540R04505

United States
Environmental Protection
Agency

The Superfund Innovative Technology Evaluation Program

Annual Report to Congress FY 2002

SITE
SUPERFUND INNOVATIVE
TECHNOLOGY EVALUATION

SM-2

EPA/540/R-04/505
August 2004

The Superfund Innovative Technology Evaluation Program

Annual Report to Congress
FY2002

Office of Research and Development
U.S. Environmental Protection Agency
Washington, DC 20460

Recycled/Recyclable
Printed with vegetable-based ink on paper that contains a minimum of 50% post-consumer fiber content processed chlorine free.

Notice

The U.S. Environmental Protection Agency, through its Office of Research and Development, partially funded and collaborated in the research described here under our contract No. 68-C-00-186 to Environmental Quality Management, Inc. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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 Agency 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 this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory'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.

Lawrence W. Reiter, Acting Director
National Risk Management Research Laboratory

Contents

Section — Page

Notice ii
Foreword iii
Figures and Tables vi
Acronyms vii
Executive Summary viii

SITE Program Description 1
- Introduction 1
- Program Principles 2
- Program Planning 2
- Program Implementation 2
- Matching Priority Sites with Innovative Cleanup Solutions 2
- Technology Field Demonstrations 4
- Information Dissemination 4

FY 02 SITE Program Cost Savings and Vendor Benefits 5
- Promotion of Innovative Technologies 5
- Cumulative Program Cost Savings, Incremental Program Cost Savings, and Vendor Contracting 6
- SITE Program Accomplishments - Federal Cost Savings from RODs Analysis 6
- Incremental Cost Savings 8
- Historical Vendor Benefits 10
- Innovative Technology Highlights - - SITE Program Case Studies 13

FY 02 Progress and Accomplishments 16
- Monitoring and Measurement Technologies Program 16
- Ongoing Demonstrations 17

Future Direction 21
- Introduction 21
- Technology Areas of Primary Interest 22
- MMT Program Areas of Interest 24
- Partnerships for Success 24
- Information Transfer 26
- Conclusions 26

Appendices

A - SITE Projects (Alphabetically by Developer State)
B - SITE Technology Demonstration Sites (Alphabetically by Demonstration Site State)
C - Electronic Technical Information Resources
D - Glossary of Remediation Technologies

Figures

Number		Page
1	SITE Program Funding History	3
2	Superfund remedial actions: in situ technologies for source control	7
3	Cost savings estimated from RODs analysis by technology type	9
4	Categorization of contracts awarded to SITE vendors following program participation	11
5	Total number of contracts awarded to SITE vendors after program participation	12
6	Share of 3,507 total contracts awarded to SITE demonstration vendors by technology type	12
7	History of Ex situ vs In situ Distribution of SITE Demonstration Projects	18

Tables

Number		Page
1	SITE Demonstration Projects Completed FY 02	18
2	SITE Ongoing Projects in FY 02	19
3	Future Contaminant Emphasis Areas 2003-2007	23
4	SITE Program Projects FY 03	23

Acronyms

ANSI/ASQC	American National Standard Institute, Assistance for Environmental Data Collection and Environmental Technology Programs
DNAPL	Dense non-aqueous phase liquids
DOD	Department of Defense
DOE	Department of Energy
ECOS	Environmental Council of States
EPA	Environmental Protection Agency
ESTCP	Environmental Security and Technology Certification Program
ETV	Environmental Technologies Verification
FY	Fiscal year
GPR	Ground penetrating radar
IDC	Interagency DNAPL Consortium
ITRC	Interstate Technology and Regulatory Council
MHI	Mitsubishi Heavy Industries
MMT	Monitoring and Measurement Technologies
NELP	Navy Environmental Leadership Program
NPL	National Priorities List
NRC	National Research Council
ORD	Office of Research and Development
PAHs	Polynuclear aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
REACHIT	Remediation Characterization Innovative Technologies
RCI	White House Rapid Commercialization Initiative
SITE	Superfund Innovative Technology Evaluation
TIP	Technology Innovation Program
TPH	Total petroleum hydrocarbon
VOC	Volatile Organic Compound

Executive Summary

The Superfund Innovative Technology Evaluation (SITE) Program has successfully promoted the development, commercialization and implementation of innovative hazardous waste treatment technologies for 16 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 potential total inflated cost savings of over $2.7 billion.

The SITE Program focuses on the remediation needs of the hazardous waste remediation community through program planning; matching priority sites with innovative cleanup solutions; technology field demonstrations; and information dissemination. The SITE Program's vision is to remain the premier organization in enhancing the credibility and implementation of effective innovative remediation options.

The SITE Program continues to earn recognition as a leader in advancing innovative technology development and commercialization. The program is participating with 149 remediation technology vendors. Through FY 02, the SITE Program has successfully demonstrated 143 technologies, 6 of which were demonstrated during FY 02. Field monitoring and measurement technologies for mercury and dioxin in soil and sediment demonstrations were initiated in 2002 as part of the SITE Monitoring and Measurement Technologies Program. Emphasis formerly placed on technologies requiring the removal of soil or groundwater (ex situ) has gravitated nearly exclusively to in situ technologies that treat contamination in place.

Information obtained annually from SITE Program vendors demonstrates the increased acceptance of innovative technologies. These vendors have received an increased share of their specific technology markets as a direct result of their involvement in the SITE Program. Cumulatively, through 2002, contracts for over 2,100 cleanups, nearly 1,400 treatability studies, and 4,200 measurement/monitoring units have been received by these vendors following demonstrations.

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 EPA, 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.

SITE Program Description

Introduction

The SITE Program is composed of a Demonstration Program, a Monitoring and Measurement Technology (MMT) Program, 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. A description of each program is listed below.

✓ **Demonstration Program**
Evaluates and verifies performance and reports cost 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 Technologies Program**
Evaluates technologies that detect, monitor, and measure hazardous and toxic substances to provide more cost-effective and accurate methods for producing real-time data during site characterization and remediation

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

The Demonstration Program is the flagship of the SITE Program. Its objective 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, unsafe, or too costly. The SITE Program solicits applications annually from those responsible for cleanup operations at hazardous waste sites. 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 Demonstration Program has participated with a total of 149 remediation technology vendors. Four applications for participation in the Demonstration Program were received in response to the 2002 solicitation. The program typically receives 10 to 20 applications annually.

The SITE Program has successfully demonstrated 143 technologies, including 6 during FY 02. Recognizing the need for a shift from ex situ remediation, eight of the Program's eleven ongoing demonstrations are in-situ technologies. SITE's Monitoring and Measuring Technologies (MMT) Program has completed 45 projects to date, with 2 more ongoing.

The foundation of the SITE Program is providing credible cost and performance data.

Program Principles

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

SITE Program direction and strategies are evaluated each year based on input from the user community and other private- and public-sector stakeholders to ensure that the program continues to focus on validating the most sought-after remediation technologies. As part of the overall program planning process, the SITE Program has developed and is implementing 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). The Site Quality Management Plan will document the EPA SITE Program quality system and will encompass the management and technical activities necessary to plan, implement, and assess the quality assurance and quality control operations applied to all SITE Projects. The Quality management plan will document the requirement for Quality Assurance Project Plans for all SITE Evaluation Projects. SITE Quality Assurance Project Plans are currently developed at a level that supports the development of environmental regulations and standards (Category II). It is important that the SITE Program quality requirements are met during planning, implementation and reporting of SITE demonstrations, and evaluations.

Program Implementation

The SITE Program was established under section 209(b) of the Superfund Amendments and Reauthorization Act (SARA) (Section 311(b) of CERCLA, as amended) to evaluate technologies for the treatment of hazardous waste. Support for the SITE program is part of the Agency's base Superfund Research Program budget. Resources to support SITE are provided by Congress via the Agency's Superfund appropriation. Figure 1 shows the SITE Program annual budget since 1997.

The SITE Program 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 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 rigorous engineering, performance, and cost data intended to aid in decisions regarding the use of the technologies at other 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 and rapid access to this information, allowing project managers to make timely decisions in selecting cleanup remedies.

Matching Priority Sites with Innovative Cleanup Solutions

The SITE Program solicits and prioritizes hazardous waste sites, and then seeks appropriate technologies for demonstration at these sites. Priority sites are selected based on feedback from the user community, including federal and state agencies. Matching a site with a technology is a flexible process, and a site owner has the option of evaluating multiple technologies. If no specific technology or vendor is identified by a site, technologies and vendors are matched by the SITE Program and other interested parties, which may include state and federal regulators and other public representatives.

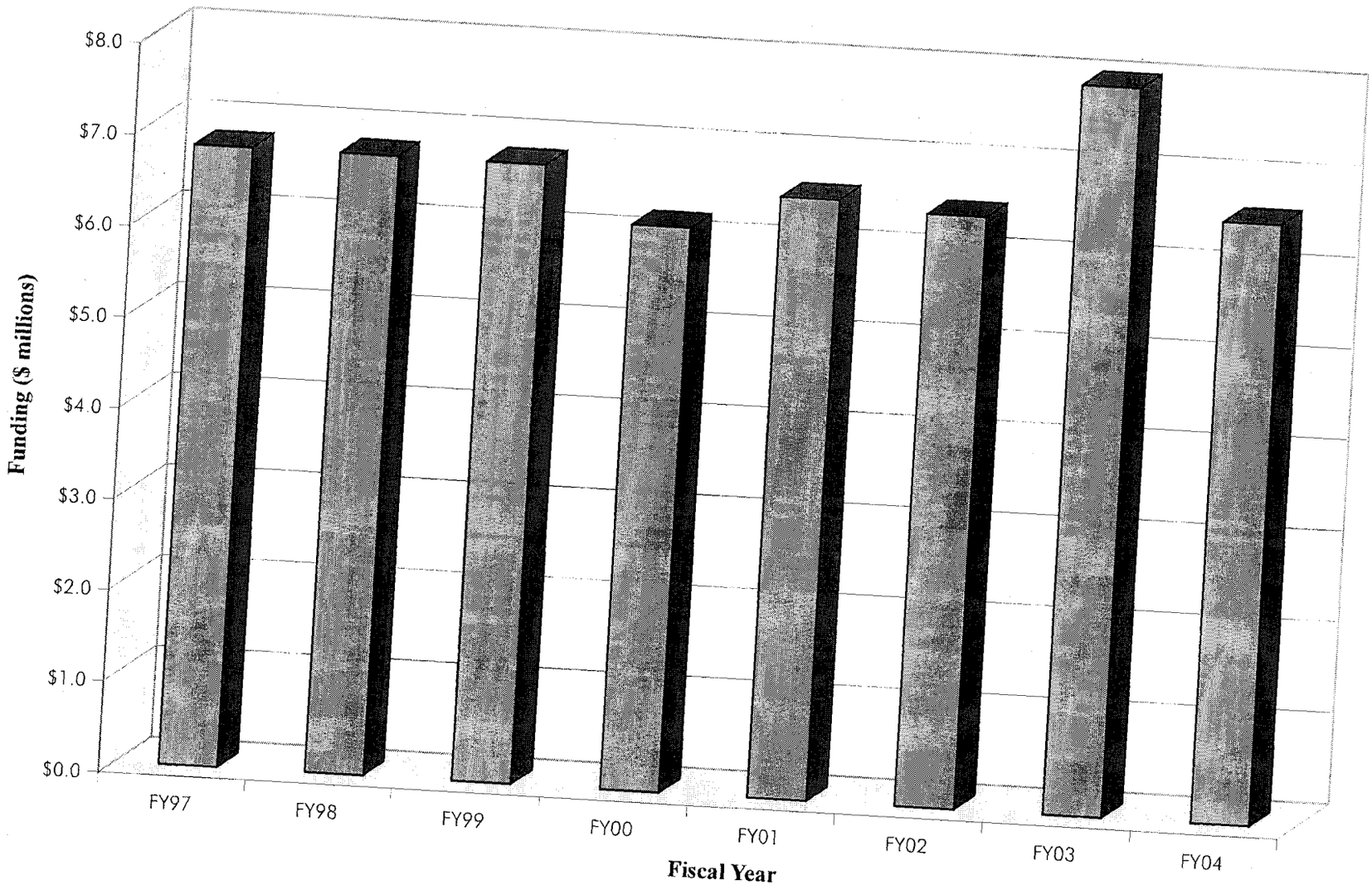


Figure 1. SITE Program Funding History

The selection of sites for the program is based on the research needs of EPA, as well as federal and state agencies.

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

SITE Program technology demonstrations are increasingly conducted in partnership with other EPA offices, other federal agencies, states, private industry, and universities. These partnerships reduce the overall costs of demonstrations to EPA, accelerate remediation of some of the most problematic sites at federal and state facilities, and significantly subsidize the technology vendors via site/logistical costs. One example of interagency partnerships is with DOD, Navy at Pearl Harbor. This group is currently working on a demonstration evaluating technologies to remediate DNAPL at Pearl Harbor, Hawaii.

Innovative remediation and monitoring/measurement technology demonstration projects are presented by developer state and by demonstration site state in Appendices A and B, respectively.

Information Dissemination

Electronic documents are accessible through the Internet at the SITE Program web page *(http://www.epa.gov/ORD/SITE)*, Environmental Technologies Verification (ETV) web site *(http://www.epa.gov/etv/)*, and a site supported by the EPA Office of Solid Waste and Emergency Response Technology Innovation Program (TIP) (*http://clu-in.org*). Several technology databases and publications summarize information about innovative treatment technologies and associated vendors, and are useful tools in identifying potential technology demonstration candidates or serve as directories for technology vendors. SITE Program and other federal demonstrations are also documented in Innovative Remediation Technologies: Field Scale Demonstration Projects in North America, 2nd Edition (*http://cluin.or/products/nairt*). Descriptions of selected databases and publication ordering information are provided in Appendix C.

The following mechanisms are used by the SITE Program to disseminate information and increase interaction with the user community:

Program-specific brochures and exhibits

Conferences, workshops, and technical working groups

Publications and videotapes (accessible on the Internet: http://www.epa.gov/ORD/SITE/document.html)

Hard copies available from EPA's National Center for Environmental Publications, 513-569-8190 or 1-800-490-9192

Electronic media, including the Internet

Technical assistance to regions, states, and remediation contractors

Technology seminars

FY 02 SITE Program Cost Savings and Vendor Benefits

Promotion of Innovative Technologies

SITE is recognized by EPA as one of its 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 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.

Responding to technology needs is the driving force behind the SITE Program.

The need for credible and reliable data for innovative technologies is significant. Often, Records of Decision (RODs—official records documenting selection of Superfund site cleanup methods) indicate 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.

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). Since then, the number has continued to rise, indicating increased credibility and confidence in a number of innovative treatment technologies.

During the first 12 years of the SITE Program, an emphasis was placed on innovative technologies for permanent treatment that usually required the removal (ex situ) 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. In the last several years, the very nature of ex situ technologies, which typically involve the excavation of contaminated soil or removal by pumping of groundwater, and subsequent treatment and/or transport/disposal have become increasingly limited in their applicability. These cost/technical/political related limitations include:

- Complex contamination and subsurface matrices which are not amenable to removal
- Mega sites whose shear expanse and volume of contaminated media preclude ex situ technologies from consideration
- Lack of approved landfills in close proximity for excavation/transportation/disposal to be cost-effective

As a result, in situ technologies are increasingly the only alternative. The need for innovative, in situ technologies that are more cost-effective, result in 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.

Figure 2 presents the number of in situ technologies as a percentage of all treatment technologies for source control by fiscal year. Over time, use of in situ technologies has been increasing, as the trendline in Figure 1 shows. A five-year moving average of the percentage of in situ treatment technologies shows a generally steady increase from 28 percent (FY1985-1988) to 50 percent (FY1999-2002). Several factors may play a role in this upward trend in the use of in situ treatment technologies. Because in situ technologies require no excavation, risk from exposure to contaminated media is reduced, compared with levels of risk associated with technologies that do require excavation. Also, in situ technologies typically are much less harsh on the natural habitat/environment than ex situ technologies. Further, for large sites where excavation and materials handling for ex situ technologies can be expensive, in situ technologies are often more cost-effective.

Cumulative Program Cost Savings, Incremental 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 cost savings realized at Superfund sites has been estimated by analysis of RODs from 1993 - 2000; this estimating technique and analytical results are described below. The SITE Program has also 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 in terms of cumulative and incremental federal cost savings and vendor successes.

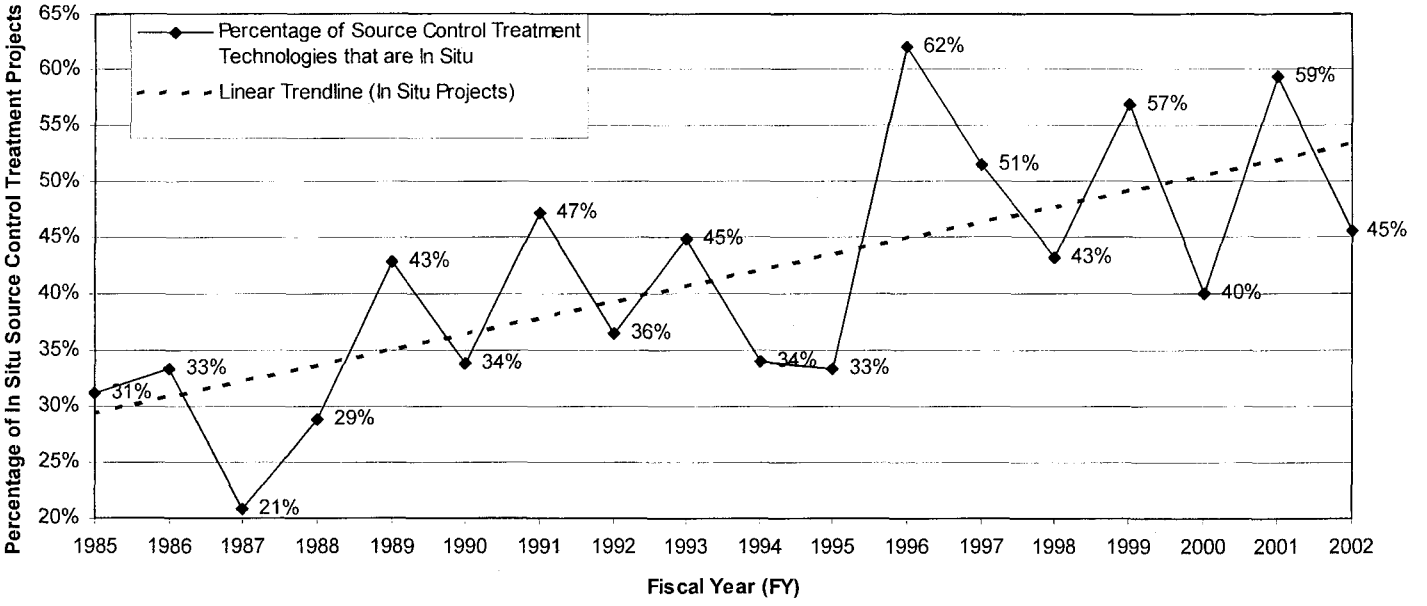
SITE Program Accomplishments - Federal Cost Savings from RODs Analysis

Since 1993, the use of innovative technologies has substantially increased, resulting in dramatic cost savings. During 1996, 1999, 2000, 2001, and 2002, the SITE Program collected information from signed RODs in all 10 EPA Regions that selected an innovative technology as the remedy. Up until 2001, these technologies included soil vapor extraction, thermal desorption, bioremediation, phytoremediation, surfactant flooding, and many other technologies that have passed through the Program. The data compiled by the SITE Program allowed environmental managers to compare innovative technologies to conventional technologies, particularly the data from the total of 204 RODs that selected innovative technologies for part or all of the remediation.

