service
5285 Port Royal Road
Springfield VA 22161
Telephone 703-487-4650 or 1-800-553-6847

[3] Out of stock

PB92-115245[2]

- Technology Demo. Summary (EPA/540/S5-91/003) PB92-224393[2]
- Demonstration Bulletin (EPA/540/M5-91/003)[3]

**Brice Environmental Services Corporation - Bescorp Soil Washing System Battery Enterprises Site**

- Demonstration Bulletin (EPA/540/MR-93/503)[3]
- Applications Analysis (EPA/540/AR-93/503) PB95-199741[2]

**Brown and Root Environmental - Subsurface Volatilization and Ventilation System**

- Demonstration Bulletin (EPA/540/MR-94/529)
- Capsule (EPA/540/R-94/529a)
- Innovative Tech. Eval. Report (EPA/540/R-94/529)

**Canonie Environmental Services Corporation - Low Temperature Thermal Aeration (LTTA)**

- Demonstration Bulletin (EPA/540/MR-93/504)[3]
- Applications Analysis (EPA/540/AR-93/504)

**CF Systems Corporation - Liquified Gas Solvent Extraction**

- Technology Evaluation Vol. 1 (EPA/540/5-90/002)
- Technology Evaluation Vol. 11 (EPA/540/5-90/002a) PB90-186503[2]
- Applications Analysis (EPA/540/A5-90/002)
- Technology Demo. Summary (EPA/540/S5-90/002)

**Chemfix Technologies, Inc. (Now Advanced Remediation Mixing, Inc.) - Chemical Fixation/Stabilization**

- Technology Evaluation Vol. 1 (EPA/540/5-89/011a) PB91-127696[2]
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- Applications Analysis (EPA/540/AR-92/019)

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- Demonstration Bulletin (EPA/540/M5-89/005)[3]

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**U.S. EPA - McColl Superfund Site - Demonstration of a Trial Excavation**
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- Journal Article AWMA Vol. 44, No. 3, March 1994

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- Emerging Tech. Report - Appendices (EPA/540/5-90/005b) PB90-252602[2]

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- Emerging Tech. Bulletin (EPA/540/F-94/502)
- Emerging Tech. Summary (EPA/540/SR-94/531)
- Emerging Tech. Report (EPA/540/R-94/531) PB95-159992[2]

**IT Corporation - Process for the Treatment of Volatile Organic Carbon & Heavy-Metal Contaminated Soil**
- Emerging Tech. Bulletin (EPA/540/F-95/509)

**J.R. Simplot - Anaerobic Destruction of Nitroaromatics (the SABRE Process)**
- Journal Article App. Env. Micro, Vol.58, No. 5, May

[1] Order documents free of charge by calling EPA's Center for Environmental Research Information (CERI) at 513-569-7562 or Fax 513-569-8695.

[2] Documents with a PB number are out of stock and must be ordered by that number at cost from:
National Technical Information Service
5285 Port Royal Road
Springfield VA 22161
Telephone 703-487-4650 or 1-800-553-6847

[3] Out of stock

1992, pp. 1683-89

**Matrix Photocatalitic, Inc. - Photocatalytic Water Treatment**
- Published Paper (EPA/600/A-93/282) PB94-130184[2]

**Membrane Technology and Research, Inc. - Volatile Organic Compound Removal from Air Streams by Membrane Separation**
- Emerging Tech. Bulletin (EPA/540/F-94/503)

**M.L. Energia - Reductive Photo-Dechlorination Process for Safe Conversion of Hazardous Chlorocarbon Waste Streams**
- Emerging Tech. Bulletin (EPA/540/F-94/508)

**New Jersey Institute of Technology - GHEA Associates Process for Soil Washing and Wastewater Treatment**
- Emerging Tech. Bulletin (EPA/540/F-94/509)

**PURUS, Inc. - Photolytic Oxidation Process [Destruction of Organic Contaminants in Air Using Advanced Ultraviolet Flashlamps]**
- Emerging Tech. Bulletin (EPA/540/F-93/501)[3]
- Emerging Tech. Summary (EPA/540/SR-93/516)[3]
- Emerging Tech. Report (EPA/540/ R-93/516) PB93-205383[2]

