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The Superfund Innovative Technology Evaluation Program:

Progress and Accomplishments Fiscal Year 1988

A Second Report to Congress

SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION

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March 1989

THE SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION PROGRAM

PROGRESS AND ACCOMPLISHMENTS
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U.S. Environmental Protection Agency
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PREFACE

This document is the second Report to Congress on the Superfund Innovative Technology Evaluation (SITE) Program. This report summarizes the progress, accomplishments, and results of the SITE Program through 1988. Although this report is similar in format to the first SITE Report to Congress there are some significant differences. The first Report to Congress covered the progress of only three components of the program because it was published prior to the implementation of the other components. In addition, the report was published prior to the completion of the program's first technology demonstration so no results were available. Field demonstrations for eight projects have been completed since publication of the first report. The second Report to Congress focuses on the completed demonstrations and provides performance data and results. The process used to assess the economic feasibility of each demonstration is presented. Specific cost information for the completed demonstrations will be presented in the Demonstration and Applications Analysis Reports as they become available. This report also describes the progress of the components that were initiated during the first year of the program and the two components implemented during this past year. Another difference between the two reports is that the second Report to Congress identifies the impediments encountered during the first two years of the program and describes the refinements that EPA has implemented to address these problems and improve the effectiveness of the SITE Program.

CONTENTS

EXECUTIVE SUMMARY vi

I. INTRODUCTION 1-1

A. Statutory Authority 1-1

B. Historical Perspective 1-2

C. SITE Program Components 1-3
1. SITE Demonstration Program 1-3
2. Emerging Technologies Program 1-4
3. Technology Transfer Program 1-4
4. Measurement and Monitoring Technologies Development Program 1-4
5. Innovative Technologies Program 1-5

II. THE SITE DEMONSTRATION PROGRAM 2-1

A. SITE Implemention Process 2-1
1. Selection of Technologies 2-1
2. Selection of Demonstration Sites 2-2
3. Negotiation of Cooperative Agreements 2-3
4. Community Relations Activities 2-3
5. Demonstration Planning Process 2-4
6. Reporting Results 2-4

B. Demonstration Program Progress and Accomplishments 2-5
1. Completed Demonstration Projects 2-5
2. Other Demonstration Projects 2-14
3. Future Activities of the Demonstration Program 2-23
4. Estimating Implementation Costs 2-24

C. Refinement of the Demonstration Process 2-26
1. Technology Selection 2-26
2. Site Selection 2-28
3. Demonstration Planning and Implementation 2-28
4. Reporting Activities 2-29
5. Management of SITE Projects 2-29
6. Financial Impediments 2-30

III. OTHER SITE PROGRAM COMPONENTS 3-1

A. Emerging Technologies Program 3-1

B. Technology Transfer Program 3-2

C. Measurement and Monitoring Technologies Development Program 3-6

D. Innovative Technologies Program 3-7

APPENDICES:
1. Sample Technology Fact Sheets
2. List of Acronyms, Abbreviations, and Trade Names

EXECUTIVE SUMMARY

The Superfund Amendments and Reauthorization Act of 1986 (SARA) directs the Environmental Protection Agency (EPA) to establish an "Alternative or Innovative Treatment Technology Research and Demonstration Program" and to submit an annual report to Congress describing the progress and results of this program. In response to this mandate, EPA established the Superfund Innovative Technology Evaluation (SITE) Program to: (1) accelerate the development, demonstration, and use of new or innovative treatment technologies and (2) demonstrate and evaluate new, innovative measurement and monitoring technologies. The strategy and program plan for the SITE Program was published in December 1986, and the progress and accomplishments of the program were first reported to the United States Congress in February 1988.

This document is the second report to Congress on the progress and results of the SITE Program. This report presents a brief history of the program and the statute that authorized its establishment. The report includes an overview of the five components of the SITE Program, and describes the process, progress, results, and future activities for each of the components. The major highlights for each component are listed below.

SITE Demonstration Program. The demonstration program was established to develop extensive performance engineering and representative cost information on innovative alternative technologies for use in remediation decision-making for hazardous waste sites.

The 30 technologies presently active in the SITE Demonstration Program represent five process categories. There are currently eight thermal, four biological, six solidification/stabilization, three chemical, and six physical technologies in the program. In addition, three technologies use combined processes to treat wastes. To date, eight technology field demonstrations have been completed, and the results described.