Many of the innovative technologies which performed successfully in their SITE Program demonstration(s) also enjoyed success in their full-scale applications at Superfund and other contaminated sites throughout the U.S. and abroad. The use of soil vapor extraction (SVE), for example, which is often employed in tandem with air sparging to remediate the unsaturated zone of contaminated soil, has increased steadily from the late 1980's, particularly after multiple successful SITE Program demonstrations.

The process for selecting innovative technologies for demonstration in the SITE Program and for deciding when these innovative technologies have become conventional technologies consists of the following:

- Consultation and review with:
  --EPA Regions
  --EPA Program Offices
  --State Regulatory Agencies
  [including the Interstate Technology and Regulatory Council (ITRC)]
- Volume of use ($ and total units) as it relates to consulting firms utilizing these technologies



Includes information from an estimated 70% of FY 2002 RODs.

Figure 2. Superfund Remedial Actions: In Situ Technologies for Source Control (FY 1985- FY 2002)

Source: U.S. EPA Office of Solid Waste and Emergency Response, Innovative Treatment Technologies Annual Status Report, 11th Edition (542-R-03-009)

- Degree of confidence that site owners have in using these technologies

As selected innovative technologies discussed in SITE Program Annual Reports to Congress prior to 2002 have become more accepted, increasingly used, and considered the baseline for remediation, they are now viewed as conventional technologies for comparison to newer technologies. These former innovative technologies, which often performed very successfully, have thus advanced from the SITE Program. They include, but are not limited to:

- Air Sparging
- Soil Vapor Extraction
- Ex Situ Thermal Desorption
- Filtration
- Soil Washing
- Most ex situ remediation

The SITE Program plans to continue to periodically evaluate whether technologies that are no longer considered innovative should be added to the baseline of conventional technologies. The Program conducted this review in FY 2002, and will again in 2007 and on a 5-year basis thereafter.

EPA guidance recommends that ROD estimates assess remedial alternatives with an accuracy of +50 percent to -30 percent. Of the 204 RODs that selected innovative technologies through 2000, 105 had sufficient information to make a cost comparison between the selected technology and a conventional technology. The procedure for estimating cost savings from RODs involves the following:

- Identification of RODs employing recognized innovative technologies over

traditional technologies (e.g., in situ bioremediation over ex situ thermal desorption)

- Assessment of the adequacy of the cost information in the identified RODs for both the innovative technology selected and the traditional technology(ies) considered but rejected
- Calculating the estimated cost difference (+ or -) between the innovative and traditional alternative technology(ies)
- Annualizing resulting estimated cost savings to present day value
- Subtracting out cost of SITE Program (does not include cost to site owners or vendors)

Potential cost savings from the use of innovative technologies for the 105 RODs was estimated at $2.7 billion in 2002 dollars, with a potential average percent savings per site of 71 percent. Only 14 of the 105 RODs reported that the innovative technology was more expensive than or equal to the established technology.

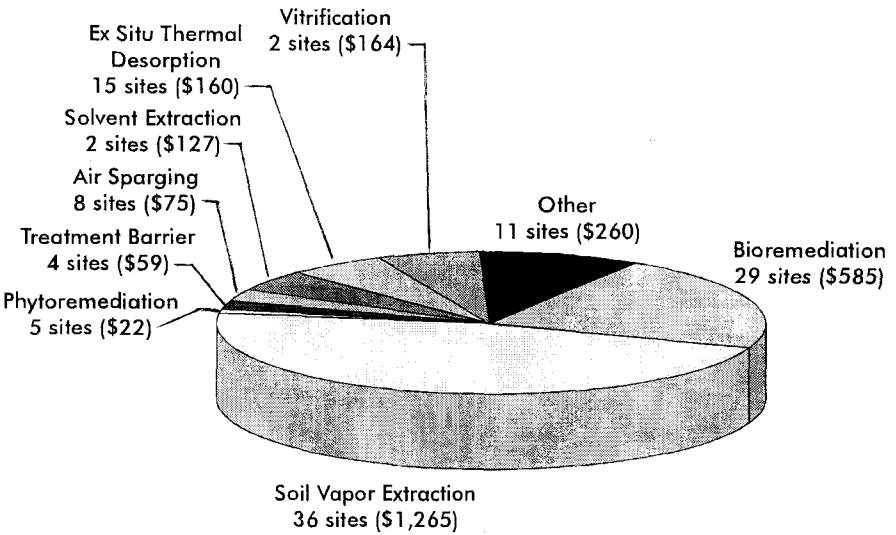
To estimate SITE Program net benefits, the FY 93-00 RODs and the SITE Program budget were adjusted for inflation to end of 2002 dollars using Consumer Price Index (CPI) inflation figures. The total inflation-adjusted potential cost savings for RODs dated 1993-2000 was $2.7 billion, and the total inflated SITE Program budget from 1986-2000 was $181 million. This comparison represents an estimated inflated potential cost savings of over $2.5 billion for various site cleanups.

Figure 3 shows a breakdown of savings by technology type. Soil vapor extraction (SVE), which was not considered an innovative technology by the SITE Program for the first time in 2002, showed the highest potential savings of over $1.25 billion, followed by $585 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, thermal desorption, and vitrification each accounted for over $100 million in potential savings. Phytoremediation and permeable reactive barriers are newer technologies that are beginning to be chosen in RODs, with six and four sites having specified their use, respectively, with an associated potential cost savings of $79 million as compared to conventional technologies. The number of sites and associated potential costs savings for phytoremediation and treatment barrier sites are expected to increase rapidly in coming years.

Incremental Cost Savings

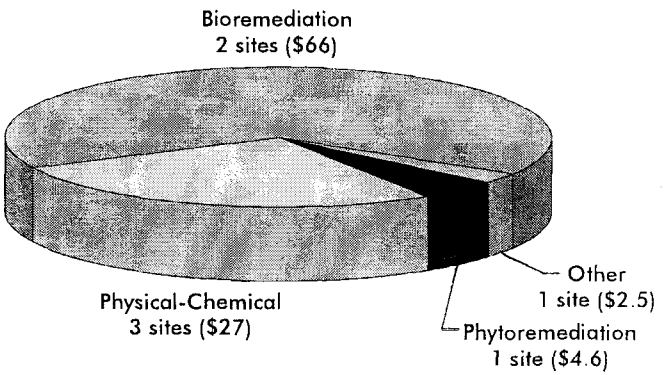
To assess the current impact of the SITE program, EPA is developing a method to estimate incremental cost savings. The method will be applied on a bi-annual basis for even years (2000, 2002, 2004, etc.) to coincide with the availability of RODs data. Using a preliminary approach, RODs data from FY2000 were evaluated. Twelve ROD sites selected innovative remedial technologies including enhanced flushing/chemical oxidation, phytoremediation, and LNAPL recovery by dual-phase extraction.

Excluded from consideration were the innovative technologies discussed earlier in this section which are now considered conventional (air sparging, SVE, etc.). Seven of these sites had sufficient cost data for both innovative and conventional technologies to make cost comparisons. Potential cost savings from the use of innovative technologies for these seven RODs (Figure 3) were estimated at $95 million (inflated to 2000 dollars) with a potential average per site savings of 47.5%. Only one of the 7 RODs reported that the innovative technology was more expensive than or equal to the established technology. The SITE Program budget for FY2000 was $6.2 million, indicating an estimated inflation-adjusted



Cumulative Cost Savings

Savings estimates based on comparison of innovative and conventional technologies for FY 93-00 RODs. Savings shared equally among technologies when multiple technologies were used and technology-specific costs were not available.



Incremental Cost Savings

Savings estimates based on comparison of innovative and conventional technologies for FY-00 RODs.

Figure 3. Cost savings estimated from RODs analysis by technology type (millions of 2002 dollars)

potential cost savings of $88 million for the seven RODs sites remediated by innovative technologies in 2000.

Historical Vendor Benefits

Technology vendors are a central part of the SITE Program, providing remediation services for sites requiring cleanup solutions. As part of the SITE Program, vendors provide historical information on jobs they have performed for the technologies they have demonstrated. Vendors experience various benefits by participating in the SITE Program, namely increased exposure, market share, technical acceptance, and recognition. Increased acceptance of innovative technologies is demonstrated by the level of commercial activity experienced by SITE Program vendors. For example, cumulative information reported in 2002 indicates that since completing SITE demonstration projects, vendors have received contracts for 2,119 cleanups and 1,388 treatability studies (Figure 4).

As part of an ongoing SITE Program evaluation initiated in 1989, 87 vendors have provided information regarding sales of their technologies. Following participation in the SITE Program, 63 percent of the responding vendors were awarded remediation contracts using technologies demonstrated in the SITE Program. Thirty-four percent of the reporting vendors have been awarded ten or more contracts each. Over 35 percent reported one or more international contracts, identifying 40 countries where jobs were contracted. Figure 5 provides a historical perspective of growth in the number of contracts awarded to SITE vendors from 1990 to 2002.

The 2002 Demonstration Program 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 3,507 remediation and treatability contracts awarded to vendors. It is clear from this chart that soil vapor extraction and bioremediation technologies have had the most commercial success; in particular, soil vapor extraction can no longer be considered an innovative technology, as discussed earlier in this section.

This trend from the vendor information is consistent with the RODs analysis results which were shown in Figure 2, providing two sources of data to confirm the outstanding commercial success of the technologies.

In addition to the 87 Demonstration Program vendors, information was obtained from 1999-2002 from 18 vendors that participated in the MMT Program. This information clearly demonstrated the benefits that vendors receive from the program, indicating that 73 percent of the vendors sold more than 25 units since their demonstration in the SITE Program. Over 60 percent of the vendors indicated that their technologies were used on international remediation projects. In total, the MMT vendors reported selling over 4,200 units on 1,043 jobs, including 56 international jobs.

"Our involvement with the SITE Program has been very successful. We appreciate everyone's efforts and the program's agenda."

Scott Larsen, STC Remediation, Inc. (Chemical Fixation/Solidification Technologies)

Overall, vendor information shows that SITE technology developers in the Demonstration and MMT Programs are achieving commercial success for demonstrated technologies. The impact of the SITE Program continues to be significant, as illustrated by the volume of vendor contracts over the last decade (Figure 5).

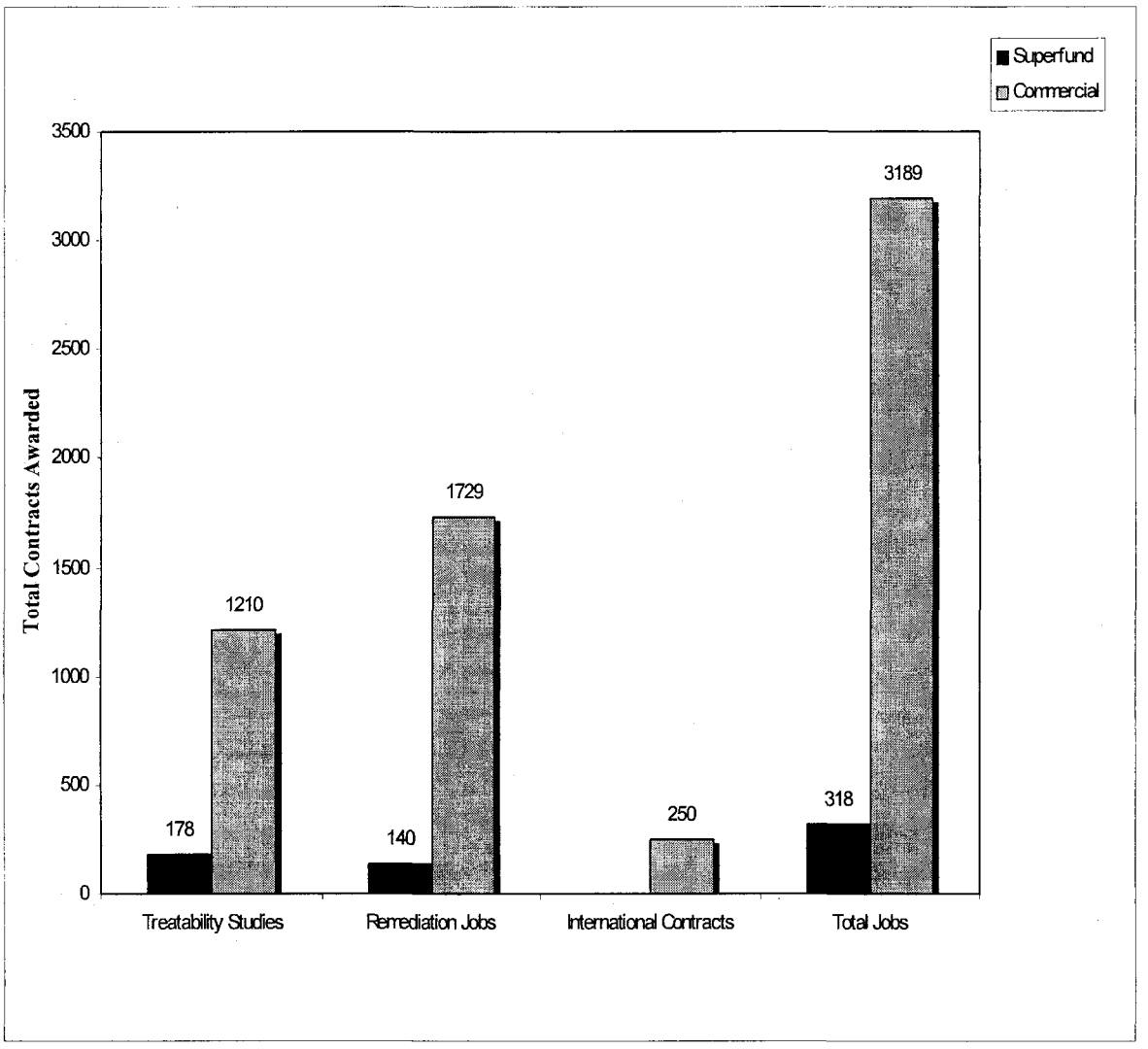


Figure 4. Categorization of contracts awarded to SITE vendors following program participation. (Source: 2002 vendor information)

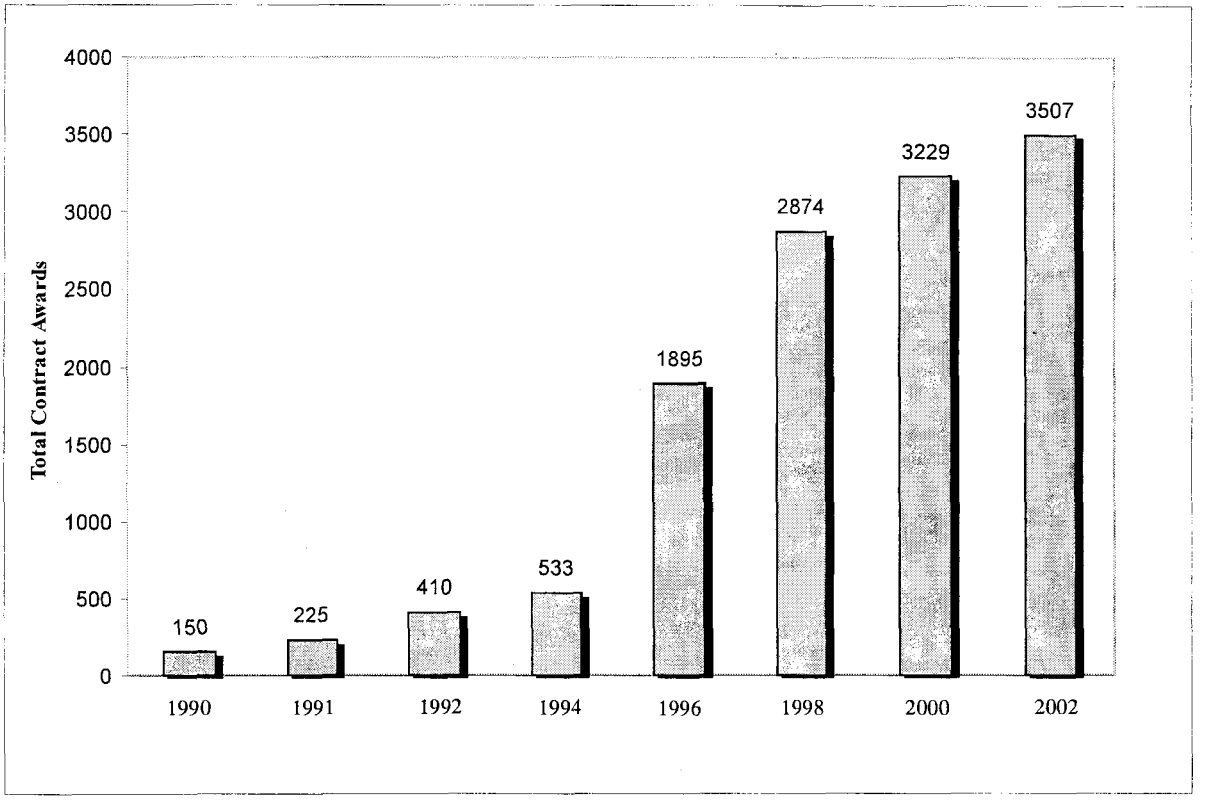


Figure 5. Total Number of contracts award to SITE vendors after program participation (Source: 1990-2002 vendor information)

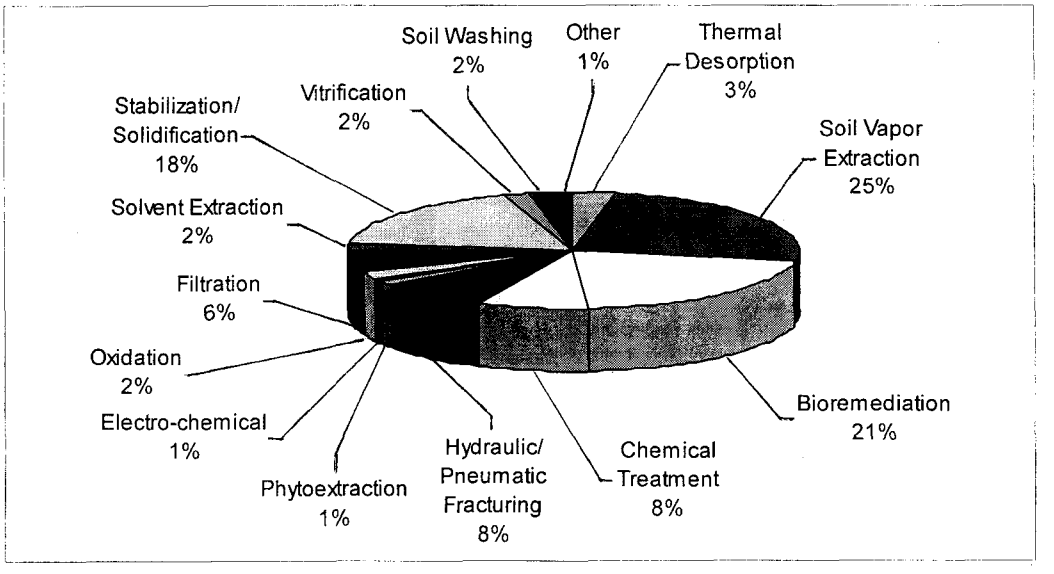


Figure 6. Share of 3,507 total contracts awarded to SITE Demonstration vendors by technology type
(Source: 1990-2002 vendor information)

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. The case studies provide brief descriptions on the use and status of representative technologies and, where available, general information on the cost of applying each technology. It is typical of the SITE Program and represents the SITE Program's approach to promoting innovative technologies by identifying user needs. In response to user needs, the SITE Program assessed the performance of a glass furnace technology for dredged sediments, a hydrogen release technology for organic contaminants, and steam enhanced remediation.