**Roy F. Weston, Inc. - Ambersorb 563 Adsorbent**
- Emerging Tech. Bulletin (EPA/540/F-95/500)
- Emerging Tech. Summary (EPA/540/SR-95/516)
- Emerging Tech. Report (EPA/540/R-95/516) PB95-264164[2]

**University of Washington - Metals Treatment at Superfund Sites by Adsorptive Filtration**
- Emerging Tech. Bulletin (EPA/540/F-92/008)[3]
- Emerging Tech. Summary (EPA/540/SR-93/515)[3]
- Emerging Tech. Report (EPA/540/ R-93/515) PB93-231165[2]

**Vortec Corporation - Vitrification**
- Published Paper, Glass Production Technol International, 1994, p. 103 - 106
- Emerging Tech. Summary (EPA/540/S-97/501)[4]

**Wastewater Technology Centre - [A] Cross-Flow Pervaporation System [for Removal of VOC's from Contaminated Water]**
- Emerging Tech. Bulletin (EPA/540/F-93/503)[3]
- Emerging Tech. Summary (EPA/540/SR-94/512)[3]
- Emerging Tech. Report (EPA/540/R-94/512) PB94-170230[2]

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Telephone 703-487-4650 or 1-800-553-6847

[3] Out of stock

## Measuring and Monitoring Program Reports

### Cone Penetrometers

**Loral Rapid Optical Screening Tool (ROST)**
- Demonstration Bulletin (EPA/540/MR-95/519)
- Innovative Tech. Eval. Report (EPA/540/R-95/519)

**Site Characterization Analysis Penetrometer System (SCAPS)**
- Demonstration Bulletin (EPA/540/MR-95/520)
- Innovative Tech. Eval. Report (EPA/540/R-95/520)

### Field Portable X-Ray Fluorescence

**HNU Systems SEFA-P Field Portable X-ray Fluorescence**
- Innovative Tech. Eval. Report (EPA/600/R-97/144)

**Metorex X-Met 920P and 940 Field Portable X-ray Fluorescence**
- Innovative Tech. Eval. Report (EPA/600/R-97/146)

**Metorex X-Met 920MP Field Portable X-ray Fluorescence**
- Innovative Tech. Eval. Report (EPA/600/R-97/151)

**Niton XL Spectrum Field Portable X-ray Fluorescence**
- Innovative Tech. Eval. Report (EPA/600/R-97/150)

**SciTec MAP Spectrum Field Portable X-ray Fluorescence**
- Innovative Tech. Eval. Report (EPA/600/R-97/147)

**TN Spectrace TN9000 and TN Pb Field Portable X-ray Fluorescence Analyzers**
- Innovative Tech. Eval. Report (EPA/600/R-97/145)

### Portable Gas Chromatographs

**Analytical & Remedial Technology Purge and Trap Gas Chromatographic Manifod System (AVOS)**
- Technology Evaluation Report (EPA/600/R-93/109)

**Bruker Mobiel Environmental Monitor**
- Technology Evaluation Report (EPA/600/X-91/079)

**Field Analytical Screening Program (FASP) Method for PCP**
- Demonstration Bulletin (EPA/540/R-95/528)
- Innovative Tech. Eval. Report (EPA/540/MR-95/528)

**Field Analytical Screening Program (FASP) Method for PCB**
- Demonstration Bulletin (EPA/540/R-95/521)
- Innovative Tech. Eval. Report (EPA/540/MR-95/521)

**HNU Portable Gas Chromatograph**
- Results reported in the Proceedings of the U.S. EPA Third International Field Screening Symposium Volume 2, Pages 682-693 (1993)

**Photovac Portable Gas Chromatograph**
- Results reported in the Proceedings of the U.S. EPA Third International Field Screening Symposium Volume 2, Pages 682-693 (1993)

**Sentex Portable Gas Chromatograph**
- Results reported in the Proceedings of the U.S. EPA Third International Field Screening Symposium Volume 2, Pages 682-693 (1993)

**SRI Instruments Low Temperature Thermal Desorption System**
- Results reported in the Proceedings of the U.S. EPA Third International Field Screening Symposium Volume 2, Pages 682-693 (1993)