With each solicitation cycle there has been a trend toward the selection of new technological processes (particularly biological and chemical) and technologies combining unit processes to form treatment trains. In the recent SITE-004 solicitation, the EPA targeted technologies capable of treating specific waste types (i.e., soils and sludges, and mixed wastes containing low-level radioactive material), those with materials handling capabilities, and those that can be combined to form treatment trains.

Future efforts will continue to inform new technology innovators of the program and to encourage their participation. The focus in the upcoming year will be the field demonstrations of approximately 17 technologies currently active in the SITE Program. Further efforts will be directed to expediting the report preparation process and providing interim reports of demonstration data through the Clearinghouse.

This report also addresses some of the refinements to the SITE Demonstration Program that EPA has implemented to enhance the program's success. Five areas of the demonstration process have been enhanced, including technology selection, site selection, demonstration planning and implementation, reporting activities, and the management of SITE projects. Refinement of these areas has included the establishment of policies, guidelines, and procedures designed to address the impediments encountered during the first two years of the program. The report also addresses the financial impediments that impact the program over which EPA has limited control.

Emerging Technologies Program. This program performs laboratory pilot-and bench-scale evaluations of technologies that are not yet ready for field demonstration. This "feeder" program to the Demonstration Program assures that technologies can be tested early in their development.

In September 1988, seven technologies were selected as a result of the E- 01 solicitation. First-year funding for

these projects totalled approximately $1,000,000. Five of these technologies are rapidly progressing toward bench- scale testing and work is underway on pilot-scale units. The E-01 projects will be applying for second year funding.

The E-02 solicitation, issued in July 1988, focused on technologies that can handle complex mixes of organic and inorganic contaminants in sludge and soils by either in-situ or surface processes. Seventeen offerors were invited to participate in the Fiscal Year 1989 Cooperative Agreement application process to be completed by January 1989. Approximately $1,000,000 will be available for the first year of the E-02 emerging technology projects.

Technology Transfer Program. Comprised of numerous components that incorporate a variety of outreach activities, this program disseminates demonstration and waste remediation data from all components of the SITE Program to Regional and State managers of Superfund cleanup activities, Federal Agencies, the engineering community, related industries, and the public.

The success of this program is demonstrated by the selection of Terra- Vac's In-Situ Volatilization technology for remediation efforts in two states. Ten areas of outreach activities are described in detail.

Technology transfer activities will continue for the technologies that are currently in the program and will be initiated for the new technologies entering the program under the SITE-004 and E-02 solicitations.

Measurement and Monitoring Technologies Development Program. Designed to improve Superfund site characterization efforts, this component of the SITE Program is continually developing new and innovative measurement and monitoring technologies. Recent research activities have focused on immunoassays for toxic substances and fiber optic sensing for in-situ analysis.

The application of immunoassays to environmental monitoring has resulted in significant advances during Fiscal Year 1988. Cooperative and interagency agreements with numerous universities, state agencies, and private developers were initiated. Significant advances were also reported for the fiber optics development program and are described.

Future activities will continue to enhance Superfund site characterization efforts.

Innovative Technologies Program. Developed as an outgrowth of early R&D efforts, the Innovative Technologies Program promotes transfer of EPA developed technologies to the private sector for use at Superfund sites.

Research on several technologies for the onsite destruction and cleanup of hazardous waste, with emphasis on the treatment of excavated soils is under way. To date, seven technologies have been tested, and several have been evaluated in the field. Three of these technologies are ready to be transferred to the private sector for commercialization and were featured at the Innovative Technologies Program Exhibition in January 1989. This event marked the beginning of EPA's initiative to phase-out the Innovative Technologies Program. The program will continue to provide guidance and assistance to commercial developers relative to identifying specific needs at Superfund sites, to identify promising technological approaches not available commercially, and to transfer technology-related information to commercial suppliers and EPA Remedial Project Managers.

I. INTRODUCTION

A. STATUTORY AUTHORITY

The Superfund Amendments and Reauthorization Act of 1986 (SARA) (Section 209 (b)) amends Title III of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) by adding Section 311 which directs the Environmental Protection Agency to establish an "Alternative or Innovative Treatment Technology Research and Demonstration Program" and to submit a report to Congress annually on the progress and results of this program. As required in Section 311(e), this report presents the program's accomplishments through Fiscal Year 1988 and is the second annual report to Congress.