> "The U.S. Navy has been using the in-field total hydrocarbon petroleum analyzer of one of the vendors who participated in SITE's Measurement and Monitoring Program. We were first contracted in 2002 solely because of our participation and performance in the SITE Program. The DOD is now one of our biggest customers...and as a result, we have piggy backed sales to contractors and/or foreign governments (particularly in the Persian Gulf)."
>
> Steve Greason, Sitelab Corporation

Case Study 1: Glass Furnace Technology for Dredged Sediments

The Glass Furnace Technology (GFT) was developed by the Minergy Corporation as a means to beneficially reuse contaminated sediment through vitrification. The target waste for the technology is sediments that have PCB and metals contamination. The GFT was designed specifically for melting materials that have no fuel value. Silica is one of the primary constituents of sediments, making it a perfectly suited material for processing. The Glass Furnace Technology is an adaptation of systems that have been used for decades in glass manufacturing. Because a glass furnace has temperatures high enough to melt materials into glass, corollary benefits include destruction of organic contaminants such as PCBs and permanent stabilization of trace metals in the resultant glass product. The glass aggregate is an inert product that is sold to construction companies.

Technology Description

A glass furnace is a refractory-lined, rectangular melter. Refractory is brick or concrete, which has been specifically treated to resist chemical and physical abrasion, has a high melting point, and provides a high degree of insulating value to the process.

Current glass furnaces use oxy-fuel burners, combining natural gas and oxygen for a bright flame above the glass. These burners raise the internal temperature of the melter to 2,900 degrees Fahrenheit. At these temperatures, PCB contaminants are destroyed, and the sediment melts and flows out of the processing system as molten glass. The molten glass is water quenched to produce an inert aggregate that is marketed to construction companies.

Status

In 2001, the Glass Furnace Technology was demonstrated in Minergy's pilot glass furnace located in Winneconne, Wisconsin. The pilot demonstration was performed using contaminated sediment dredged from the lower Fox River, Wisconsin. During the demonstration, the glass furnace processed a total of 25,800 pounds of dried sediment and produced approximately 16,200 pounds of glass aggregate product. PCB and mercury concentrations of sediment fed into the system during the evaluation averaged 28.1 ppm and 0.72 ppm, respectively. PCB

and mercury concentrations in the glass aggregate product were below laboratory method detection limits.

Case Study 2: Time Release Electron Acceptors and Donors for Accelerated Natural Attenuation

The U.S. EPA and Regenesis Bioremediation Products, Inc. demonstrated the Hydrogen Release Compound (HRC) technology at the Fisherville Mill site and Rocky Mountain Arsenal site. The HRC technology was designed to enhance natural degradation of organic contaminants in groundwater aquifers.

Technology Description

The specific products involved in the process include: 1) Oxygen Release Compound (ORC®), which provides the electron acceptor oxygen to enhance the aerobic bioremediation of compounds such as petroleum hydrocarbons and 2) Hydrogen Release Compound (HRC®), which provides the electron donor hydrogen to enhance the anaerobic bioremediation of compounds such as chlorinated solvents. The ORC® is a proprietary formulation of magnesium peroxide that only releases oxygen when hydrated and can provide a continuous source of oxygen (electron receptor) for up to 12 months. The HRC® is a polyactate ester and also requires hydration before it releases lactic acid, a fermentable substrate, which generates hydrogen (electron donor) for up to 18 months. The treatment is typically in situ and both products are applied to the subsurface via direct-push injection or borehole delivery methods.

The bioremediation component of natural attenuation describes a process by which contaminants are reduced in concentration over time by biological action. The process is facilitated by microbes that can be aerobic or anaerobic, requiring either oxygen or hydrogen, respectively, to help carry out the degradation of target contaminants. At most sites the subsurface is lacking these key substrates, or they are present in insufficient amounts, which prevents the natural microbial population from facilitating bioremediation. The use of time-released substrates such as ORC® and HRC® typically accelerates natural attenuation of 10 to 100 times faster than unassisted natural attenuation.

Status

Regenesis demonstrated the technology at two sites in 2000-2001: Rocky Mountain Arsenal and Fisherville Mill. The Rocky Mountain Arsenal demonstration located in Denver, Colorado was designed to treat a plume contaminated with organic compounds. Based on a 60-day bench-scale study in March 2000, the HRC® was shown to be very effective in dramatically reducing the entire range of contaminants. Following the bench-scale success, a demonstration was conducted at the site from February 2001 to May 2002. Time plots of chlorinated organic concentrations during the demonstration also provided evidence for reductive dechlorinatoin. The results of the Fisherville Mill demonstration are currently being evaluated.

Case Study 3: Steam Enhanced Remediation

SteamTech Environmental Services, Inc., U.S. EPA, and the Air Force Base Conversion Agency conducted a research project on Steam Enhanced Remediation (SER) for the recovery of dense nonaqueous phase liquids (DNAPL) from fractured limestone at the former Loring Air Force Base Quarry site. The former quarry had been used for the disposal of more than 400 drums of spent solvents.

Technology Description

Steam Enhanced Remediation is a combination of technologies previously used separately, adapted to the hydrogeology of typical contaminated sites. Steam is injected at the periphery of the contaminated area to heat permeable subsurface areas, vaporize volatile compounds bound to the soil, and drive contaminants to centrally located vapor and liquid extraction wells. Electrical heating is used for less-permeable clays and fine-grained sediments to vaporize contaminants and drive them into the vapor.

SER is capable of extracting, separating and treating effluent vapors, nonaqueous phase liquids (NAPL), and water on site for complete contaminant destruction or off-site disposal. SER is highly effective for removal of both volatile and semivolatile compounds. SER works both above and below the groundwater table, and both LNAPL and DNAPL contaminants can be removed. The dominant removal mechanisms for volatile contaminants are the increased volatization and steam stripping when the mixture of water and NAPL reaches the boiling point. Another major removal mechanism of contaminants is the fast removal of liquid contaminants by physical transport to centrally located extraction wells. NAPL is removed from the extraction. In situ destruction of contaminants by thermally accelerated oxidation processes converts harmful chemicals into carbon dioxide and water.

Status

Excellent cleanup results have been achieved in the laboratory, simulating cleanup using steam injection and Joule heating for gasoline, oils, creosote, and chlorinated solvent DNAPL. The research project conducted at the Loring Air Force Base Quarry site suggested that SER can be effective for increasing the mass removal rate compared to more traditional methods such as pump and treat or soil vapor extraction. Aqueous and vapor phase concentrations of contaminants increased throughout the demonstration.

"On behalf of the environmental community of the State of Maine, I want to commend the SITE Program staff for their contribution to the research program at Loring AFB. Environmental experts and scientists from all over the country closely monitored your progress. This project is an important step for the remediation of bedrock contamination throughout the country."

Angus S. King, Jr.
Governor of Maine
December 2001

FY 02 Progress and Accomplishments

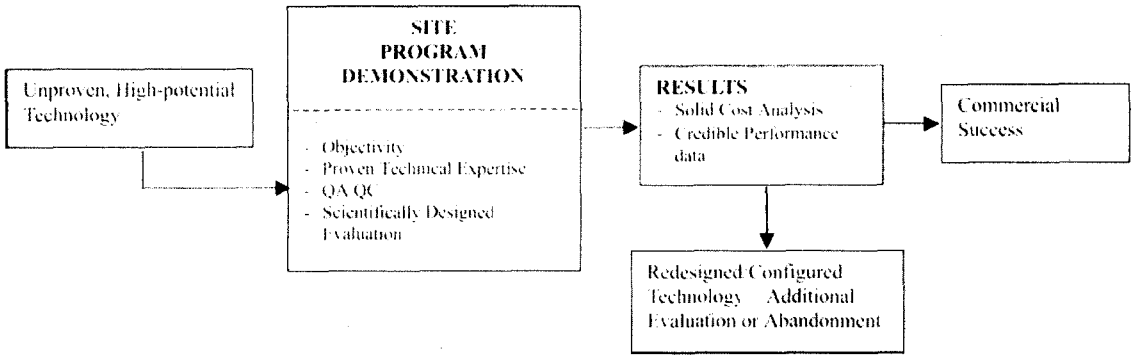
Over the past 17 years, SITE has earned increased recognition as a leader in advancing innovative technology development and commercialization and has participated cooperatively with more than 149 technology developers. Through FY 02, the SITE Program has successfully demonstrated 143 technologies, 6 of which were demonstrated during FY 02. 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. SITE has been responsive to the user community during this time, and has recently focused on the need for in situ remediation technologies to more cost-effectively remediate sites. As shown in Figure 6, 77 completed SITE projects have been ex situ and 66 in situ, with a marked increase in ongoing in situ technology demonstrations as compared with ex situ since 1997. Eight of the eleven ongoing demonstrations are in situ.

Field demonstration and evaluation of in situ technologies may require several months or years of data collection. This is in contrast to field demonstrations of ex situ technologies where field work can be completed in 1 to 3 weeks; thus, in situ techniques have higher budget requirements. 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.

During FY 02, 6 new innovative technologies were evaluated in the field. Completed demonstration projects are presented in Table 1, and ongoing projects are provided in Table 2. All completed and ongoing projects are listed in Appendices A and B. Figure 7 presents a history of ex situ versus in situ distribution for SITE demonstration projects.

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



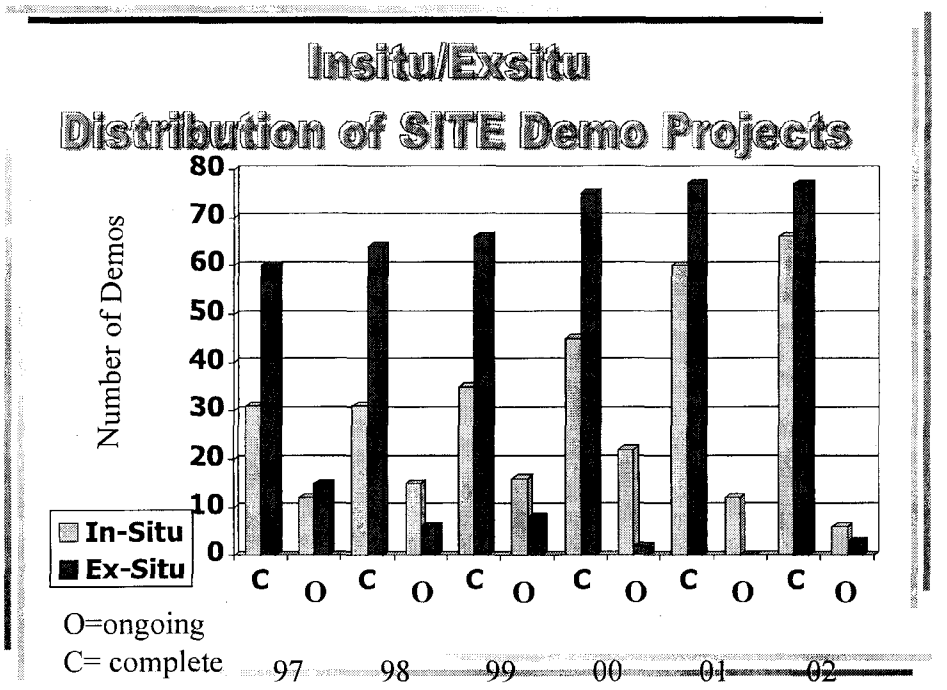


Figure 7. History of Ex Situ vs. In Situ Distribution of SITE Demo Projects

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 issues relevant to EPA.

Ongoing Demonstrations

The MMT Program has two ongoing demonstrations. Approximately five vendors are participating in a mercury in soils and sediments demonstration at the Oak Ridge National Laboratory. In addition, a dioxin detection technology demonstration is also ongoing.

Table 1. SITE Demonstration Projects Completed in FY 02			
Developer Location	**Developer**	**Technology**	**Site Location**
CA	Geokinetics International, Inc.	Geokinetics has constructed a closed loop lead recovery process to treat contaminated soil from a battery shop. Soil is excavated and stored in storage containers on-site. An electrolyte solution (EDTA) is passed through the soil. The lead/EDTA solution will then be processed using the electrochemical lead recovery system, where the lead will be recovered as lead plate and the EDTA reused.	Pearl Harbor, HI
CA	Integrated Water Resources, Inc.	IWR has designed a steam heating with co-air injection system for the stripping and recovery of TCE and DNAPL. The system will inject steam and air to strip the TCE. The TCE will not condense at the steam front as the plot is heated. The steaming will strip the TCE and the Vapor Recovery wells will collect the steam and TCE for separation and off-site disposal.	Cape Canaveral, FL
TX CA	Micro-Bac International, Inc. X-19 Biological Products, Inc.	This project involves two processes (Micro-Bac and X-19) for the biological treatment of PCB's. Products are mixed with the contaminated soil to promote a reduction in PCB concentrations.	Goldwaithe, TX
CA	Regenesis	In Situ anaerobic-aerobic bioremediation of chlorinated solvents, pesticides, and other contaminants. Hydrogen Release Compound (HRC) diffuses into groundwater passing through passive treatment wall. This acts as a base and cometabolite for bioremediation.	Rocky Mountain Arsenal, CO
MA	Terra Therm LLC	This in situ technology utilizes conductive heating from heater wells to volatilize organic contaminants in the soil. The contaminants are then removed with heater/vacuum wells.	Rocky Mountain Arsenal, CO

Table 2. SITE Ongoing Projects in FY 02			
Developer Location	**Developer**	**Treatment Technology**	**Site Location**
CA	ARCO	This project involves evaluation of an innovative acid mine drainage (AMD) treatment technology. Lime lagoons are used to provide reaction time and sludge settling while pH of the AMD is increased to around 8.5.	Leviathan Mine Site, CA
IL	Argonne National Laboratory East	This project involves the phytoremediation of radionuclides and solvents. Specifically, trees were utilized to degrade organic contaminants or to draw tritium out of the groundwater flow.	ANL-E Argonne National Lab-East
MI, MS	Army Corps of Engineers	The purpose of the demonstration is to develop and refine a protocol for beneficial reuse of dredged sediment. The process consists of characterization of the site to determine the contaminant concentration spatially and at depth, identifying possible end users of dredged materials, and working with the material until it achieves the appropriate quality for the intended use.	Milwaukee, WI
ON, Canada	Geosyntec	This project involves DNAPL remediation using emulsified zero-valent iron. Site characterization and injection of the emulsified iron was completed.	Cape Canaveral, FL
MA	Harding-Lawson Engineers	In Situ anerobic-aerobic bioremediation of chlorinated solvents. Hydrogen Release Compound (HRC) diffuses into groundwater passing through passive treatment wall. This acts as a base and cometabolite for bioremediation.	Grafton, MA
CA	State of California	This project involves evaluation of an innovative acid mine drainage (AMD) treatment technology. Biphasis treatment uses lime or other aklali to raise pH and precipitate metals in two stages.	Leviathan Mine Site, CA
CA	Steam Tech Environmental Services	This project utilizes steam-enhanced remediation, which is an in situ thermal treatment soil cleanup technology. The technology involves installation of a steam injection system and an aggressive vapor and liquid extraction system for the reduction of organic contaminants.	Ridgefield, WA
CA	Steam Tech Environmental Services	This project will extend the highly successful steam injection remediation technology to fractured rock media. The demonstration is aimed at the recovery of chlorinated solvents and to provide additional information regarding remediating other fractured rock aquifers.	Caribou, ME
CT	University of Connecticut	This project involves the evaluation of the DUOX (Dual Oxidation) technology for remediating chlorinated organics. The DUOX technology utilizes two different chemical oxidants (potassium permanganate and sodium persulfate) injected into the subsurface for the oxidation of the chlorinated solvent contaminants.	Vernon, CT
NV	University of Nevada, Reno	This project involves evaluation of an innovative acid mine drainage (AMD) treatment technology. Sulfate reducing bacteria in bioreactors generate H_2S gas which reacts with the water column to precipitate metals and raise the pH of the AMD.	Leviathan Mine Site, CA
CA	Weiss Associates	The Electrochemical Geoxidation (ECGO) process employs electrode pairs inserted into contaminated soils and/or sediments. A low voltage, low amperage coupled AC/DC current is applied to create an induced polarization field. Redox reactions mineralize organic contaminants and metals are deposited at the electrodes.	Bellingham, WA

Table 2 (continued)

Developer Location	Developer	Monitoring and Measurement Technology	Site Location
		Mercury Testing in Soils and Sediments	
CT	Milestone	Thermal decomposition, atomic absorption	Oak Ridge National Laboratory
NC	MTI Inc.	Anodic Stripping Voltammetry	Oak Ridge National Laboratory
NJ	Metorex	XRF	Oak Ridge National Laboratory
OH	Ohio Lumex	Atomic Absorption Spectroscopy	Oak Ridge National Laboratory
MA	NITON Corp.	XRF	Oak Ridge National Laboratory
		Dioxin Testing in Soils and Sediments	
DE	Strategic Diagnostics	Immunoassay and Colorimetry	To be determined
NY	Paracelsian	Cellular Receptor Immunoassay	To be determined
NC	Xenobiotics	Cell Based Immunoassay	To be determined
ME	Cape Technologies	DFI Immunoassay	To be determined
NC	Hybrizyme	Immunoassay and Colorimetry	To be determined

Future Direction

Introduction

The science of site investigation has advanced dramatically in the past 20 years. Advancements in field detection equipment and laboratory analyses have revealed new information about the problems at waste sites.