### Spectrometers

**MDA Scientific Long-Path Fourier Transform Infrared Spectrometer**
- Technology Evaluation Report (EPA/600/S3-91/071)

**Xontech, Inc. Canister-based Sector Sample**
- Report (EPA/600/S3-91/071)

### PCP/PCB Immunoassay Test Kits

**Char-N-Soil PCB Test Kit - Dexel**
- Demonstration Bulletin (EPA/540/MR-95/518)
- Innovative Tech. Eval. Report (EPA/540/ R-95/518)

**EnviroGard PCB Test Kit - Millipore Inc.**
- Demonstration Bulletin (EPA/540/MR-95/517)
- Innovative Tech. Eval. Report (EPA/540/ R-95/517)

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5285 Port Royal Road
Springfield VA 22161
Telephone 703-487-4650 or 1-800-553-6847

[3] Out of stock

**Millipore Immunoasay Test Kit for PCB**
- Demonstration Bulletin (EPA/540/MR-95/517)
- Innovative Tech. Eval. Report (EPA/540/ R-95/517)

**PCP Immunoassay Technologies: Ensys Inc. - PENTA Risc: Ohmicron Corp., - Penta RaPid; Millipore Inc. - Envirogard**
- Demonstration Bulletin (EPA/540/MR-95/515)
- Innovative Tech. Eval. Report (EPA/540/ R-95/514)

**U-Hanby PCP Test Kit**
- Demonstration Bulletin (EPA/540/MR-95/515)
- Innovative Tech. Eval. Report (EPA/540/ R-95/515)

**Westinghouse PCP Test Kit**
Technology Evaluation Report (EPA/600/X-90/146)

## Soil & Soil Gas Samples

**Art's Manufacturing Soil Sampler**
- Innovative Tech. Eval. Report (EPA/600/R-98/093)

**Clements & Associates Soil Sampler**
- Innovative Tech. Eval. Report (EPA/600/R-98/097)

**Geoprobe® Soil Sampler**
- Innovative Tech. Eval. Report (EPA/600/R-98/092)

**Simulprobe® Soil Sampler**
- Innovative Tech. Eval. Report (EPA/600/R-98/094)

**Quandrel Soil Gas Sampler**
- Innovative Tech. Eval. Report (EPA/600/R-98/096)

**W.L. Gore & Associates Soil Gas Sampler**
- Innovative Tech. Eval. Report (EPA/600/R-98/095)

[1] Order documents free of charge by calling EPA's Center for Environmental Research Information (CERI) at 513-569-7562 or Fax 513-569-8695.

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# Appendix D

# ELECTRONIC TECHNICAL INFORMATION RESOURCES

**CONTENTS**

**EPA Sources of Information on**
**Innovative Remediation and Site Characterization Technologies**

Listed below are U.S. Environmental Protection Agency (EPA) sources of information on Innovative Remediation and Site Characterization Technologies. Sources of information include: electronic information sources in the form of databases or Internet sites, as well as programs, partnerships and organizations accessible on the Internet.

## REMEDIATION TECHNOLOGIES

### *Electronic Information Sources*

**Alternative Treatment Technology Information Center (ATTIC).** The Alternative Treatment Technology Information Center (ATTIC) is a comprehensive computer database system that provides up-to-date information about innovative treatment technologies. The database contains information about biological, chemical, and physical treatment processes; solidification and stabilization processes; and thermal treatment technologies. The on-line automated bibliographic reference integrates existing data on hazardous waste into a unified searchable resource. The ATTIC system provides users with access to several independent databases, an electronic bulletin board system, a hotline, and a repository of publications related to alternative and innovative treatment technologies. The ATTIC database can be accessed through the Internet at ***<http://www.epa.gov/attic>*** or by modem at (703) 908-2138. Assistance can be reached by telephone at (703) 908-2137.

**Bioremediation in the Field Search System (BFSS) Version 2.1**. BFSS is a PC-based searchable database of information about sites at which bioremediation is being tested or implemented or at which cleanup by bioremediation has been completed. The database covers sites being addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), as well as those being addressed under the Underground Storage Tank (UST) Program. Information is available about location, media, contaminants, technology, cost and performance. BFSS can be downloaded free of charge from the ATTIC or the Hazardous Waste Clean-Up Information (CLU-IN) Internet sites at ***<clu-in.org>***.