In response to SARA, EPA has established a formal program to (1) accelerate the development, demonstration, and use of new or innovative treatment technologies and (2) demonstrate and evaluate new, innovative measurement and monitoring technologies. This program is called the Superfund Innovative Technology Evaluation (SITE) Program. The strategy and program plan was published in December 1986, and the progress and accomplishments of the program were first reported to the United States Congress in February 1988 (*The Superfund Innovative Technology Evaluation Program Progress and Accomplishments: A Report to Congress;* EPA/540/5-88/001).

The overall goal of the SITE Program is to "carry out a program of research, evaluation, testing, development, and demonstration of alternative or innovative treatment technologies... which may be utilized in response actions to achieve more permanent protection of human health and welfare and the environment." Specifically, the goal of the program is to maximize the use of alternatives to land disposal in cleaning up Superfund sites by encouraging the development and demonstration of new, innovative treatment and monitoring technologies. SARA defines "alternative technologies" as "those technologies, including proprietary or patented methods, which permanently alter the composition of hazardous waste through chemical, biological, or physical means so as to significantly reduce the toxicity, mobility, or volume (or any combination thereof) of the hazardous waste or contaminated materials being treated. The term also includes technologies that characterize or assess the extent of contamination, the chemical and physical character of the contaminants, and the stresses imposed by the contaminants on complex ecosystems at sites." Under the SITE Program, alternative technologies are categorized by their development status as follows:

- *Available Alternative Technology.* Technologies, such as incineration, that are fully proven and in routine commercial or private use.

- *Innovative Alternative Technology.* Any fully developed technology for which cost or performance information is incomplete, thus hindering routine use at hazardous waste sites. An innovative alternative technology requires field-testing before it is considered proven and available for routine use.

- *Emerging Alternative Technology.* An emerging technology is one in an earlier stage of development; the research has involved laboratory testing and is being developed for pilot-scale testing prior to field testing at Superfund sites.

The commercialization process for alternative technologies, depicted in Exhibit I-1, illustrates the interrelationships of the phases of development and the technology categories.

The SITE Program assists technology developers in the development and evaluation of new and innovative treatment technologies, and thus enhances the eventual commercial availability and use of these technologies at hazardous waste cleanup sites as alternatives to land-based containment systems presently in use. The program consists of the following major objectives:

- To conduct and monitor demonstrations of promising innovative technologies to provide reliable performance and cost information for future site characterization and cleanup decision-making.
- To identify and remove informational impediments to the use of alternative technologies.
- To encourage the development of emerging technologies.

Section 121(b) of SARA states a preference for treatment technologies that permanently reduce the volume,