In addition, years of experience in the cleanup of hazardous waste sites have shown that quick, inexpensive solutions are usually elusive. As a remediation proceeds, the task of site cleanup is often found to be much greater and much more complex than was originally expected. Thus the improvements in site investigation and the lessons learned from both successful and unsuccessful site remediation have demonstrated a great demand for effective innovative technologies.

A number of promising technologies based on sound scientific principles, but lacking engineering and performance documentation, are appearing on the horizon. Some of these, described below, are being studied under the SITE Program, and by the U.S. Department of Energy, U.S. Department of Defense, and others. It is likely that field demonstrations may occur within the next few years for these technologies or for second-generation improvements of these techniques.

The SITE Program 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. Over the past several years the SITE program has been focusing on in situ techniques. A wide range of representation from relevant federal and state agencies helps ensure that the most pressing issues are prioritized and addressed.

Site Program Partners
- **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 Council (ITRC)**

In response to Agency priorities and stakeholder input, the MMT program is working to verify the performance of innovative field technologies which can be used to measure mercury and dioxin in soil and sediment. The mercury verification study includes five developers who are using a variety of scientific techniques to measure mercury under field locations. The dioxin field study consists of five technologies using a variation of an immunoassay technique. The technologies offer the promise of ultra low detection levels and a cost significantly below that of conventional high-resolution GC/MS.

The next phase of the program will include an updated demonstration of X-Ray Fluorescence (XRF) technologies. The XRF industry has changed significantly since the first demonstration of this technology was conducted nearly 7 years ago. This will be the first demonstration of this type and represents

an evolution of the program. Other planned verification studies included the measurement of phenol and its halogenated analogs as well as the detection of certain pesticides which are no longer in use but represent a significant health hazard.

Technology Areas of Primary Interest

One of the critical needs for remediation technology is for methods to accelerate aquifer cleanup. Groundwater contamination may consist of dissolved-phase contaminant plumes, light non-aqueous phase liquids (LNAPLS), and dense non-aqueous phase liquids (DNAPLS), all of which can potentially move in different directions. As the complexity of the geological formation increases so does the need for innovative technologies to treat or detect non-aqueous phase contamination in groundwater. New technologies are needed to control and remediate this widespread problem.

In addition to groundwater contamination, The SITE Program continues to place priority on evaluating technologies for treatment of metals and/or recalcitrant organic compounds in soil. In situ technologies for either soil or groundwater continue to remain a priority for the SITE Program.

Because of technical difficulties related to sediment remediation, this 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 that will be addressed in the future.

More recently there have been significant technology breakthroughs in chemical conversion methodologies. Technologies that rely on chemical conversion of the contaminant species rather than destruction or stabilization will end the remediation process at treatment. Metal enhanced dechlorination or treatment barriers fall into this category. This technology is a groundwater treatment technique that degrades chlorinated volatile organics (VOCs) using an electrochemical process that oxidizes granular iron while reducing and dechlorinating VOCs. Two methods of in situ metal enhanced dechlorination have been developed: in situ permeable treatment trenches (including funnel and gate configurations) and reactor vessels containing granular iron and located in the subsurface. In the future, material effectiveness on VOCs and other groundwater contaminants may be evaluated.

The SITE Program emphasizes 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. The program continues to evaluate in situ thermal and chemical oxidation type technologies under a broad array of geological conditions. In addition, effective remediation technologies for metals in soils, treatment of recalcitrant compounds, and the general need for in situ treatment remain high on the priority list.

The SITE Program will also continue to emphasize the need for technologies that focus more on types of contaminated sites rather than single contaminants (i.e., wood preserving sites, manufactured gas plant sites). Most sites are not contaminated with a single contaminant, but with mixtures including by-products formed from normal degradation. Recent applications have lead the SITE Program to move in this direction. Based on input from the multi-agency review board, a list of new priority areas are:

- Sediments
- Mining Issues\Acid Mine Drainage
- Manufactured Gas Plants
- Wood Treating\Preserving
- Pesticide Manufacturers\Formulators

Table 3 outlines the contaminant areas of interest, and Table 4 describes the demonstrations that are planned for FY02.

Table 3. Future Contaminant Emphasis Areas 2003 - 2007		
Groundwater/Surface Water	**Sediments**	**Soils**
DNAPL\ Chlorinated Solvents	PCBs	DNAPL
Arsenic, Mercury or other Heavy Metals	Arsenic, Mercury, or other Heavy Metals	Arsenic, Mercury
PCBs	PAHs	Chlorinated Solvents
	Pesticides	PCBs

Table 4. SITE Program Projects FY 03			
Site Name/ Location	**Technology**	**Project Description**	**Proposed Schedule**
Former Manufactured Gas Plant Site Millville,NJ	Ex situ Biotreatment reactor technique	Comingled groundwater plume contaminated with PAHs, MTBE and BTEX	Demonstration FY03
Summitville, CO	Multiple innovative passive drainage techniques	Treatment of acid mine drainage	Demonstration FY03
Port of Ridgefield Ridgefield, WA	In situ steam heating	Groundwater and soils contaminated with DNAPL	Demonstration FY03-04
Cape Canaveral Cocoa Beach, FL	In situ reactive iron slurry	Groundwater and soils contaminated with TCE	Technology demonstration FY02-03
Cape Canaveral Cocoa Beach, FL	In situ biological treatment	Groundwater and soils contaminated with TCE	Technology demonstration FY02-03
Pearl Harbor Naval Base	In situ capping techniques	Evaluate biological and stabilization\detoxification techniques	Demonstration planning to begin summer FY 03-04

MMT Program Areas of Interest

The Monitoring and Measurement Technologies Program will continue to test and evaluate in situ and ex situ field analytical technologies, sampling techniques, and methods for the determination of the chemical and physical properties of hazardous waste sites. The schedule of field demonstrations have kept pace with the emergence of new technologies. Input from clients and developers shows an ongoing need to explore new applications which support the goals of the SITE Program. In particular, there remain many monitoring and measurement technology needs including the detection and measurement of organic compounds in the subsurface (particularly LNAPLs and DNAPLs).

Technologies are emerging that show promise for DNAPL detection, but they may not be ready for testing until 2003 or 2004. There is a demand for non-invasive technologies that can be used to detect the presence of contaminants in the subsurface as well as to image the hydrogeologic properties of sites. The detection and measurement of mercury in soil has also been identified as a technology area of considerable interest. The MMTP will be testing as many as nine technologies which address this need during FY02. The measurement of dioxin has typically required that samples be analyzed in fixed laboratories using prescribed, labor-intensive analytical methods. During FY02, a survey was conducted to identify a number of emerging technologies that may be used to detect and possibly quantify the concentration of dioxin in soil. Some of these technologies will be considered for a field demonstration in FY03.

The use of biological test kits which can determine the toxicity of environmental media will also be considered for demonstration. Biosensor and microelectronic devices represent areas of intense research interest. The first candidates from this class of technologies will be ready for testing in FY04.

Since the program has matured, a number of developers in the area of X-ray fluorescence and gas chromatography /mass spectrometry have made significant improvements in their technology and will be candidates for abbreviated demonstrations which will evaluate the improvements. These demonstrations will be conducted in FY 03 and FY04.

Partnerships for Success

Federal to Federal Interface

The SITE Program will continue to recognize the importance of cooperation between federal agencies to find common areas of need and interest. Interfacing with other federal agencies is an important aspect of enhancing the benefits of technology demonstrations. It allows for leveraging resources, expedited performance and cost information exchange and cross fertilization of technical expertise between agencies. In addition, this type of collaboration encourages the implementation of innovative approaches by federal end users in a more expedited manner and, in many cases, implementation at other non-federal site locations.

One example of shared interest is in DNAPL contamination in the subsurface. It is an environmental problem shared by many of the member agencies of the Federal Remediation Technologies Roundtable (FRTR). These agencies have a mutual interest in finding cost-effective solutions to the characterization, treatment and monitoring of their DNAPL sites.

In 1997, NASA, DOE, EPA and DoD joined forces in forming the Interagency DNAPL Consortium (IDC) in order to evaluate a variety of DNAPL treatment technologies at a site on Cape Canaveral, Florida. These agencies, under the auspices of the FRTR, believe that they should expand on the concept of the IDC by formation of the Federal DNAPL Technologies Initiative

Program (FeDTIP). Our vision is for FeDTIP to be a cooperative program with objectives broadly focused on finding cost-effective technologies for treating DNAPL contamination across a spectrum of site conditions.

The primary objectives of the FeDTIP are to:

- Develop linkages among the many federal DNAPL science and technology activities currently ongoing; the goal is to be complementary rather than duplicative of these activities.

- Sponsor and participate in technology demonstrations and deployments at federal DNAPL sites representing a variety of site conditions to gain cost and performance data.

- Identify the key science and technology issues resulting from demonstrations and deployments that must be resolved in order to reduce costs and improve performance of DNAPL site cleanup.

- Develop or participate in development of technical practices and design guidance manuals for key technologies that will become the standard for application at DNAPL contaminated sites.

- Develop an effective technology transfer process for the benefit of the broader DNAPL remediation and regulatory community.

To date, three technologies have been demonstrated at Cape Canaveral Air Station Launch Complex 34. New project selections and starts are scheduled for FY 03.

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 to have federal to federal cooperation. Cooperation with organizations such as the Environmental Council of States (ECOS) and Interstate Technology Regulatory Council (ITRC) promotes partnerships and builds confidence within the environmental community that proven innovative technology can provide more-effective and less-expensive environmental protection.

The ITRC provides a mechanism to interact with multiple state regulatory agencies and state specific verification programs. The ITRC is a state-led national coalition dedicated to achieving better environmental protection through the use of innovative technologies.

"The SITE Program has been tremendously valuable to the State of Maine's environmental program. The success of the work done by the SITE Program will enable us to resolve various environmental issues throughout the State of Maine."

Naji Akladiss, P.E.,Project Manager
Maine Dept. of Environmental Protection

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, and 4) Sediment Workgroup. These groups are and will continue to be invited to participate in SITE Program demonstration 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 requirements early in the planning of SITE projects. For instance, ITRC's DNAPL workgroup is focused on developing innovative techniques to remedy the DNAPL challenge. The workgroup consists of members from states, federal partners such as DOE and EPA, and industry members.

Direct interaction with multiple state agencies provides many benefits. State regulatory agencies are also faced with the difficult problems associated with hazardous waste clean-up, and the variation of regulations 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.

An example of the federal-to-state interface is demonstrated at the Loring Air Force Base SITE Demonstration. On September 10 and 11, a 2-day technical seminar was held at Loring AFB to present all the details about the Quarry site characterization and monitoring, steam remediation process, and site tour. The following day, September 12, dignitaries from the state, federal EPA, DOD, Loring Development Authority, and Senator Collins office attended a visitors day designed to showcase the SteamTech SITE Demonstration. Brief presentations were made on site history, test design, and technology followed by a field visit to the demonstration location. The Loring AFB, Site Demonstration is the first field DNAPL recovery research project of this scale in fractured rock. Results from this demonstration will have significant impact in the scientific community.

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 numerous programs, such as DOD's ESTCP Program, the Environmental Council of States (ECOS) sponsored ITRC, and the DOE's Science and Technology Program.

ITRC Team meetings and special site tours have been conducted near SITE Program field demonstrations in order to capitalize on multiple State participation.

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 period of 3-6 months. Most are evaluated for one year. In the case of biological treatment or in situ capping techniques demonstrations may span 2-3 years. The summaries will need updating as the technologies mature and information becomes available.

Conclusions

The SITE program is a key element in EPA's efforts to increase the availability and use of innovative technologies for remediation of the nation's hazardous waste sites. The SITE Program technology evaluations are used by the remediation community to choose cleanup technology options, and that data is credible because of the rigorous quality assurance and careful planning of the demonstrations. Some technologies once considered innovative have been accepted as standard in part because of this program. Superfund site managers, who in 1986 had the choice of incineration or landfill, can now find many other tools in the "remediation toolbox." SITE continues to look to the future for innovative solutions to solve the cleanup challenges of the past.

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	Arctic Foundations Anchorage, AK	Freeze Barrier	Ed Yarmak 907-562-2741	Demonstration	Completed 1998
	Brice Environmental Service Corp. (BESCORP) Fairbanks, AK	Soil Washing Plant	Craig Jones 907-452-2512	Demonstration	Completed 1992
Arizona	Arizona State University Tempe, AZ	Photocatalytic Oxidation and Air Stripping	Gregory Raupp 606-965-2828 Elliot Berman 352-867-1320	Emerging Technology	Completed 1999
	STC Omega (formerly Silicate Technology Corporation) Scottsdale, AZ	Solidification and Stabilization Treatment	Stephen Pelger Scott Larsen 602-948-7100	Demonstration	Completed 1990
California	Analytical and Remedial Technology, Inc., Milpitas, CA	Automated Sampling and Analytical Platform	Gary Hopkins 408-263-8931	Monitoring and Measurement Technologies	Completed 1991
	ARCO CA	Lime Lagoons	Baffy Duff 406-563-5211	Demonstration	Ongoing
	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	Completed 2000
	Energy and Environmental Research Corporation Irvine, CA	Hybrid Fluidized Bed System	Richard Koppang 714-859-8851	Emerging Technology	Completed 1992

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
California (continued)	Energy and Environmental Research Corporation Irvine, CA	Reactor Filter System	Neil Widmer 714-859-8851	Emerging Technology	Completed 1995
	Environmental Biotechnologies Montara, CA	Microbial Composting	Douglas Munnecke 415-596-1020	Emerging Technology Demonstration	Completed 1999 Completed
	EPOC Water, Inc. Fresno, CA	Precipitation, Microfiltration, Sludge Dewatering	Scott Jackson 209-291-8144	Demonstration	Completed 1993
	General Atomics (formerly Ogden Environmental Services) San Diego, CA	Circulating Bed Combuster	Robert Goforth 619-455-2499	Demonstration	Completed 1989
		Acoustic Barrier Separator	Anthony Gattuso 619-455-2910	Emerging Technology	Completed 1995
	Geokinetics Berkeley, CA	Electrokinetics	Steven Clark 510-704-2940	Demonstration	Completed 2000
	Geokinetics Berkeley, CA	Closed Loop Lead Recovery	Steven Clark 510-704-2940	Demonstration	Completed 2002
	Geokinetics & Duke Engineering	Electrokinetic Heating & Surfactant Flushing	Steven Clark 510-704-2940	Demonstration	Completed 1999
	GIS\Solutions, Inc. Concord, CA	GIS\Key Environmental Data Management Software	Garry Reid 510-827-5400	Demonstration	Completed 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 1993
	Integrated Water Resources, Inc.	Stripping of TCE	805-565-0996	Demonstration	Completed 2002
	Lockheed Martin Missiles & Space Co., Inc. Palo Alto, CA	Electrokinetic Remediation	Steven H. Schwartzkopf 415-424-3176	Demonstration	Completed

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
California (continued)	Magnum Water Technology El Segundo, CA	CAV-OX Process	Dale Cox 310-322-4143 Jack Simser 310-640-7000	Demonstration	Completed 1993
	Membrane Technology and Research, Inc. Menlo Park, CA	VaporSep Membrane Process	Marc Jacobs Doug Gottschlich 415-328-2228	Emerging Technology	Completed 1991
	North American Technologies Aprotek San Ramon, CA	Oleofilter	Cathryn Wimberly 916-366-6185	Demonstration	Completed
	NOVATERRA, Inc. (formerly Toxic Treatments USA, Inc.) Los Angeles, CA	In-situ and Air Stripping	Philip LaMori 310-328-9433	Demonstration	Completed 1989
	Praxis Environmental Services Burlingame, CA	In-situ Steam Enhanced Extraction	Lloyd Stewart 415-641-9044	Demonstration	Completed 1997
	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	Completed
	Radian Corporation (formerly AWD Technologies, Inc.) Walnut Creek, CA	Integrated Vapor Extraction and Steam Vacuum Stripping	David Bluestein 415-227-0822	Demonstration	Completed 1990
	Regenesis	Biological Treatment, HRC of Organics	Dr. Stephen Koeningberg 949-366-8000	Demonstration	Completed 2002
	Retech, Inc. Ukiah, CA	Plasma Arc Vitrification	Ronald Womack Leroy B. Leland 707-462-6522	Demonstration	Completed 1991
	Rochem Separation Systems, Inc. Torrance, CA	Rochem Disc Tube Module System	David LaMonica 310-370-3160	Demonstration	Completed 1994
	Roy F. Weston Sherman Oaks, CA	In well Air Stripping	Jeff Bannon 818-971-4900 Eric Klingel 704-660-1673	Demonstration	Completed 1994
	Simulprobe Technologies, Inc.	Core Barrel Soil Sampler	Richard Laton 415-883-8787	Monitoring and Measurement Technologies	Completed

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
California (continued)	SIVE Services Dixon, CA	Steam Injection and Vacuum Extraction	Douglas Dieter 916-678-8358	Demonstration	Exited
	SRI Instruments Torrance, CA	Portable Gas Chromatograph	Douglas Gavilanes 310-214-5092	Monitoring and Measurement Technologies	Completed 1992
	State of California	Biphasic Lime Treatment	Chris Stetler 530-542-5461	Demonstration	Ongoing
	Steam Tech Environmental Services Bakersfield, CA	Steam Enhanced Remediation	Hank Sowers 661-322-6478	Demonstration	Ongoing
	Steam Tech Environmental Services Bakersfield, CA	In-situ Thermal (Steam Injection)	Hank Sowers 661-322-6478	Demonstration	Ongoing
	Terra-Kleen Response Group, Inc. Del Mar, CA	Solvent Extraction	Alan Cash 619-558-8762	Demonstration	Completed 1994 Completed 1997
	Texaco, Inc. S. El Monte, CA	Entrained-Bed Gasification	John Wintor 310-908-7387	Demonstration	Completed 1994
	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	John Blevins 415-744-2400	Demonstration	Completed 1990
	U.S. Filter (formerly Ultrox) Santa Ana, CA	Ultraviolet Radiation and Oxidation	John Lowry 412-722-1247	Demonstration	Completed 1989
	Weiss Associates Emeryville, CA	Electrochemcial Geoxidation	Joe Lovenitti 510-450-6141	Demonstration	Ongoing
	Xon Tech, Inc. Van Nuys, CA	Xon Tech Sector Sampler	Matt Young 818-787-7380	Monitoring and Measurement Technologies	Completed 1991
	X-19 Biological Products, Inc.	Microbial Degradation of PCBs	Paul E. Gill 408-970-9485	Demonstration	Completed 2002
Colorado	CF Systems Corporation Arvada, CO	Solvent Extraction	L.V. Benningfield 303-420-1550	Demonstration	Completed 1988
		Batch Organics Extraction Unit	L.V. Benningfield 303-420-1550	Demonstration	Completed