**Completed North American Innovative Remediation Technology Demonstration Projects Database.** The searchable database contains information about more than 300 completed innovative technology field demonstration projects in North America. The purpose of the database is to consolidate key information from innovative demonstration projects into a single source and present that information in a format that enables the user to easily identify innovative technologies that may be appropriate to the user's particular site remediation needs. The database, which is limited to completed demonstration projects and a small number of full-scale cleanup efforts, does not include emerging technologies or laboratory-scale projects. The database can be downloaded free of charge from the CLU-IN Internet site at ***<http://clu-in.org>***.

**Hazardous Waste Clean-Up Information (CLU-IN) Home Page.** CLU-IN is a streamlined source of information about innovative remediation and site characterization technologies for hazardous waste cleanup professionals. It provides access to information about programs, organizations, publications, and other tools for EPA and other Federal and State personnel, consulting engineers, technology developers and venders, remediation contractors, researchers, community groups, and individual citizens. Access to various pools of information is presented in the form of downloadable publications and databases. Sources of additional information on the Internet also are presented through a series of links. CLU-IN is sponsored by EPA's Technology Innovation Office (TIO). For additional information about the CLU-IN home page, call (301) 589-8368. CLU-IN can be accessed through the Internet at ***<http://clu-in.org>***.

**Innovative Treatment Technologies: Annual Status Report (Ninth Edition)** This contains information about remedies selected at contaminated waste sites. The sites include Superfund remedial and removal sites and some non-Superfund sites being remediated by the U.S. Department of Energy (DOE), the U.S. Department of Defense (DoD), or under the RCRA corrective action program. The EPA REACHIT online system database includes such site-specific data as contaminants and media treated, project status, and site contact. If you have questions or comments about the system, please call EPA's TIO at (703) 603-9910. The database can be downloaded free of charge from the CLU-IN Internet site at ***<http://clu-in.org>***. To obtain a copy of the report, call EPA's National Center for Environmental Publications and Information

(NCEPI) at (800) 490-9198 or (513) 489-8190.

**Remediation Technologies Screening Matrix and Reference Guide, Version 3.0.** The Remediation Technologies Screening Matrix and Reference Guide, Version 3.0, prepared for federal agencies participating on the Federal Remediation Technology Roundtable (FRTR), provides a "yellow pages" of remediation technologies information. The guide is intended to assist remedial project managers (RPM) to screen and evaluate candidate cleanup technologies and select the best remedial alternative(s) for contaminated installations, facilities, or waste sites. The guide also assists environmental professionals in gathering essential descriptive information on the respective technologies. The guide incorporates cost and performance data to the maximum extent available and focuses primarily on demonstrated technologies. However, information on emerging technologies also is included in the guide. The guide can be accessed through the Internet at ***<http://www.frtr.gov>***.

**TechDirect**. TechDirect, hosted by EPA's TIO, is an information service that highlights new publications and events of interest to environmental professionals. Information about site characterization and remediation technologies is available through this Internet subscription service. Approximately once a month, the service distributes by electronic mail a message describing the availability of publications and announcements of events. For publications, the message explains how to obtain a hard copy or how to download an electronic version from the Internet. For additional information about TechDirect, contact Jeff Heimermann at (703) 603-7191 or by E-mail at *heimerman.jeff@epamail.epa.gov*. TechDirect can be accessed through the Internet at ***<http://clu-in.org/membersh.htm>***.

***Programs, Partnerships, And Organizations***

**EPA Library Network Program.** The EPA National Library Network Program is a repository of information from EPA's Headquarters, Regional and Field Offices, Research Centers, and specialized laboratories throughout the country. The Library Network provides access to its collection through the On-line Library System (OLS), a menu-driven database of the library's holdings. The OLS provides users with the ability to perform online searches by author, title, or keyword. The EPA National Library Network Program can be accessed through the Internet at ***<http://www.epa.gov/natlibra>***.