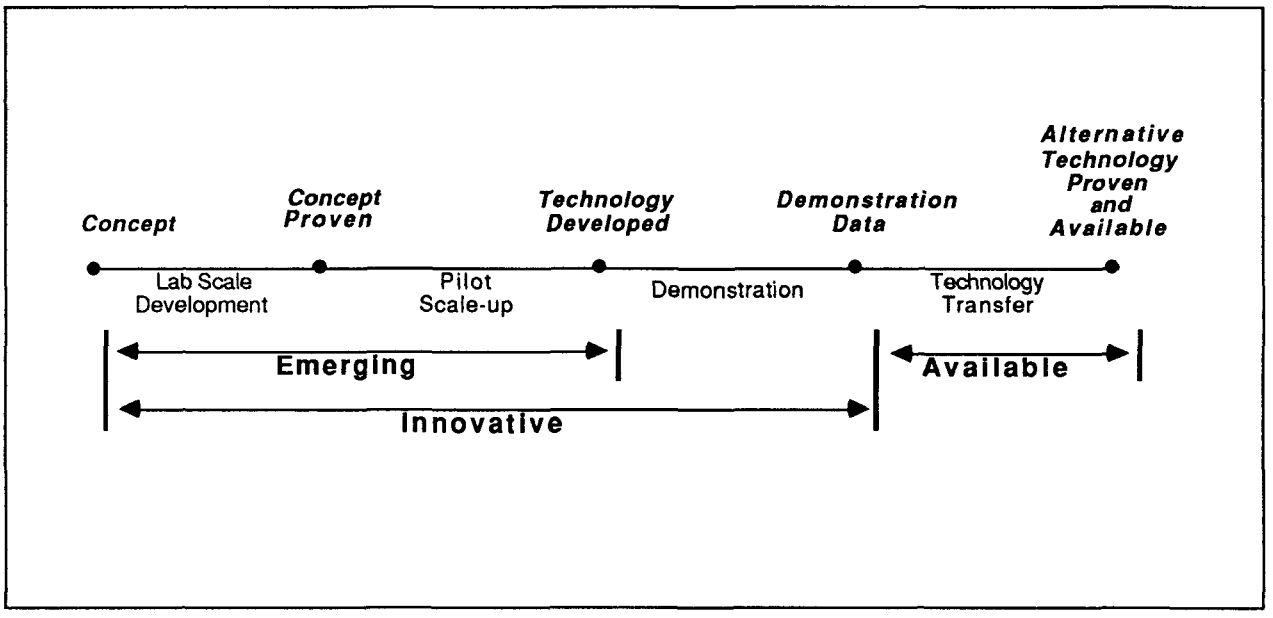


Exhibit I-1. Development process for alternative technologies.

toxicity, or mobility of the hazardous waste. Section 209(b) of SARA authorizes EPA to use hazardous waste from, or representative of, Superfund sites for alternative technology research and demonstrations.

The SITE Program also supports the testing and development of improved monitoring and measurement technologies to be used at Superfund sites. This component of the program is intended to improve capabilities in site assessment, measuring the extent of contamination, as well as measuring the effectiveness of a selected technology.

Recognizing that access to accurate, pertinent information is essential to the acceptance and use of alternative technologies, Section 311(b)(8) also directs EPA to ". . . conduct a technology transfer program including the development, collection, evaluation, coordination, and dissemination of information relating to the utilization of alternative or innovative treatment technologies for response actions . . ." The statute requires the Agency to establish and maintain a technology transfer program. As described in Section IIIB of this report, EPA has established a clearinghouse to ensure that program findings, as well as other treatability data, will be available to the Agency and other parties responsible for remediation activities at hazardous waste sites.

This report documents the progress made by the SITE Program through Fiscal Year 1988. It also summarizes activities planned for the future. The report includes the following:

- An overview of the development of the program and its components.
- A description of the process used for the technology demonstration program.
- A description of progress made by the program to date.
- A summary of activities planned for the future.

B. HISTORICAL PERSPECTIVE

Prior to the enactment of SARA, concern had been growing among the scientific community, citizens, and government officials over the effectiveness and cost of conventional methods for handling hazardous wastes at Superfund sites and the volume of hazardous waste being generated. Land disposal is not the best solution for much of the hazardous waste present at these sites. The need for reliable, low-cost treatment solutions has been stressed by studies and recent legislation. In addition to the preferences for waste treatment contained in SARA, the Hazardous and Solid Waste Amendments (HSWA) of 1984 (reauthorization of the Resources Conservation and Recovery Act) imposed additional prohibitions on land disposal of most hazardous wastes, effective August 8,

1988. These restrictions affect nearly one-third of all hazardous wastes regulated by EPA and will require treatment of many Superfund wastes that previously may have been placed untreated into land disposal units. Additional prohibitions on the second third of remaining wastes will be imposed on June 8, 1989. By May 8, 1990, the disposal of all hazardous wastes regulated by EPA under HSWA will be restricted.

The scientific and engineering communities recognized that the demand for treatment often exceeded the availability and capability of existing technologies. Studies have concluded that research, development, and demonstration (RD&D) devoted to innovative cleanup technologies were inadequate. The EPA Science Advisory Board also recommended embarking on a comprehensive research program to investigate more effective, permanent solutions.

In response to these growing concerns, EPA moved ahead in early 1986 to develop a technology demonstration program. A strategy was developed to lay out the problems, impediments, and possible solutions relative to the increased use of innovative treatment technologies at Superfund sites, prior to the enactment of SARA.

EPA advertised its first solicitation (SITE-001) for innovative treatment technology demonstration proposals in the *Commerce Business Daily* on February 13, 1986. This solicitation attracted 20 proposals ranging from containerization to incineration to robotics. As a result of this initial work on the program, when SARA was enacted in October 1986, EPA was able to respond with a program that was already in the planning stages, although funding had not been available.