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Colorado (continued)	Colorado Dept. of Health Denver, CO	Wetland-Based Treatment for Mineral Mine Drainage	Jim Lewis 303-692-3390	Demonstration	Completed 1999
	Colorado School of Mines, Golden, CO and Colorado Department of Health Denver, CO	Wetlands-Based Treatment	Thomas Wildeman 303-273-3642	Emerging Technology	Completed
	General Environmental Corporation Englewood, CO	Electrocoagulation	Carl Dalrymple 303-761-6960	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	Completed 2000
		Biostabilization of Mercury Mining Wastes	Leslie Thompson 303-367-8443	Demonstration	Completed
		Biological Stabilization of Arsenic in Soils	Leslie Thompson 303-367-8443	Demonstration	Completed 2000
	Region 8 and State of Colorado	Multiple Innovative Passive mine Drainage Technologies	Victor Kettellapper 303-312-6578	Demonstration	Completed 2001
	Rocky Mountain Remediation Services Golden, CO	Environmental Soil Amendment (Stabilization)	Jim Barthel 303-215-6620	Demonstration	Completed
	Smith Environmental Technologies Corporation (formerly Canonie Environmental Services Corp.) Englewood, CO	Low Temperature Thermal Aeration	Joseph Hutton 303-790-1747	Demonstration	Completed 1992
		Anaerobic Thermal Processor	Joseph Hutton 303-790-1747	Demonstration	Completed 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 1993

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Connecticut (continued)	University of Connecticut	Permanganate/ Persulfate Oxidation Treatment for PCE	George Hoag 860-486-2781	Demonstration	Ongoing
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 1990
	Hewlett-Packard (formerly MTI Analytical Instruments) Wilmington, DE	Portable Gas Chromatograph	Hewlett-Packard 800-227-9770 Bob Belair 302-633-8487	Monitoring and Measurement Technologies	Completed 1992
Florida	Strategic Diagnostics Inc. (formerly Ensys, Inc.) Newark, DE	Immunoassay for PCP	Tim Lawruk 800-544-8881 302-456-6782	Monitoring and Measurement Technologies	Completed 1993
	Funderburk and Associates Apollo Beach, FL	Dechlorination and Immobilization	Ray Funderburk 800-723-8847	Demonstration	Completed 1997
	High Voltage Environmental Applications, Inc./Florida International University and University of Miami Miami, FL	High-Energy Electron Irradiation (Aqueous)	William Cooper 910-962-3450	Emerging Technology Demonstration	Completed 1993 Completed 1994
	High Voltage Environmental Applications, Inc. Miami, FL	High Energy Electronic Beam (Solids)	William Cooper 305-593-5330	Emerging Technology	Completed
	PCP, Inc. West Palm Beach, FL	Ion Mobility Spectrometry	Martin Cohen 407-683-0507	Monitoring and Measurement Technologies	Completed 1991
Georgia	American Combustion, Inc. Norcross, GA	PYRETRON Thermal Destruction	Gregory Gitman 404-564-4180	Demonstration	Completed 1988
	ETG., Inc. Norcross, GA	Long-Path Fourier Transform Infrared Spectrometer	Orman Simpson 404-242-0977	Monitoring and Measurement Technologies	Completed 1992
	Sonotech, Inc. Atlanta, GA	Frequency Tunable Pulse Combustion System	Ben Zinn 404-894-3033	Demonstration	Completed 1995

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Georgia (continued)	Williams Environmental Services, Inc. (Formerly Harmon Environmental Services, Inc.) Stone Mountain, GA	Soil Washing	S. Jackson Hubbard (U.S. EPA) 513-569-7507	Emerging Technology	Exited 1992
Idaho	Aquatic Research Instruments	Sediment Core Sampler	Will Young 208-768-2222	Monitoring and Measurement	Completed
	Aquatic Research Instruments	Russian Peat Borer	Will Young 208-768-2222	Monitoring and Measurement Technologies	Completed
	Argonne National Laboratory West Idaho Fall, ID	Phytoremediation of Radionuclides	Scott Lee 208-533-7829	Demonstration	Ongoing
	Art's Manufacturing and Supply	AMS™ Dual-Tube Liner Soil Sampler	Brian Anderson 800-635-7330	Monitoring and Measurement Technologies	Completed
		AMS™ Split Core Sampler	Brian Anderson 800-635-7330	Monitoring and Measurement Technologies	Completed 1999
	J.R. Simplot Co. Pocatello, ID	Anaerobic Biological Process	Russell Kaake 208-235-5620	Emerging Technology	Completed 1993
		Anaerobic Biological Process	Tom Yergovich 209-858-2511	Demonstration	Completed 1994
	Morrison Knudsen Corp./STG Technologies Boise, ID	Grouting Technique	Kathryn Levihn Rick Raymondi 208-386-6115	Demonstration	Completed
	Process Technologies, Inc. Boise, ID	Photolytic Destruction of SVE off-gases	Michael Swan 208-385-0900	Demonstration	Exited
	U.S. DOE/ Duke Engineering Lockheed, ID	Surfactant Enhanced Acquifer Remediation	Michael Shook 208-526-6945	Demonstration	Completed 1999
Illinois	Allied Signal Corporation Des Plains, IL	Submerged Aerobic Fixed Film Reactor	Steve Lupton 708-391-3500	Demonstration	Completed
	Argonne National Laboratory East	Phyroremediation of Radionuclides	Christina Negri	Demonstration	Ongoing
	Institute of Gas Technology	Chemical and Biological Treatment	Robert Kelley 847-768-0722	Emerging Technology	Completed 1993

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Illinois (continued)		Fluid Extraction-Biological Degradation Process	Albert Paterek 847-768-0720	Emerging Technology	Completed 1992
		Fluidized-Bed Cyclonic Agglomerating Incinerator	Mike Mensinger 847-768-0602 Amir Rehmat 847-768-0588	Emerging Technology	Completed
	Institute of Gas Technology	Superficial Extraction/Liquid Phase Oxidation of Waste	Mike Mensinger 847-768-0602	Emerging Technology	Completed
	OHM Environmental (formerly RUST Remedial Services, Inc.) Lombard, IL	X-TRAX Thermal Desorption	Dick Ayen 803-646-2413	Demonstration	Completed 1992
	Recycling Sciences, Inc. Chicago, IL	Desorption and Vapor Extraction System	William Meenan 312-663-4269	Demonstration	Completed
	Wheelabrator Clean Air Systems (formerly Chemical Waste Management) Schaumburg, IL	Evaporation and Chemical Oxidation	Bob Hernquist 708-706-6900	Demonstration	Completed
Indiana	Bio-Rem, Inc. Butler, IN	Augmented In-situ Subsurface Bioremediation Process	David Mann 219-868-5823 800-428-4626	Demonstration	Completed 1993
	Geoprobe Salina, KS	Soil, Water, Vapor Sampling Cone Penetrometer	Wes McCall Tom Omli 800-436-7762	Monitoring and Measuring Technologies	Completed 1995
	Sevenson Environmental Services, Inc. Munster, IN	Chemical Stabilization of Mercury Mining Wastes	Steve Chisick 219-836-0116	Demonstration	Exited
	Sevenson Environmental Services, Inc. Munster, IN	MAECTITE® Treatment Process	Chuck McPheeters 219-836-0116	Demonstration	Completed 2000
	Soil Tech, ATP Systems Inc Porter, IN	Thermal Desorption	Joe Hutton 219-926-8651	Demonstration	Completed 1992
Iowa	Clements Associates, Inc.	JMC Environmentalist's Subsoil Probe	Jim Clements 515-792-8285	Monitoring and Measurements Technologies	Completed

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Kansas	Geoprobe Systems Salina, KS	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	Sam Pizzitola 504-461-0466	Demonstration	Completed 1989
	Electrokinetics, Inc. Baton Rouge, LA	Electrokinetic Remediation	Elif Acar 504-388-3992	Emerging Technology Demonstration	Completed 1989 Exited
		Electro-Klean Electrokinetic Soil Remediation	Elif Acar 504-753-8004	Emerging Technology	Exited
	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
Massachusetts	ABB Environmental Services, Inc. Wakefield, MA	Anaerobic/ Aerobic Sequential Bioremediation	Willard Murray 617-245-6606	Emerging Technology	Completed 1998
	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
	Harding-Lawson Engineers Wakefield, MA	In-situ Anerobic-aerotic Bioremediation	William Murray 617-245-6606	Demonstration	Ongoing
	Bruker Instruments Billerica, MA	Bruker Mobile Environmental Monitor	Dr. Brian Abraham 508-667-9580	Monitoring and Measurement Technologies	Completed
	HNU Systems, Inc. Newtown, MA	Portable Gas Chromatograph	Jack Driscoll 800-724-6690 617-964-6690	Monitoring and Measurement Technologies	Completed 1992

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Massachusetts (continued)	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	Completed 1999
	Maxymillian Technologies, Inc. (formerly Clean Berkshires) Lanesboro, MA	High Temperature Thermal Process	Jim Maxymillian 413-499-3050	Demonstration	Completed 1993
	Millipore Corporation Bedford, MA	EnviroGard PCB Immunoassay Test Kit	Alan Weiss 617-275-9200	Monitoring and Measurement Technologies	Completed 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
	Terra-Therm LLC Fitchburg, MA	In-Situ Thermal	Ralph Baker 978-343-0300	Demonstration	Completed 2002
	UV Technologies, Inc. (formerly Energy and Environmental Engineering, Inc.) East Cambridge, MA	Laser-Induced Photochemical Oxidative Destruction	John Roll James Porter 617-666-5500	Emerging Technology	Completed 1993
Michigan (and Mississippi)	Army Corps of Engineers	Phytoremediation	Detroit, MI and Vicksburg, MS	Demonstration	Ongoing
Minnesota	BioTrol Inc. Eden Prairie, MN	Biotreatment of Groundwater	Dennis Chilcote 612-942-8032	Demonstration	Completed 1989
	BioTrol, Inc. Eden Prairie, MN	Methanotropic Bioreactor System	Durell Dobbins 612-942-8032	Emerging Technology	Completed 1992
	BioTrol, Inc. Eden Prairie, MN	Biological Aqueous Treatment System	Durell Dobbins 612-942-8032	Demonstration	Completed 1989

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Minnesota (continued)	BioTrol, Inc. Eden Prairie, MN	Soil Washing System	Dennis Chilcote 612-942-8032	Demonstration	Completed 1989
	Membrane Corporation Minneapolis, MN	Membrane Gas Transfer in Waste Remediation	Charles Gantzer 612-378-2160	Emerging Technology	Discontinued
Missouri	COGNIS TERRAMET Gross, MO	Removal of Lead from Soils	Lou Magdits 573-626-3476	Demonstration	Completed 1994
Montana	Montana College of Mineral Science and Technology Butte, MT	Air-Sparged Hydrocyclone	Theodore Jordan 406-496-4112 406-496-4193	Emerging Technology	Completed 1994
		Campbell Centrifugal Jig	Gordon Ziesing 406-496-1573 406-496-4193	Emerging Technology	Ongoing
Nebraska	University of Nebraska Lincoln, NE	Spray Irrigation	Ray Spalding 402-483-3931	Demonstration	Completed 1996
Nevada	U.S. EPA Las Vegas, NV	Field Analytical Screening Program (FASP)	Howard Fribush 703-603-8831 Larry Jack 702-798-2373	Demonstration	Completed 1996
	University of Nevada, Reno Reno, NV	Passive Constructed Wetlands	Tim Tsukamoto 775-784-4413	Demonstration	Ongoing
New Jersey	Accutech Inc Keyport, NJ and New Jersey Institute of Technology Newark, NJ	Pneumatic Fracturing Extraction and Hot Gas Injection	John Liskowitz 908-739-6444	Demonstration	Completed 1992
	ART International, Inc. (formerly Enviro Sciences, Inc.) Denville, NJ	Low-Energy Solvent Extraction Process	Werner Steiner 201-627-7601	Emerging Technology	Completed 1994
	Dehydro-Tech. Corporation Somerville, NJ	Carver-Greenfield Process for Extraction of Oily Waste	Theodore Trowbridge 908-904-1606	Demonstration	Completed 1991
	Geotech Development Corporation Newark, NJ	Cold Top Vitrification	William Librizzi 201-596-5846 Thomas Tate 610-337-8515	Demonstration	Exited
	Envirogen, Inc. Lawrenceville, NJ	Microbial Degradation/ Solvent Extraction	Ronald Unterman (609) 936-9300	Demonstration	Completed 2000

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
New Jersey (continued)	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	Completed
	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 1992
	New Jersey Institute of Technology Newark, NJ and GeoTech Development Corporation King of Prussia, PA	Cold Top Vitrification	William Librizzi 201-596-5846 Thomas Tate 610-337-8515	Demonstration	Exited
	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	Completed 1998
	Sentex Sensing Technology, Inc. Ridgefield, NJ	Portable Gas Chromatograph	Amos Linenberg 201-945-3694	Monitoring and Measurement Technologies	Completed 1992
	Solucorp Saddle Back, NJ	Molecular Bonding System	Robert Kuhn 914-623-2333	Demonstration	Completed
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 1994
	Commodore Advanced Sciences, Inc. Albuquerque, NM	Set Process for PCBs in soil	Mark Jones 505-872-6803	Demonstration	Completed 2000
	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	Completed 1999

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
New Mexico (continued)	Thermo Nutech (formerly TMA Eberline) Albuquerque, NM	Segmented Gate System for Radioactive Materials	Jeff Brown 423-481-0683	Emerging Technology	Completed
New York	Photovac International, Inc. Deer Park, NY	Portable Gas Chromatograph	Mark Collins 516-254-4199	Monitoring and Measurement Technologies	Completed 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
	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
	Texaco Syngas, Inc. White Plains, NY	Gasification Process	John Winter 316-251-4000 ext. 536	Demonstration	Completed 1994
	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	Phytoremediation of TCE in Groundwater	Greg Harvey 513-255-7716	Demonstration	Completed 1998
	Babock and Wilcox Alliance Research Center Alliance, OH	Cyclone Vitrification	Lawrence King 216-829-7576	Demonstration	Completed 1991
	Battelle Memorial Institute Columbus, OH	In-situ Electroacoustic Soil Decontamination	Satya Chauhan 614-424-4812	Emerging Technology	Completed
	Commodore Environmental Columbus, Ohio	Solvated Electron Treatment of Chlorinated Organics	Neil Dronby 614-297-0365	Demonstration	Completed 1996

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Ohio (continued)	Ferro Corporation Independence, OH	Waste Vitrification Through Electric Melting	S.K. Muralidhar 216-641-8580	Emerging Technology	Completed
	IT Corporation Cincinnati, OH	Chelation/ Electro-deposition of Toxic Metals from Soil	Radha Krishnan 513-782-4700	Emerging Technology	Completed
	IT Corporation (formerly OHM Remediation Services Corp.) Findlay, OH	Oxygen Microbubble In-situ Bioremediation	Douglas Jerger 423-690-3211	Emerging Technology	Completed 1998
	Monsanto/ Dupont • Cincinnati, OH	In-situ Electroosmosis of TCE in soil/ Groundwaters "Lasagna Process"	Thomas Holdsworth 513-569-7675	Demonstration	Completed 1998
	University of Dayton Research Institute Dayton, OH	Photothermal Detoxification Unit (PDU)	Berry Dellinger John Graham 513-229-2846	Emerging Technology	Completed 1994
	US EPA Mobile Volume Reduction Unit Cincinnati, Ohio	Soil Washing	Richard Griffith 908-321-6629	Demonstration	Completed 1992
	U.S. EPA NRMRL Cincinnati, OH	Bioventing	Paul McCauley 513-569-7444	Demonstration	Completed 1997
	U.S. EPA NRMRL and ETG Environmental Cincinnati, OH	Base-Catalyzed Dechlorination Process	George Huffman 513-569-7341 Yei-Shong Shieh 215-832-0700	Demonstration	Completed 1993
	U.S. EPA Risk Reduction Engineering Laboratory and IT Corporation Cincinnati, OH	Debris Washing System	Michael Taylor 513-782-4700	Demonstration	Completed 1990
	U.S. EPA Risk Reduction Engineering Laboratory and FRX, Inc. Cincinnati, OH	Hydraulic Fracturing	William Slack 513-469-6040	Demonstration	Completed 1992
	U.S. EPA NRMRL Cincinnati, OH	Alternate Cover Assessment Program (ACAP)	Steve Rock 513-569-7149	Demonstration	Completed 2001

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Oklahoma	Geo-Microbial Technologies, Ochelata, OK	Technology for Metals Release and Removal from Wastes	Donald Hitzman 918-535-2281	Emerging Technology	Completed 2001
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
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
	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	Completed 1999
	Geo-Con, Inc. Monroeville, PA 2 Demonstrations	In-situ Solidification/ Stabilization	Linda Ward Robert Hayden 412-856-7700	Demonstration	Completed 1988
	Horsehead Resource Development Co. Inc. Monaca, PA	Flame Reactor	Regis Zagrocki 610-826-8810	Demonstration	Completed

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Pennsylvania (continued)	Lewis Environmental Services, Inc. Pittsburgh, PA	Soil Leaching Process	Tom Lewis III 412-322-8100	Emerging Technology	Exited
	Strategic Diagnostics, Inc. Newtown, PA	Immunoassay for PCP	Craig Kostyshyn 215-860-5115 ext. 634	Monitoring and Measurement Technologies	Completed 1993
	Remediation Technologies, Inc. Pitsburgh, PA	Slurry Biodegradation	David Nakles 412-826-3340	Demonstration	Completed 1991
	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 1992
	Roy F. Weston, Inc. West Chester, PA	Thermal Desorption	Mike Cosmos 215-430-7423	Demonstration	Completed 1992
	Roy F. Weston, Inc. West Chester, PA	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 Demonstration	Completed 1993 Exited
South Carolina	E&C Williams Summerville, SC	Chemical Stabilization of Mercury Mining Wastes	Charlie Williams 843-821-4200	Demonstration	Completed 2001
	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 1992
	Brown and Root Environmental/ Illinois Institute of Technology Oak Ridge, TN	Radio Frequency Heating	Clifton Blanchard 423-483-9900	Demonstration	Completed 1994

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Tennessee (continued)	IT Corporation Knoxville, TN	Batch Steam Distillation and Metal Extraction	Stuart Shealy 423-690-3211	Emerging Technology	Completed 1992
		Eimco Biolift Slurry Reactor as developed by Tekno Associates	Kandi Brown 423-690-3211	Emerging Technology	Completed 1992
		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 1991
Texas	Geokinetics and Duke Engineering	Electrokinetic Flushing & Surfactant Flushing	Harry Linnemeyer 512-425-2000 Steven Clark 510-704-2940	Demonstration	Completed 1999
	EET, Inc. Bellaire, TX	PCB/Metals Extraction from Porous Surfaces	Tim Tarrillion 713-662-0727	Demonstration	Completed 1997
	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
	Filter Flow Technology, Inc. League City, TX	Colloid Polishing Method	Todd Johnson 713-334-6080	Demonstration	Completed 1992
	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 1993