**Federal Remediation Technologies Roundtable (FRTR)**. FRTR is an interagency working group that provides a forum for the exchange of information regarding the development and demonstration of innovative technologies for the remediation of hazardous waste sites. The forum also synthesizes the technical knowledge that Federal Agencies have compiled and provides a more comprehensive record of performance and cost of the technologies. Participating agencies include DoD, the U.S. Army Corps of Engineers, the U.S. Navy, the U.S. Air Force, DOE, the U.S. Department of the Interior, and EPA. FRTR can be accessed through the Internet at ***<http://www.frtr.gov>***.

**Ground-Water Remediation Technologies Analysis Center (GWRTAC).** GWRTAC was established through a cooperative agreement between the National Environmental Technology Applications Center (NETAC) of the Center for Hazardous Materials Research (CHMR) and EPA. The goal of GWRTAC is to compile, analyze, and disseminate information about innovative ground-water remediation technologies to industry, the research community, contractors, government, investors, and the public. The center currently is compiling information to be included in databases of interactive case studies and vendor information that will be available on the GWRTAC Internet site. GWRTAC can be accessed through the Internet at ***<http://www.gwrtac.org>***.

**Office of Research and Development (ORD)**. ORD, under the Assistant Administrator, Norine E. Noonan, Ph. D., is the scientific and technological arm of EPA. Comprised of three headquarters offices, three national research laboratories and two national centers, ORD is organized around a basic strategy of risk assessment and risk assessment management to remediate environmental and human health problems. ORD focuses on the advancement of basic peer-reviewed scientific research and the implementation of cost-effective, common sense technology. Fundamental to ORD's mission is a partnership with the academic scientific community through extramural research grants and fellowships to help develop the sound environmental research necessary to ensure effective policy and regulatory decisions. ORD also implements such programs as the Superfund Innovative Technology Evaluation (SITE) program which focuses on treatment technologies and EPA's Environmental Technology Verification Program (ETV) which focuses on site characterization technologies. ORD can be accessed through the Internet at ***<http://www.epa.gov/ORD/>***.

**Remediation Technologies Development Forum (RTDF).** RTDF was established by EPA to foster public-private partnerships that would conduct laboratory and applied research to develop, test, and evaluate innovative remediation technologies. RTDF's

home page provides access to information about various remediation technologies currently being designed, developed and evaluated through seven action teams of RTDF including: the Bioremediation of Chlorinated Solvents Consortium, the LASAGNA™ Partnership, the Permeable Reactive Barriers Action Team, the Sediments Remediation Action Team, the In-Place Inactivation and Natural Ecological Restoration Technologies (IINERT) Soil-Metals Action Team, the Phytoremediation of Organics Action Team, and the *In Situ* Flushing Action Team. RTDF can be accessed through the Internet at ***<http://www.rtdf.org>***.

**Superfund Innovative Technology Evaluation (SITE) Demonstration Program.** The SITE Demonstration program was established by EPA's Office of Solid Waste and Emergency Response and the Office of Research and Development to encourage the development and implementation of innovative treatment technologies for the remediation of hazardous waste sites, and monitoring and measurement. Through the program, technologies are field-tested on hazardous waste materials and engineering and cost data are gathered on the innovative technology so that potential users can assess the technology's applicability to a particular site. Data collected during the field demonstrations are used to assess the performance of the technology, the potential need for pre- and post-processing of the waste, applicable types of wastes and waste matrices, potential operating problems, and approximate capital and operating costs. The collected information is then provided in a Innovative Technology Evaluation Report, Technology Capsule, and Demonstration Bulletin. These reports evaluate all available information on the technology and analyze its overall applicability to other site characteristics, waste types, and waste matrices. Testing procedures, performance and cost data, and quality assurance and quality standards also are presented. The SITE Demonstration program can be accessed through the Internet at ***<http://www.epa.gov/ORD/SITE>***.

**Technology Innovation Office (TIO).** The U.S. Environmental Protection Agency's (EPA) TIO was created in 1990 to act as an advocate for new technologies. TIO's mission is to increase the application of innovative treatment technologies to contaminated waste sites, soils, and groundwater. To meet that mission, TIO has expanded its focus from treatment technologies to include site characterization technologies in order to improve the remediation process. TIO has encouraged and relied on cooperative ventures with other partners to accomplish many of its goals. This effort to effectively use resources has led to numerous joint efforts that have enhanced the state of both remediation and site characterization. For additional information about TIO, contact Jeff Heimerman of EPA's TIO at (703) 603-7191. TIO can be accessed through the Internet at ***<http://clu-in.org/tiomiss.htm>***.