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Texas (continued)	Solidtech, Inc. Houston, TX	Solidification and Stabilization	Bill Stallworth 713-497-8558	Demonstration	Completed 1988
	Star Organics Dallas, TX	Injection Soil Amendment (Stabilization)	Phil Clarke 214-522-0742	Demonstration	Completed 1999
	TN Spectrace Round Rock, TX	Portable X-Ray Fluorescence Spectrometer	Peter Barry 512-388-9100	Monitoring and Measuring Technologies	Completed 1995
	Micro-Bac International, Inc.	Microbial Degradation of PCBs	Todd Kenney 512-310-9000	Demonstration	Completed 2002
	University of Houston Houston, TX	Concentrated Salt Extraction of Lead	Dennis Clifford 713-743-4266	Emerging Technology	Completed 1999
	Western Product Recovery Group, Inc. Houston, TX	CCBA Physical and Chemical Treatment	Donald Kelly 713-493-9321 Bert Elkins 619-749-8856	Emerging Technology	Completed 1994
Utah	Phytokinetics, Inc. North Logan, UT	Phytoremediation of Soils	Ari Ferro 801-750-0985	Emerging Technology Demonstration	Completed 1999 Completed 1999
Vermont	Green Mountain Laboratories	Biodegradation of PCBs in Soils	Adam Longee 802-223-1468	Demonstration	Completed 2000
Virginia	BioGenesis Enterprises, Inc. Fairfax Station, VA	Soil Washing/ Biological Treatment	Charles Wilde 703-250-3442	Demonstration	Completed 1992
	BWX Tech., Inc. (Affiliate of Babcock and Wilcox Co. Lynchburg, VA	Cyclone Furnace	Evan Reynolds 804-522-6000	Emerging Technology Demonstration	Completed 1992 Completed 1991
	Dynaphore, Inc. Richmond, VA	Removal of Dissolved Heavy Metals via FORAGER Sponge	Norman Rainer 804-288-7109	Demonstration	Completed 1994
	ITT Industries Roanoke, VA	Enhanced In-Situ Bioremediation of Chlorinated Compounds	Rosann Kryczkowski 540-362-7356	Demonstration	Completed 1999
Washington	ECOVA Corporation Redmond, WA	Bioslurry Reactor	Alan Jones 206-883-1900	Demonstration	Completed 1991
	Geosafe Corporation Richland, WA	In-situ Vitrification	James Hansen Matthew Haass 509-375-0710	Demonstration	Completed 1994

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Washington (continued)	Ionics/ Resources Conservation Co. Bellevue, WA	BEST Solvent Extraction	William Hines 206-828-2400	Demonstration	Completed 1992
	Keeco	Chemical Stabilization of Mercury Mining Wastes	Amy Anderson 888-977-9156	Demonstration	Completed 2001
	Remediation Technologies, Inc. (ReTec) Seattle, WA	Methanotrophic Biofilm Reactor	Hans Stroo 206-624-9349	Emerging Technology	Completed 1995
	Remediation Technologies, Inc. (ReTec) Seattle, WA	Liquid and Soils Biological Treatment	Merv Cooper 206-624-9349	Demonstration	Completed 1994
	Scitec Corporation Richland, WA	Field Portable X-Ray Fluorescence	Steve Santy 800-466-5323 509-783-9850	Monitoring and Measurement Technologies	Completed 1995
	University of Washington Seattle, WA	Asdorptive Filtration	Mark Benjamin 206-543-7645	Emerging Technology	Completed 1992
	Wilder Construction	Matcon Modified Asphalt Cap	W. Randall Garrett 800-484-9404	Demonstration	Completed 2001
Wisconsin	Minergy	Thermal Sediment Reuse Technology	Terry Carroll 920-727-1411	Demonstration	Completed 2001
	Svedala Industries (formerly Allis Mineral Systems) Oak Creek, WI	Pyrokiln Thermal Encapsulation Process	Jim Kidd 414-798-6341 Glenn Heian 414-762-1190	Emerging Technology	Completed 1993
	US EPA/ NRMRL US-DA Forest Products Lab Madison	Fungus Treatment Technology	Richard Lamar 608-231-9469	Demonstration	Completed 1991
	University of Wisconsin, Madison, WI	Photoelectro-catalytic Treatment of Metals and Organics in Water	Marc Anderson 608-262-2674 Charles Hill, Jr. 608-263-4593	Emerging Technology	Completed
Wyoming	Western Research Institute Laramie, WY	Contained Recovery of Oily Wastes (CROW)	James Speight 307-721-2011	Emerging Technology Demonstration	Completed 1991 Completed 1997
Canada	Atomic Energy of Canada, Limited Chalk River, Ontario	Ultrasonic-Acid Leachate Treatment for Mixed Wastes	Shiv Vijayan 613-583-3311 ext. 3220/6057	Emerging Technology	Completed

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Canada (continued)	Atomic Energy of Canada, Limited Chalk River, Ontario	Chemical Treatment and Ultrafiltration	Leo Buckley 613-584-3311	Emerging Technology	Completed 1993
	Cone Tech Investigations Vancouver, British Colombia	Resistivity, pH, Seismic, Temperature, Cone Penetrometer	Ward Phillips 604-327-4311	Monitoring and Measuring Technologies	Completed 1992
	ELI Ecologic International, Inc. Rockwood, Ontario	Thermal Gas Phase Reduction Process and Thermal Desorption	Jim Nash 519-856-9591	Demonstration	Completed 1992
	EnviroMetal Technologies, Inc.	In Situ Reactive Barrier	John Vogan 519-824-0432	Demonstration	Completed 2000
	EnviroMetal Technologies, Inc. Guelph, Ontario 2 Demonstrations	Metal Enhanced Abiotic Degradation	William Matulewicz 609-722-6700	Demonstration Ex-situ In-situ	 Completed 1995 Completed
	Geosyntec Guelph, Ontario	Emulsified Zero-valent Iron for DNAPL Remediation	Suzanne O'Hara 519-822-2230	Demonstration	Ongoing
	Grace Dearborn, Inc. Mississauga, Ontario	Daramend Process	Alan Seech Paul Bucen 905-272-7480	Demonstration	Completed 1994
	Matrix Photocatalytic Limited (formerly Nutech Environmental) London, Ontario, Canada	TiO_2 Photocatalytic Treatment of Aqueous Waste Streams	Bob Henderson 519-660-8669	Emerging Technology	Completed 1994
	Matrix Photocatalytic Limited	TiO_2 Photocatalytic Air Treatment	Bob Henderson 519-660-8669	Demonstration	Completed 1995
	Toronto Harbour Comission Toronto, Ontario	Soil Recycling	Dennis Lang 416-863-2047	Demonstration	Completed 1992
	Wastewater Technology Centre Burlington, Ontario	Cross-Flow Pervaporation System	Chris Lipski 905-639-6320	Emerging Technology	Completed 1992
	Zenon Environmental Systems, Inc. Burlington, Ontario	Bioreactor Integrated with an Ultrafiltration Membrane System	Lisa Ashton 905-639-6320 ext. 244	Demonstration	Completed 1995

SITE PROJECTS - BY DEVELOPER STATE

State	Developer	Technology	Contact	Program	Status
Canada (continued)	Zenon Environmental Systems, Inc. Burlington, Ontario	Cross-Flow Pervaporation System	Phil Canning Tony Tonelli 905-639-6320	Demonstration	Completed 1995
	Zenon Environmental Systems, Inc. Burlington, Ontario	ZenoGem Process	Chris Lipski 905-639-6320	Demonstration	Completed 1995
England/United Kingdom	AEA Technology (formerly Warren Spring Laboratory) Oxfordshire, England	Physical and Chemical Treatment	Steve Barber 011-44-1235-463062	Emerging Technology	Completed 1994
	Graseby Ionics, Limited Waterford Herts, England	Ion Mobility Spectrometry	John Brokenshire 011-44-1923-816166 Martin Cohen 561-683-0507	Measuring and Monitoring Technologies	Completed 1990
Italy	Gruppo Italimpresse (developed by Shirco Infrared Systems, Inc.) (formerly ECOVA) Rome, Italy 2 Demonstrations	Infrared Thermal Destruction	John Cioffi 206-883-1900	Demonstration	Completed 1987
Puerto Rico	Terra Vac, Inc. San Juan, PR	In-situ Vacuum Extraction	James Malot 787-725-8750	Demonstration	Completed

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 ABE Superfund Site (Region 10)	Soil Washing	Brice Environmental Services Corporation (BESCORP) Fairbanks, AK Craig Jones 907-452-2515	Demonstration	Completed 1992
Arizona	Phoenix, AZ Pesticide Site (Region 9)	Low Temperature Thermal Aeration	Smith Environmental Services (formerly Canonie) Englewood, CO Joe Hutton 219-926-8651	Demonstration	Completed 1992
	Phoenix, AZ Pesticide Site (Region 9)	Anaerobic Thermal Processor	Smith Environmental Services (formerly Canonie) Englewood, CO Joe Hutton 219-926-8651	Demonstration	Completed
	Phoenix, AZ Williams AFB (Region 9)	In-situ Subsurface Bioremediation	Bio-Rem Butler, IN David O. Mann 219-868-5823	Demonstration	Completed 1993
Arkansas	Jefferson, AR Incineration Research Facility (IRF) (Region 6)	Tunable-Pulse Combustion	Sonotech, Inc. Atlanta, GA Ben Zinn 404-894-3033	Demonstration	Completed 1995
		Pyreton Burner (Thermal Destruction)	American Combustion Technologies Norcross, GA Gregory Gitman 404-564-4180	Demonstration	Completed 1988
California	Burbank, CA Lockheed Site (Region 9)	Integrated In-situ Vapor Extraction and Steam Vacuum Stripping Process	Radian Corporation (formerly AWD Technologies, Inc.) Walnut Creek, CA David Bluestein 415-227-0822	Demonstration	Completed 1990
	Clear Lake, CA	Biostabilization of Mercury Mining Wastes	Pintail Systems, Inc. Aurora, CO Leslie Thompson 303-367-8443	Demonstration	Completed

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
California (continued)	Clear Lake, CA	Chemical Stabilization of Mercury Mining Wastes	Sevenson, W.C. Munster, IN Steve Chisick 219-836-0116	Demonstration	Exited
	Clear Lake, CA	Chemical Stabilization of Mercury Mining Wastes	E&C Williams Summerville, SC Charlie Williams 84-821-4200	Demonstration	Completed 2001
	Edwards AFB, CA (Region 9)	CAV-OX Oxidation Process	Magnum Water Technology El Segundo, CA Dale Cox 310-640-7000	Demonstration	Completed 1993
	Fresno, CA Selma Site (Region 9)	Entrained-Bed Gasfication	Texaco, Inc. S. El Monte, CA John Wintor 310-908-7387	Demonstration	Completed 1994
	Fresno, CA Selma Site (Region 9)	Silicate Compounds by Solidification/ Stabilizatioin	STC Omega (formerly Silicate Technology Corporation) Scottsdale, AZ Steve Pegler 602-948-7100	Demonstration	Completed 1990
	Fullerton, CA McColl Superfund Site (Region 9)	Excavation and Foam Suppression of Volatiles	U.S. EPA Region 9 San Francisco, CA Jon Blevins 415-744-2400	Demonstration	Completed 1990
	Huntington Beach, CA Rainbow Disposal (Region 9)	Steam Injection/ Vacuum Extraction (SIVE)	Hughes Environmental Manhattan Beach, CA (No longer a vendor for SIVE) Paul De Percin U.S. EPA 513-569-7797	Demonstration	Completed 1993
	Jackson, CA Pintail Systems, Inc. (Region 9)	Biological Stabilization of Arsenic in Soils	Pintail Systems, Inc. Aurora, CO Leslie Thompson 303-367-8443	Demonstration	Completed 2000
	Leviathan Mine Site (Region 9)	Biphasic Lime Treatment	State of CA Chris Stetler 530-542-5461	Demonstration	Ongoing

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
California (continued)	Leviathan Mine Site (Region 9)	Passive Constructed Wetlands	University of NV, Reno Tim Tsukamoto 775-784-4413	Demonstration	Ongoing
	Leviathan Mine Site (Region 9)	Lime Lagoons	ARCO Barry Duff 406-563-5211	Demonstration	Ongoing
	Livermore, CA Lawrence Livermore National Laboratory (LLNL) (Region 9)	Chemical Oxidation Perox-Pure	Calgon Carbon Oxidation Technologies (formerly Peroxidation Systems, Inc. Pittsburgh, PA Bertrand Dussert 412-787-6681	Demonstration	Completed 1995
	Livermore, CA LLNL (Region 9)	In-situ Enhanced Extraction	Berkley Environmental Restoration (formerly Udell Technologies, Inc.) Emeryville, CA Kent Udell 510-653-9477	Demonstration	Completed 1993
	March AFB, CA (Region 9)	In well Air Stripping	Roy Weston Woodland Hills, CA Jeff Bannon 818-971-4900	Demonstration	Completed 1994
	Port Hueneme, CA Naval Facilities Engineering Service Center (Region 9)	Solvated Electron Treatment of Chlorinated Organics	Commodore Environmental Columbus, OH Neil Dronby 614-297-0365	Demonstration	Completed 1996
	Redding, CA Iron Mountain Superfund Site	Precipitation, Microfiltration, Sludge Dewatering	EPOC Water, Inc. Fresno, CA Scott Jackson 209-291-8144	Demonstration	Completed 1993
	Sacramento, CA McClellan AFB (Region 9)	Photolytic Destruction for SVE Off-gases	Process Technologies, Inc. Boise, ID Michael Swan 208-385-0900	Demonstration	Exited
	Sacramento, CA McClellan AFB (Region 9)	Groundwater Extraction	Xerox Two Phase Extraction Webster, NY Ron Hess 716-422-3694	Demonstration	Completed 1995

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
California (continued)	San Diego, CA	Circulating Bed Cumbuster	General Atomics (formerlt Ogden Environmental Services) San Diego, CA Robert Goforth 619-455-2499	Demonstration	Completed 1989
	San Diego, CA Naval Air Station North Island (NASNI) (Region 9)	In Well Vapor Stripping of Ground Water	MACTEC Environmental, Inc. Pittsburgh, PA Mark McGlathery 800-444-6221	Demonstration	Completed 1999
	San Diego, CA NASNI Site 9 (Region 9)	Cross-flow Pervaporation System for Removal of VOCs from Groundwater	Zenon Environmental, Inc. Burlington, Ontario, Canada Phil Canning 905-639-6320	Demonstration	Completed 1995
	San Francisco, CA Westin Hotel (Region 9)	GIS/KEY Software for HW Site Data Management	GIS Solutions, Inc. Concord, CA Garry Reid 510-827-5400	Demonstration	Completed 1993
	San Jose, CA Lorentz Barrel and Drum Site (Region 9)	Ultraviolet Ozone Treatment for Liquids	US Filter (formerly Ultrox International, Inc) Santa Ana, CA John Lowry 412-772-1247	Demonstration	Completed
	San Pedro, CA Annex Terminal (Region 9)	In-situ Steam/ Air Stripping	Novaterra, Inc. (formerly Toxic Treatment, Inc.) Torrance, CA Phil La Mori 310-328-9433	Demonstration	Completed 1989
	Santa Barbara, CA Santa Marie Health Care Services (UST Site) (Region 9)	Soil Washing/ Geological Treatment	BioGenesis Enterprises (formerly BioVersal USA) Fairfax Station, VA Charles Wilde 703-250-3442 Mohsen Amiran 708-827-0024	Demonstration	Completed 1992

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
California (continued)	South El Monte, CA (Region 9)	Gasification Process	Texaco Syngas, Inc. White Plains, NY John Winter 316-251-4000 ext. 536	Demonstration	Completed 1994
Colorado	Clear Creek, CO Burleigh Tunnel (Region 8)	Wetland-Based Treatment for Mineral Mine Drainage	Colorado Department of Health Denver, CO Jim Lewis 303-692-3390	Demonstration	Completed 1999
	Denver, CO Rocky Flats (Region 8)	Colloid Polishing Method	Filter Flow Technology League City, TX Tod Johnson 713-334-6080	Demonstration	Completed 1992
	Denver, CO DOE Rocky Flats (Region 8)	Core Barrel Soil Sampler	Simulprobe Technologies, Inc. CA Richard Laton 415-883-8787	Monitoring and Measurement	Completed
	Denver, CO (Region 8)	Dual Tube Liner Soil Sampler	Art's Manufacturing and Supply American Falls, ID Brian Anderson 800-635-7330	Monitoring and Measurement	Completed
	Denver, CO (Region 8)	Electrocoa-gulation	General Environmental Inc. (formerly Hydrologics, Inc.) Englewood, CO Carl Dalrymple 303-761-6960	Demonstration	Completed 1995
	Denver, CO (Region 8)	EMFLUX Soil Gas Survey System	Quadrel Services, Inc. MD Bruce Tucker Paul Henning 301-874-5510	Monitoring and Measurement	Completed
	Denver, CO (Region 8)	Gore-Scrubber Passive Soil Gas Sampler	W. L. Gore and Associates, Inc. Elkton, MD Ray Fenstermacher 410-392-7600	Monitoring and Measurement	Completed

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Colorado (continued)	Denver, CO (Region 8)	JMC Environmentalist's Subsoil Probe	Clements Associates, Inc. IA Jim Clements 515-792-8285	Monitoring and Measurement	Completed
	Denver, CO (Region 8)	Large Bore Soil Sampler	Geoprobe Systems Salina, KS Wesley McCall Tom Omli 800-436-7762	Monitoring and Measurement	Completed
	Rocky Flats, CO (Region 8)	In-situ Reactive Barrier	EnviroMetal Technologies, Inc. Guelph, Ontario John Vogan 519-824-0432	Demonstration	Completed 2000
	Rocky Mountain Arsenal, CO (Region 8)	Biological Treatment, HRC of Organics	Regenesis CA Stephen Koenigsberg 949-366-8000	Demonstration	Completed 2002
	Rocky Mountain Arsenal, CO (Region 8)	In-Situ Thermal	Terra-Therm LLC Ralph Baker 978-343-0300	Demonstration	Completed 2002
	Summitville, CO (Region 8)	Multiple Innovative Passive mine Drainage Technologies	Region 8 and Sate of Colorado Victor Kettellapper 303-312-6578	Demonstration	Completed 2001
Connecticut	Roosevelt Mills Vernon, CT	Permanganate/ Persulfate Oxidation Treatment for PCE	Univ. of Connecticut George Hoag 860-486-2781	Demonstration	Ongoing
Delaware	Dover, DE (Region 3) & Elgin, IL (Region 5)	Matcon Modified Asphalt Cap	Wilder Construction Co., WA W. Randall Garrett 800-484-9404	Demonstration	Completed 2001
Florida	Brandon, FL Peak Oil Superfund Site (Region 4)	Infrared Incinerator	Grupo Italimprese (Ecova Europa) (formerly ECOVA) Rome, Italy John Cioffi 206-883-1900	Demonstration	Completed 1987
	Cape Canaveral, FL (Region 4)	Dynamic Underground Stripping of TCE	Integrated Water Resources, Inc. 805-565-0996	Demonstration	Completed 2002