## SITE CHARACTERIZATION TECHNOLOGIES

### *Electronic Sources of Information*

**EPA, National Exposure Research Laboratory - Hazardous Waste Site Characterization (on CD-ROM) (EPA 600-C-96-001).** The Hazardous Waste Site Characterization CD-ROM, developed by NERL's ESD-LV, compiles guidance documents and related software to aid environmental professionals in the complex, multidisciplinary, characterizing of hazardous waste sites. The CD-ROM is a compilation of computer programs related to EPA's RCRA and Superfund programs that can be printed, as well as searched by key words. Using the CD-ROM requires a personal computer with DOS Version 3.0 or higher, 640K of Ram, and 3 MB of hard disk space. A math co-processor is recommended but not required. The CD-ROM can be ordered on-line through the NTIS Internet site at ***<www.ntis.gov>***.

**Field Sampling and Analysis Technologies Matrix**. The Matrix, developed by participating agencies of the Federal Remediation Technologies Roundtable (FRTR), is a matrix and reference guide that is intended to provide users with an understanding of the site characterization technologies available to them and the applicability of various technologies to their particular problem(s). The Matrix provides a general understanding of state-of-the-art technologies for site characterization. The Matrix and reference guide also enhances technology information transfer and provides much needed comparison among competing technologies. The Matrix can be accessed through the Internet at ***<http://www.frtr.gov/site>***.

**Hazardous Waste Clean-Up Information (CLU-IN) Home Page.** CLU-IN is a streamlined source of information about innovative remediation and site characterization technologies for hazardous waste cleanup professionals. It provides access to information about programs, organizations, publications, and other tools for EPA and other Federal and State personnel, consulting engineers, technology developers and venders, remediation contractors, researchers, community groups, and individual citizens. Access to various tools of information is presented in the form of downloadable publications and databases. Sources of additional information on the Internet also are presented through a series of links. CLU-IN is sponsored by EPA's Technology Innovation

Office (TIO). For additional information about the CLU-IN home page, call (301) 589-8368. CLU-IN can be accessed through the Internet at ***<http://clu-in.org>***.

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***Programs, Partnerships, and Organizations***

**Consortium for Site Characterization and Technology (CSCT).** CSCT was established as one of 10 pilot projects currently implemented by EPA's Environmental Technology Verification (ETV) Program. The CSCT is a partnership program among the U.S. Environmental Protection Agency (EPA), the U.S. Department of Defense (DoD), and the U.S. Department of Energy (DOE) that is responsible for evaluating and verifying the performance of innovative site characterization technologies. The CSCT provides support to technology developers, evaluates and verifies data generated during demonstrations, and develops and disseminates information about the performance of site characterization technologies. CSCT can be accessed through the Internet at ***<http://clu-in.org/csct.htm>***.

**Environmental Technology Verification Program.** The ETV program seeks to provide credible performance data on environmental technologies from independent third parties under the auspices of EPA. It verifies the performance of innovative technical solutions to problems that threaten human health or the environment. Managed by EPA's ORD, ETV was created to substantially accelerate the entrance of new environmental technologies into domestic and international marketplaces. It supplies buyers of technologies, developers of those technologies, consulting engineers, states, and EPA regions with high-quality data on the performance of new technologies. ETV expands on past verification efforts, such as those conducted under the SITE program for remediation technologies. ETV currently implements 10 pilot projects, including the Consortium for Site Characterization Technology (CSCT). The ETV program can be accessed through the Internet at ***<http://www.epa.gov/etv>***.

**EPA Library Network Program.** The EPA National Library Network Program is a repository of information from EPA's Headquarters, Regional and Field Offices, Research Centers, and specialized laboratories throughout the country. The Library Network provides access to its collection through the On-line Library System (OLS), a menu-driven database of the library's holdings. The OLS provides users with the ability to perform online searches by author, title, or keyword. The material on OLS is updated every two weeks. The EPA National Library Network Program can be accessed through the Internet at ***<http://www.epa.gov/natlibra>***.

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