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Florida (continued)	Cape Canaveral, FL (Region 4)	Emulsified Zero-valent Iron for DNAPL Remediation	Geosyntec Guelph, Ontario Suzanne O'Hara 519-822-2230	Demonstration	Ongoing
	Hialeah, FL General Electric Service Shop	In-situ Solidification/ Stabilization	Geo-Con, Inc. Monroville, PA Linda Ward Robert Hayden 412-856-7700	Demonstration	Completed 1988
	Pensacola, FL American Creosote Works (Region 4)	Filtration	SBP Technologies, Inc. Baton Rouge, LA Clayton Page 504-755-7711	Demonstration	Completed 1992
	Pensacola, FL Escanbia Wood Preserving Site (Region 4)	Soil Washing	U.S. EPA Mobile Volume Reduction Unit Cincinnati, OH Richard Griffith 908-321-6629	Demonstration	Completed 1992
	Petroleum Products Corporation Miami, FL	Oleofilter	North American Technologies Aprotek San Ramon, CA Cathryn Wmberly 916-366-6185	Demonstration	Completed
Georgia	Chickamuga, GA and Hopkinsville, GA (Region 4)	Debris Washing System	U.S. EPA NRMRL Cincinnati, OH Mike Taylor 512-782-4700	Demonstration	Completed 1990
	Warner Robins, GA Robins AFB (Region 4)	Stabilization of Organics	WASTECH, Inc. Oak Ridge, TN Benjamin Peacock 615-483-6515	Demonstration	Completed 1991
Hawaii	Pearl Harbor, HI (Region 9)	PCB/Metals Extraction from Porous Surfaces	EET Inc. Bellaire, TX Tim Tarrillion 713-662-0727	Demonstration	Completed 1997
	Pearl Harbor, HI Naval Facility (Region 9)	Electrokinetics	Geokinetics CA Steven Clark 510-704-2940	Demonstration	Completed 2000

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Hawaii (continued)	Pearl Harbor, HI Naval Facility (Region 9)	Electrokinetic Flushing & Surfactant Flushing	Geokinetics and Duke Engineering TX Steven Clark 510-704-2940 Harry Linnemeyer 512-425-2000	Demonstration	Completed 1999
	Pearl Harbor, HI Naval Facility (Region 9	Set Process for PCBs in Soil	Commodore Advanced Sciences, Inc. Albuquerque, NM Mark Jones 505-872-6803	Demonstration	Completed 2000
	Pearl Harbor, HI Naval Facility (Region 9	Closed Loop Lead Recovery	Geokinetics CA Stephen Clark 510-704-2940	Demonstration	Completed 2002
Idaho	Aberjona River	Sediment Core Sampler	Aquatic Research ID Will Young (208) 768-2222	Monitoring and Measurements	Completed
	INEEL Lab	Phytoremediation	Argonne National Laboratory West Idaho Fall, ID Scott Lee (208) 533-7829	Demonstration	Ongoing
Illinois	Chicago, IL (Region 4)	Hydraulic Fracturing	U.S. EPA/ NRMRL Cincinnati, OH William Slack 513-469-6040	Demonstration	Completed 1992
	Elgin, IL (Region 5) & Dover, DE (Region 3)	Matcon Modified Asphalt Cap	Wilder Construction Co., WA W. Randall Garrett 800-484-9404	Demonstration	Completed 2001
	Waukegan Harbor, IL (Region 5)	Thermal Desorption	SoilTech, ATP Systems Inc. Porter, IN Joe Hutton 219-926-8651	Demonstration	Completed 1992
Indiana	Gary, IN Indiana Harbour (Region 5)	Solvent Extraction	Ionics/Resources Conservation, Co. Bellevue, WA Bill Hines 206-828-2400	Demonstration	Completed 1992

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Iowa	Albert City, IA (Region 7)	Core Barrel Soil Sampler	Simulprobe Technologies, Inc. CA Richard Laton 415-883-8787	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. MD Bruce Tucker Paul Henning 301-874-5510	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 410-392-7600	Monitoring and Measurement	Completed
	Albert City, IA (Region 7)	JMC Environmentalist's Subsoil Probe	Clements Associates, Inc. IA Jim Clements 515-792-8285	Monitoring and Measurement	Completed
	Albert City, IA (Region 7)	Large Bore Soil Sampler	Geoprobe Systems Salina, KS Wesley McCall Tom Omli 800-436-7762	Monitoring and Measurement	Completed
Kansas	**Bendena, KS (Region 7)**	**Biological Denitrification**	**Eco Mat, Inc. Hayward, CA Kim Halley 510-783-5885**	**Demonstration**	**Completed 2000**
Kentucky	Paducah, KY Gaseous Diffustion Plant (Region 4)	In-situ Electroosmosis of TCE in Soil/ Groundwaters "Lasagna" Process	Monsanto/Dupont OH Thomas Holdsworth 513-569-7675	Demonstration	Completed 1998
	DOE- Paducah, KY	Oxidation and Vitrification Process	Vortec Corporation Collegeville, PA James Hnat 610-489-2255	Emerging Technology	Completed 1993

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Louisiana	Fort Polk, LA (Region 6)	Electrokinetic Extraction	Electrokinetics, Inc. Baton Rouge, LA Elif Acar 504-388-3992	Demonstration	Exited
	Lake Charles, LA	Evaporation and Chemical Oxidation	Wheelbrator Clean Air Systems (formerly Chemical Waste Management) Schaumburg, IL Bob Hernquist 708-706-6900	Demonstration	Completed
Maine	Loring AFB Caribou, ME (Region I)	In-situ Thermal (Steam Injection)	Steam Tech Environmental Services Bakersfield, CA Hank Sowers 661-322-6478	Demonstration	Ongoing
Massachusetts	Boston, MA (Region 1)	AMS Split Core Sampler	Art's Manufacturing and Supply ID Brian Anderson 800-635-7330	Monitoring and Measurement	Completed 1999
	Boston, MA (Region 1)	Russian Peat Borer	Aquatic Research Instruments ID Will Young 208-768-2222	Monitoring and Measurement	Completed
	Grafton, MA (Region 1)	Anerobic-aerotic Bioremediation	Harding-Lawson Enginners, MA Willard Murray 781-245-6606	Demonstration	Ongoing
	Groveland, MA Groveland Wells Superfund Site	In-situ Vacuum Extraction	Terra Vac, Inc. San Juan, PR James Malot 787-725-8750	Demonstration	Completed
	New Bedford, MA (Region 1)	Batch Organics Extraction Unit	CF Systems Corporation Arvada, CO L.V. Benningfield 303-420-1550	Demonstration	Completed
	New Bedford, MA (Region 1)	Solvent Extraction	CF Systems Corporation Arvada, CO L.V. Benningfield 303-420-1550	Demonstration	Completed 1988

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Massachusetts (continued)	North Dartsmouth, MA Resolve Superfund Site (Region 1)	Thermal Desorption	OHM Environmental (formerly Chemical Waste Management Inc.) Lombarda, IL Dick Ayen 803-846-2413	Demonstration	Completed 1992
Michigan	Adrian, MI Anderson Development (Region 5)	Thermal Desorption (physical)	Roy F. Weston, Inc. West Chester, PA Michael Cosmos 215-430-7423	Demonstration	Completed 1992
	Bay City, MI Bay City Municipal Landfill (Region 5)	Thermal Gas Phase Reduction Process and Thermal Desorption	ELI Eco Logic International, Inc. Rockwood, Ontario, Canada Jim Nash 519-856-9591	Demonstration	Completed 1992
	Buchanan, MI Electro-Voice (Region 5)	Subsurface Volatilization and Ventilation System (SVVS)	Billings & Associates, Inc. Albuquerque, NM Gale Billings 505-345-1116	Demonstration	Completed 1994
	Detroit, MI (Region 5)	Debris Washing System	U.S. EPA/ NRMRL Cincinnati, Ohio Donald Sanning 513-569-7444	Demonstration	Completed 1990
	Essexville, MI Saginaw Bay Confined Disposal Facility (Region 5)	Sediment Soil Washing	Bergmann, USA Gallatin, TN George Jones 615-230-2217	Demonstration	Completed 1992
	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

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Michigan (continued)	St. Joseph, MI	Submerged Aerobic Fixed Film Reactor	Allied Signal Corporation Des Plains, IL Steve Lupton 708-391-3500	Demonstration	Completed
Minnesota	McGillis & Gibbs Superfund Site New Bridge, MN (Region 5)	Biotreatment of Groundwater	BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032	Demonstration	Completed 1989
	McGillis & Gibbs Superfund Site New Bridge, MN (Region 5)	Soil Washing	BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032	Demonstration	Completed 1989
	McGillis & Gibbs Superfund Site New Bridge, MN (Region 5)	Biological Aqueous Treatment System	BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032	Demonstration	Completed 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 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
	St. Louis Park, MN (Region 5)	Bioventing (air-injection)	U.S. EPA/NRMRL Cincinnati, OH Paul McCauley 513-569-7444	Demonstration	Completed 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

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Montana	Butte, MT Butte-Silverbow Site (Region 8)	Plasma Heat	Retech, Inc. Ukiah, CA R.C. Eschenback 707-462-6522	Demonstration	Completed 1991
	Butte, MT (Region 8)	Chemical Stabilization of Mercury Mining Waste	E&C Williams, SC Charlie Williams 843-821-4200 and Keeco, WA Amy Anderson 888-977-9156	Demonstration	Completed 2001
	Mike Horse Mine, MT (Region 8)	Grouting Technique	Morrison Knudsen Corporation Boise, ID Kathryn Levihn Rick Raymondi 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 Tom Yergovich 209-858-2511	Demonstration	Completed 1994
Nebraska	Hastings, NE (Region 7)	Spray Irrigation	University of Nebraska-Lincoln Hasting, NE Ray Spalding 402-783-3931	Demonstration	Completed 1996
Nevada	Battle Mountain, NV (Region 9)	Biodegradation of Cyanide	Pintail Systems, Inc. Aurora, CO Caren Caldwell 303-367-8443	Demonstration	Completed 1998
New Hampshire	Milford, NH Savage Superfund Site (Region 1)	Surfactant Enanced Aquifer Remediation	U.S. DOE. Duke Engineering G. Michael Shook 208-526-6945	Demonstration	Completed 1999
	Plaistow, NH (Region 1)	Biodegradation of PCB's in Soils	Green Mountain Laboratories Montpelier, VT Adam Longee 802-223-1468	Demonstration	Completed 2000
New Jersey	Edison, NJ EPA (Region 2)	Solvent Extraction Carver-Greenfield Process	Dehydro Tech Corporation East Hanover, NJ Theodore Trowbridge 908-904-1606	Demonstration	Completed 1991

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
New Jersey (continued)	Hillsborough, NJ (Region 2)	Pneumatic Fracturing, Extraction and Hot Gas Injection	Accutech, Inc. Keyport NJ & New Jersey Institute of Technology, Newark, NJ John Liskowitz 908-739-6444	Demonstration	Completed 1992
	Millville, NJ Nascoilte Site (Region 2)	Bioreactor Integrated with an Ultrafiltration Membrane System	Zenon Environmental, Inc. Burlington, Ontario, Canada Lisa Ashton 905-639-6320 ext. 244	Demonstration	Completed 1995
	Millville, NJ Nascoilte Site (Region 2)	ZenoGem Process	Zenon Environmental, Inc. Burlington, Ontario, Canada Chris Lipski 905-639-6320	Demonstration	Completed
	Morganville, NJ Imperial Oil Co., Inc. Site (Region 3)	Solidification	Solidtech, Inc. Houston, TX Bill Stallworth 713-497-8558	Demonstration	Completed 1988
	Pedricktown, NJ National Lead Industries (Region 2)	Removal of Dissolved Metals	Dynaphore/ Forager Sponge Richmond, VA Norman Rainer 804-288-7109	Demonstration	Completed 1994
	Trenton, NJ (Region 2)	Phytoextraction of Metal from Soil	Phytotech, Inc. Monmouth, NJ Burt Ensley 908-438-0900	Demonstration	Completed 1998
	Wayne, NJ (Region 2)	Ex-situ Metal-enhanced Abiotic Degredation	EnviroMetal Technologies, Inc. Guelph, Ontario William Matulewicz 609-722-6700	Demonstration	Completed 1995
New Mexico	Albuquerque, NM (Region 6)	Electrokenitic Extraction in Unsaturated Soils	Sandia National Laboratories, Albuquerque, NM Eric Lindgren 505-844-3820	Demonstration	Completed 1999

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
New York	Brant, NY Wide Beach (Region 2)	Thermal Desorption Dechlorination	SoilTech, ATP Systems, Inc. Porter, IN Joe Hutton 219-926-8651	Demonstration	Completed 1992
	Brockport, NY Sweden-3 Chapman Site (Region 2)	Biovault, Bioventing and Groundwater Circulation Biological Treatment Process (multi-developer project)	NY State Bioremediation and SBP Technologies, Inc. White Plains, NY Clayton Page 504-755-7711	Demonstration	Completed 1995
	Niagara Falls, NY (Region 2)	Cold Top Vitrification	New Jersey Institute of Technology (NJIT) Newark, NJ and Geo Tech Development Corporation, King of Prussia, PA William Librizzi 201-596-5846 Thomas Tate 610-337-8515	Demonstration	Exited
	Upstate NY (Region 2)	In-situ Metal-enhanced Abiotic Degredation	EnviroMetal Technologies, Inc. Guelph, Ontario John Vogan 519-824-0432	Demonstration	Completed
	Utica, NY (Region 2)	High Temperature Thermal Processor	Maxymillian Technologies, Inc. (Formerly Clean Berkshires) Lanesboro, MA Jim Maxymillian 413-499-3050	Demonstration	Completed 1993
	Utica, NY Town Gas Site (Region 2)	Slurry Biodegradation	Remediation Technologies Inc. (ReTec) (formerly Mo Tec Inc.) Pitsburgh, PA David Nakles 412-826-3340	Demonstration	Completed 1991

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
North Carolina	Morrisville, NC Koppers Site (Region 4)	Base-Catalyzed Destruction (Dehalogenation)	U.S. EPA/ NRMRL Cincinnati, OH George Huffman 513-569-7341 Environmental Inc. Blue Bell, PA Yei-Shong Shieh 215-832-0700	Demonstration	Completed 1993
Ohio	Aliance, OH Babcock & Wilcox Alliance Research Center (Region 5)	Cyclone Vitrification	Babcock & Wilcox Alliance Research Center Alliance, OH Lawrence King 216-829-7576	Demonstration	Completed 1991
	Cincinnati, OH EPA T&E Facility (Region 5)	Bioslurry Reactor	ECOVA Corporation Redmond, WA Alan Jones 206-883-1900	Demonstration	Completed 1991
	Crooksville, OH Pintail Systems, Inc. (Region 5)	Biostabilization of Lead	Pintail Systems, Inc. Aurora, CO Leslie Thompson 303-367-8443	Demonstration	Completed 2000
	Dayton, OH (Region 5)	Hydraulic Fracturing	U.S. EPA/ NRMRL Cincinnati, OH William Slack 513-469-6040	Demonstration	Completed 1992
	DOE Fernald Facility, OH (Region 5)	Solvent Extraction	Terra Kleen Corporation (name changed back from Sevenson Extraction Technology, Inc.) Del Mar, CA Alan Cash 619-558-8762	Demonstration	Completed 1997
	Roseville/ Crooksville, OH	Envirobond Soil Amendment (Stabilization)	Rocky Mountain Remedation Services Jim Barthel 303-215-6620	Demonstration	Completed
	Roseville/ Crooksville, OH	Injection Soil Amendment (Stabilization)	Star Organics Phil Clarke 214-522-0742	Demonstration	Completed

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Oregon	Clackamas, OR Portable Equipment Co. Site (Region 10)	Chemical Fixation/ Stabilization	Advanced Remediation Mixing, Inc. (formerly Chemfix Technologies, Inc.) Metarie, LA Sam Pizzitola 504-461-0466	Demonstration	Completed 1989
Pennsylvania	Douglassville, PA (Region 3)	Solidification/ Stabilization	Hazcon and Funderburk & Associates) Apollo Beach, FL Ray Funderburk 813-645-9620	Demonstration	Completed 1987
	Monaca, PA	Flame Reactor	Horsehead Resource Development Co., Inc. Regis Zagrocki 610-826-8810	Demonstration	Completed
	Palmerton, PA Palmerton Zinc Pile (Region 3)	Membrane Microfiltration	E.I. DuPont DeNemours & Company Newark, DE Oberlin Filter Company Waukesha, WI Ernest Mayer 302-774-2277	Demonstration	Completed 1990
	Stroudsburg, PA (Region 3)	Contained Recovery of Oil Wastes	Western Research Institute Laramie, WY James Speight 307-721-2011	Demonstration	Completed 1997
Rhode Island	Central Landfill, RI (Region 1)	Reverse Osmosis: Disc-Tube Module Technology	ROCHEM Separations, Inc. Torrence, CA David LaMonica 310-370-3160	Demonstration	Completed 1994
	N. Smithfield, RI (Region 1)	AIR II Photocatalytic Technology for Air Streams	KSE, Inc. Amhurst, MA James Kittrell 413-549-5506	Demonstration	Completed 1999

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
South Carolina	Savannah River Site, SC (Region 4)	High Energy Irradiation for Destruction of Organics in Aqueous Solutions and Sludge	High Voltage Environmental Application, Inc. Florida and International University Miami, FL William Cooper 910-962-3450	Demonstration	Completed 1994
Tennessee	Oak Ridge, TN (Region 4)	Photocatalytic Aqueous Phase Organics Destruction Matrix	Matrix, Inc. London, ON Robert Henderson 519-660-8669	Demonstration	Completed 1995
	Oak Ridge, TN DOE Oak Ridge Facility (Region 4)	Freeze Barrier	Arctic Foundations Anchorage, AK Ed Yarmak 907-562-2741	Demonstration	Completed 1998
Texas	Fort Worth, TX Carswell AFB (Region 6)	Phytoremediation of TCE in Groundwater	ASC/EMR Wright Patterson AFB Dayton, Ohio Greg Harvey 513-255-7716	Demonstration	Completed 1998
	Goldthwaite, TX Lower Colorado River Authority Electrical Substation	Microbial Degradation/ Solvant Extraction	Envirogen, Inc. Lawrenceville, NJ Ronald Unterman 609-936-9300	Demonstration	Completed 2000
	Goldthwaite, TX (Region 6)	Microbial Degradation of PCBs	Micro-BAC Int., TX 512-310-9000 X-19 Biological Products, CA 408-970-9485	Demonstration	Completed 2002
	San Antonio, TX Kelly AFB (Region 6)	Hot Air Injection	Hrubetz Evironmental Services, Inc. Dallas, TX Michael or Barbara Hrubetz 214-363-7833	Demonstration	Completed 1993

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Texas (continued)	San Antonio, TX Kelly AFB (Region 6)	Radio-frequency Heating	IITRI/NUS IITRI-Chicago, IL and Haliburton/ NUS Oak Ridge, TN Clifford Blanchard 615-483-9900	Demonstration	Completed 1994
	San Antonio, TX Kelly AFB (Region 6)	Radio-frequency Heating	KAI/HNUS Oak Ridge, TN Cliff Blanchard 615-483-9900	Demonstration	Completed 1994
Utah	Hill AFB, UT (Region 8)	Steam Injection/ Vacuum Extraction	Praxis Environmental Services San Francisco, CA Dr. Lloyd Steward 415-641-9044	Demonstration	Completed 1997
	Midvale Slag, UT	Molecular Bonding System	Solucorp Saddleback, NJ Robert Kuhn 914-623-2333	Demonstration	Completed
	Ogden, UT Chevron Transfer Facility (Region 8)	Phytoremediation of Petroleum in Soil and Groundwater	Phytokinetics, Inc. Logan, UT Ari Ferro 801-750-0985	Demonstration	Completed 1999
Virginia	Roanoke, VA ITT Night Vision Facility (Region 3)	Enhanced In-situ Bioremediation of Chlorinated Compounds	ITT Industries Roanoke, VA Rosann Kryczkowski 540-362-7356	Demonstration	Completed 1999
Washington	Ellensburg, WA (Region 10)	Anaerobic Biological Destruction of Dinoseb in Soil	J. R. Simplot Company Pocatello, ID Tom Yergovich 209-858-2511	Demonstration	Completed July 1993
	Whatcom Waterway Bellingham, WA	Electrochemical Geooxidation	Weiss Associates Joe Lovenitti	Demonstration	Ongoing
	Ridgefield, WA (Region 10)	Steam Enhanced Remediation	Steam Tech Environmental Services Bakersfield, CA Hank Sowers 661-322-6478	Demonstration	Ongoing

TECHNOLOGY DEMONSTRATION SITES - BY SITE STATE (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Wisconsin	Fox River, WI (Region 5)	Thermal Sediment Reuse Technology	Minergy, WI Terry Carroll 920-727-1411	Demonstration	Completed 2001
	Green Bay, WI (Region 5)	AMS Split Core Sampler	Art's Manufacturing and Supply ID Brian Anderson 800-635-7330	Monitoring and Measurement	Completed 1999
	Green Bay, WI (Region 5)	Russian Peat Borer	Aquatic Research Instruments ID Will Young 208-768-2222	Monitoring and Measurement	Completed
	Sparta, WI U.S. DOD Fort McCoy (Region 5)	MAECTITE® Treatment Process	Sevenson Environmental Services, Inc. Munster, IN Chuck McPheeters 219-836-0116	Demonstration	Completed 2000
	Jones Island CDF Milwaukee, WI (Region 5)	Phytoremediation	Army Corps of Engineers (Vicksburg, MS and Detroit MI)	Demonstration	Ongoing
Various locations in U.S.	10 sites around the nation	Alternate Cover Assessment Program (ACAP)	U.S. EPA NRMRL	Demonstration	Completed 2001
Canada	Toronto, Canada Toronto Port Industrial Division	Treatment Train for Contaminated Soils	Toronto Harbor Commissioners Toronto, Canada Dennis Lang 416-863-2047	Demonstration	Completed 1992
	Trenton, Ontario Domtar Wood Preserving Site	Bioremediation	GRACE Bioremediation Technologies Mississauga, Ontario, Canada Alan Seech 905-272-7480	Demonstration	Completed 1994

Appendix C

ELECTRONIC TECHNICAL INFORMATION RESOURCES

CONTENTS

Section **Page**

REMEDIATION TECHNOLOGIES C-3

Electronic Information Sources C-3

Innovative Remediation Technologies: Field-Sectors Demonstration Projects in North America, Second Edition and Database C-3
Hazardous Waste Clean-Up Information (CLU-IN) Home Page C-3
Innovative Treatment Technologies: Annual Status Report (Tenth Edition) EPA 542/R-01-004 . . . C-3
EPA Technologies (EPA REACH IT). C-3
Site Remediation Technology Infobase. C-3
Cost and Performance Catalog of Case Studies C-4
Remediation Technologies Screening Matrix and Reference Guide, Version 3.0 . . . . . C-4
TechDirect. C-4

Programs, Partnerships, And Organizations C-4

EPA Library Network Program C-4
Federal Remediation Technologies Roundtable (FRTR) C-4
Ground-Water Remediation Technologies Analysis Center (GWRTAC) C-4
Office of Research and Development (ORD) C-4
Remediation Technologies Development Forum (RTDF) C-5
Superfund Innovative Technology Evaluation (SITE) Demonstration Program C-5
Interstate Technology Regulatory Cooperative (ITRC)
Technology Innovation Program (TIP) C-5

SITE CHARACTERIZATION TECHNOLOGIES C-5

Electronic Sources of Information C-5

EPA, National Exposure Research Laboratory - Hazardous Waste
Site Characterization (on CD-ROM) (EPA 600-C-96-001) C-5
Field Sampling and Analysis Technologies Matrix C-6
TechDirect C-6

Programs, Partnerships, and Organizations C-6

Consortium for Site Characterization and Technology (CSCT) C-6
Environmental Technology Verification Program C-6
EPA Library Network Program C-6
Office of Research and Development (ORD) C-6
Superfund Innovative Technology Evaluation (SITE) Demonstration Program C-6
Technology Innovation Program (TIP) C-7

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

Innovative Remediation Technoliges: Field-Scale Demonstration Projects in North America, Second Edition and Database. The searchable database contains information about 600 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. A summary report, EPA 542-B00/004 of the same name is available from EPA's National Service Center for Environmental Publications or accessed free of charge from the CLU-IN Internet site at ***<http://clu-in.org/products/nairt>***.

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) 589-5318. CLU-IN can be accessed through the Internet at ***<http://clu-in.org>***.

Innovative Treatment Technologies: Annual Status Report (ASR) Eleventh Edition EPA/542/R-03/009 and ASR Search System. This report 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 ASR online site cleanup information system includes Superfund site-specific data such as remedy selected, contaminants and media treated, project status, and site contact. The online database is available at http://cfpub.epa.gov/asr. If you have questions or comments about the system, please call EPA's TIP at (703) 603-9904. The report can be ordered or downloaded free of charge from the CLU-IN Internet site at <http://clu-in.org/asr>. To order a copy of the report by phone, call EPA's National Service Center for Environmental Publications at (800) 490-9198 or (513) 489-8190.

EPA Remediation and Characterization Innovative Technologies (EPA REACH IT). EPA REACH IT, sponsored by EPA's Technology Innovation Program (TIP), is a system that lets environmental professionals use the power of the Internet to search, view, download, and print information about innovative remediation and characterization technologies. EPA REACH IT provides information about more than 750 service providers that offer almost 1,300 remediation technologies and more than 150 characterization technologies. EPA REACH IT combines information from three established EPA databases, the Vendor Information System for Innovative Treatment Technologies (VISITT), the Vendor Field Analytical and Characterization Technologies System (Vendor FACTS), and the Innovative Treatment Technologies (ITT), to give users access to comprehensive information about treatment and characterization technologies and their applications. It combines information submitted by technology service providers about remediation and characterization technologies with information from EPA, the U.S. Department of Defense (DoD), the U.S. Department of Energy (DOE), and state project managers about sites at which innovative technologies are being deployed. EPA REACH IT can be accessed through the Internet at ***<http://www.epareachit.org>***. It is best viewed using Netscape Navigator or Microsoft Internet Explorer, version 4.0 or higher.

Site Remediation Technology Infobase. The Site Remediation Technology Infobase was founded by EPA and prepared for the federal agencies participating in the Federal Remediation Technologies Roundtable. It provides information on federal cleanup programs; federal site remediation technology development assistance programs, and databases; federal electronic resources for site remediation; other electronic resources for site remediation technology information; a bibliography of selected federal

publications on alternative and innovative site remediation technologies; technology survey reports; and technology program contacts for DOD, DOE, and EPA. It can be accessed through the Internet at: <http://www.frtr.gov/publications/infobse/98.html>.

Cost and Performance Catalog of Case Studies. The Cost and Performance Catalog of Case Studies is a joint effort of Federal Remediation Technologies Roundtable members to publish case study reports on full- and demonstration-scale remediation projects. As of May 2001, member agencies of the Roundtable have completed 274 cost and performance case study reports. The reports (March 1995-May 2001) can be accessed by the Cost and Performance Case Studies Search: ***<http://bigisland.ttclients.com/frtr/search.html>.***

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 TIP, 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. 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 Heimerman 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>.***

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, Paul Gilman, 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>.**

Interstate Technology and Regulatory Council (ITRC). ITRC is a state-led coalition working together with industry an stakeholders to achieve regulatory acceptance of environmental technologies. ITRC consists fo more than 35 states, the District of Columbia, multiple federal partners, industry participants, and other stakeholders, cooperation to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. Originating in 1995 from a previous initiative by the Western Governors Association (WGA). ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and streamline the regulation of new environmental technologies. ITRC accomplishes its mission in two ways: it develops guidance documents and training courses to meet the needs of both regulators and environmental consultants, and it works with state representatives to ensure that ITRC products and services have maximum impact among state environmental agencies and technology users. ITRC technical work teams develop guidance documents and both classroom and Internet-based training courses to meet the information needs of regulatory staff, technology vendors, and environmental consultants. These products help state environmental agencies gain valuable technical knowledge and develop consistent regulatory approaches for reviewing and approving specific technologies. State regulators lead ITRC technical teams, which rely on broad-based participation from federal agencies, industry, academia, and other stakeholders in building collective knowledge and collaborative products. ITRC can be accessed through the Internet at ***<http://www.itrcweb.org>.***

Technology Innovation Program (TIP). The U.S. Environmental Protection Agency's (EPA) TIP was created in 1990 to act as an advocate for new technologies. TIP's mission is to increase the application of innovative treatment technologies to contaminated waste sites, soils, and groundwater. To meet that mission, TIP has expanded its focus from treatment technologies to include site characterization technologies in order to improve the remediation process. TIP 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 TIP, contact Jeff Heimerman of EPA's TIP at (703) 603-7191. TIP can be accessed through the Internet at
<http://clu-in.org/tiomiss.cfm>.

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>***.

TechDirect. TechDirect, hosted by EPA's TIP, is an information service that highlights new publications and events of interest to environmental professionals. Information about site characterization and remediation technologies are 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/tech.drct>***.

Programs, Partnerships, and Organizations

Consortium for Site Characterization and Technology (CSCT). CSCT was established as one of 12 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>***.

Office of Research and Development (ORD). ORD, under the Assistant Administrator, Paul Gilman, 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/>***.

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 Program (TIP). The U.S. Environmental Protection Agency's (EPA) TIP was created in 1990 to act as an advocate for new technologies. TIP's mission is to increase the application of innovative treatment technologies to contaminated waste sites, soils, and groundwater. To Meet that mission, TIP has expanded its focus from treatment technologies to include site characterization technologies in order to improve the remediation process. TIP 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 TIP, contact Jeff Heimerman of EPA's TIP at (703) 603-7191. TIP can be accessed through the Internet at ***<http://clu-in.org/tiomiss.cfm>***.

Appendix D

GLOSSARY OF REMEDIATION TECHNOLOGIES

This Appendix presents definitions and brief discussions of the innovative remediation technologies mentioned in the text of this Annual SITE Report. Established/conventional technologies (including pump and treat, stabilization, vitrification, incineration, and excavation/disposal) are being replaced by these state-of-the-art, typically more cost-effective technologies are also presented.

Innovative Remediation Technologies

BIOREMEDIATION uses microorganisms to degrade organic contaminants in either excavated or in situ soil, sludge, and solids. The microorganisms break down contaminants by using them as a food source or cometabolizing them with a food source. Land farming, biopiles, composting, and slurry-phase bioremediation are examples of ex situ applications. Bioventing is a common form of in situ bioremediation which uses extraction wells to circulate air through the ground, sometimes also pumping air into the ground.

CHEMICAL TREATMENT, also known as chemical reduction/oxidation, typically converts hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, or inert. The oxidizing agents most commonly used for treatment of hazardous contaminants in soil are ozone, hydrogen peroxide, hypochlorites, chlorine, chlorine dioxide, potassium permanganate, and Fentons reagent (hydrogen peroxide and iron). Cyanide oxidation and dechlorination are examples of chemical treatment. This method may be applied in situ or ex situ, to soils, sludges, sediments, and other solids, and may also be applied for the in situ treatment of groundwater.

IN SITU SOIL FLUSHING: large volumes of water, at times supplemented with surfactants, cosolvents, or treatment compounds, are applied to the soil or injected into the groundwater to raise the water table into the contaminated soil zone. Injected water and treatment agents are isolated within the underlying aquifer and recovered together with flushed contaminants.

PHYTOREMEDIATION is a process that uses plants (roots, shoots, tissues, and leaves) to remove, transfer, stabilize, or destroy contaminants in soil, sediment, and groundwater. Phytoremediation applies to all biological, chemical, and physical processes that are influenced by plants and that aid in cleanup of the contaminated substances. Plants can be used in site remediation, both through the mineralization of toxic organic compounds and through the

accumulation and concentration of heavy metals and other inorganic compounds from soil into aboveground shoots. Phytoremediation may be applied in situ or ex situ, to soils, sludges, sediments, other solids, or groundwater.

DUAL-PHASE EXTRACTION, also known as multi-phase extraction, uses a vacuum system to remove various combinations of contaminated groundwater, separate-phase petroleum product, and vapors from the subsurface. The system lowers the water table around the well, exposing more of the formation. Contaminants in the newly exposed unsaturated zone are then accessible to soil vapor extraction. Once above ground, the extracted vapors or liquid-phase organics and ground water are separated and treated.

SOLIDIFICATION/STABILIZATION (S/S) reduces the mobility of hazardous substances and contaminants in the environment through both physical and chemical means. The S/S process physically binds or encloses contaminants within a stabilized mass. S/S is performed both ex situ and in situ. Ex situ S/S requires excavation of the material to be treated, and the resultant material must be disposed. In situ S/S uses auger/caisson systems and injector head systems to add binders to the contaminated soil or waste without excavation, and the resultant material is left in place.

SOLVENT EXTRACTION uses an organic solvent as an extractant to separate organic and metal contaminants from soil. The organic solvent is mixed with contaminated soil in an extraction unit. The extracted solution is then passed through a separator, where the contaminants and extractant are separated from the soil. Organically bound metals may be extracted along with the target organic contaminants.

IN SITU THERMAL DESORPTION: wastes are heated so that organic contaminants and water volatilize. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a gas treatment system.

THERMALLY ENHANCED RECOVERY uses heat to increase the volatilization rate of organics and facilitate extraction. Volatilized contaminants are typically removed from the vadose zone using soil vapor extraction. Specific types of these thermally enhanced recovery techniques include Contained Recovery of Oily Waste (CROW™), radio frequency heating, conductive heating, steam heating, in situ steam stripping, hot air injection, dynamic underground stripping, in situ thermal desorption, and electrical resistance heating. Thermally enhanced recovery is usually applied to contaminated soil, but may also be applied to

groundwater.

VITRIFICATION uses an electric current to melt contaminated soil at elevated temperatures (1,600 to 2,000°C or 2,900 to 3,650°F). Upon cooling, the vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock. The high temperature component of the process destroys or removes organic materials. Radionuclides and heavy metals are retained within the vitrified product. Vitrification may be conducted in situ or ex situ.

TREATMENT BARRIERS, also known as permeable reactive barriers (PRBs) or passive treatment walls, are installed across the flow path of a contaminated groundwater plume, allowing the water portion of the plume to flow through the wall. These barriers allow the passage of water while prohibiting the movement of contaminants by employing agents within the wall such as zero-valent metals, chelators, sorbents, and microbes. The contaminants are either degraded or retained in a concentrated form by the barrier material, which may need to be replaced periodically.

Conventional Remediation Technologies

AIR SPARGING involves the injection of air or oxygen through a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes volatile and semivolatile organic contaminants by volatilization. Soil Vapor Extraction is usually implemented in conjunction with air sparging to remove the generated vapor-phase contamination from the unsaturated zone. Oxygen added to the contaminated groundwater and vadose-zone soils also can enhance biodegradation of contaminants below and above the water table.

EX SITU THERMAL DESORPTION: wastes are heated so that organic contaminants and water volatilize. Typically, a carrier gas or vacuum system transports the volatilized water and organics to a gas treatment system.

SOIL VAPOR EXTRACTION (SVE) is used to remediate the zone of soil which is unsaturated with contaminated groundwater. A vacuum is applied to the soil to control the flow of air and remove volatile and some semivolatile organic contaminants from the soil.

For SOIL WASHING, contaminants are absorbed onto fine soil particle surfaces are separated from bulk soil in a water-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, or chelating agent or by adjustment of

pH to help remove organics and heavy metals. Soils and wash water are mixed ex situ in a tank or other treatment unit. The wash water and various soil fractions are usually separated using gravity settling.

VERTICAL ENGINEERED BARRIERS (VEBs) are subsurface barriers made of an impermeable material designed to contain or divert groundwater. VEBs can be used to contain contaminated groundwater, divert uncontaminated groundwater from a contaminated area, or divert contaminated groundwater from a drinking water intake or other protected resource.

INCINERATION involves the ex situ destruction of contaminated soil, sludge, and sediment in high temperature (1,800 - 2,200°F) combustion devices. A typical hazardous waste incinerator, diagrammed below, consists of a rotary kiln (primary combustion chamber), an afterburner (secondary combustion chamber), connected to an air pollution control system, all of which are controlled and monitored.

PUMP-AND-TREAT involves removal of contaminated groundwater is from the subsurface treatment, and discharge or reinjection, is one of the most widely used ground-water remediation technologies. The pump and treat remediation approach is used at about three-quarters of the Superfund sites where ground water is contaminated and at most sites where cleanup is required by the Resource Conservation and Recovery Act and state laws. It is often associated with treatment technologies such as Air Stripping and Liquid -phase Granular Activated Charcoal. Although the effectiveness of pump and treat systems has been called into question after two decades of use, this approach remains a necessary component of most ground-water remediation efforts and can be appropriate for both restoration and plume containment.

United States
Environmental Protection
Agency

Office of Research and Development
National Risk Management
Research Laboratory
Cincinnati, OH 45268

PRESORTED STANDARD
POSTAGE & FEES PAID
EPA
PERMIT No. G-35

Official Business
Penalty for Private Use
$300

EPA/540/R-04/505
August 2004
www.epa.gov

Recycled/Recyclable
Printed with vegetable-based ink on
paper that contains a minimum of
50% post-consumer fiber content
processed chlorine free