C. SITE PROGRAM COMPONENTS

There are a number of impediments inhibiting the acceptance and use of alternative technologies for the treatment of hazardous wastes at Superfund sites. These technologies often have not had the opportunity to be proven effective on a commercial scale or have not been used for specific applications at hazardous waste sites. As a result, it is difficult to assure potentially responsible parties, site owners, and the affected community that technologies that have not undergone field-scale demonstration will be effective in remediating a site. A key component of the SITE Program is the removal of these informational impediments by supporting demonstrations that will provide reliable performance and cost data.

To foster this comprehensive program for the development and acceptance of new and improved technologies, the SITE Program includes the following five components:

- SITE Demonstration Program
- Emerging Technologies Program
- Technology Transfer Program
- Measurement and Monitoring Technologies Development Program
- Innovative Technologies Program.

1. SITE Demonstration Program

One of the most important aspects of the SITE Program is the evaluation of the demonstrations of full-scale technologies or pilot-scale technologies that can be scaled up for commercial use. The Demonstration Program is the primary focus of the SITE Program because these technologies are close to being available for selection in remediation of Superfund sites. The major objective of the SITE Demonstration Program is to develop extensive performance engineering and cost information on innovative alternative technologies so that they can be adequately considered in remediation decision-making for hazardous waste sites. The demonstrations are designed to provide information to assist potential users to make sound judgments as to the applicability of the technology for a specific site and to compare the technology's effectiveness and cost to other alternatives. The results of the demonstrations identify the limitations of the technology, the potential need for pre- and post-processing of wastes, the types of wastes and media to which the process can be applied, the potential operating problems, and the approximate capital and operating costs. The demonstrations also permit evaluation of long-term risks. Demonstrations usually occur at Superfund sites or under conditions that duplicate or closely simulate actual wastes and conditions found at Superfund sites to assure the reliability of the information collected and acceptability of the data by users.

Developers are responsible for demonstrating their innovative systems at selected sites and are expected to pay the costs to transport equipment to the site, operate the equipment onsite during the demonstration, and remove

the equipment from the site. EPA is responsible for project planning, sampling and analysis, data quality assurance and quality control, report preparation, and information dissemination. If the developer is unable to obtain financing elsewhere, in some instances, EPA will consider bearing a greater portion of the total project cost. The demonstrations enable EPA to assess the performance, reliability, applications, limitations, and costs of new and innovative technologies. This information can then be used in conjunction with existing data to select the most appropriate technologies for the cleanup of existing Superfund sites. Currently, EPA is working with 30 technologies and eight field demonstrations have been completed.

During the first two years of the SITE Program, EPA has gained valuable insight into management and implementation of all aspects of the SITE Demonstration Program. The Agency has incorporated refinements in the demonstration process, including establishing policies, guidelines, and procedures to streamline and improve technology selection, site selection, demonstration planning and implementation, and preparation and dissemination of final reports. These refinements, and their impact on the program, are discussed in Section IIC.

2. Emerging Technologies Program

This portion of the SITE Program carries out pilot- and bench-scale evaluation of technologies or approaches that are not yet ready for full-scale demonstration. Its goal is to ensure that a steady stream of improved technologies will be ready to be demonstrated, thereby increasing the number of viable alternatives available for use in Superfund site remediations. The Emerging Technologies Program incorporates innovative technologies for recycling, separation, detoxification, destruction, and solidification/stabilization of hazardous constituents and materials handling technologies. Candidate technologies must show promise at the bench/laboratory-scale. It is anticipated that the emerging technologies will "feed" into the SITE Demonstration Program for field demonstration and evaluation. The projects are cooperatively funded by EPA and the developer, and in Fiscal Year 1988, EPA accepted the first seven projects in the Emerging Technologies Program. These projects examine technologies ranging from a constructed wetlands-based treatment technology to laser-stimulated photochemical oxidation, and are described in Section IIIA.

3. Technology Transfer Program

The Technology Transfer Program encompasses a variety of public outreach and information dissemination activities that support the SITE Program. These efforts are integral components of the program and are essential to its success. Dissemination of data from demonstrations conducted under the SITE Program and access to existing hazardous waste remediation data are the key to increasing the use of alternative technologies at Superfund sites. The overall purpose of the technology transfer activities is the development of an interactive communication process with those requiring up-to-date technical information and assistance.

The Technology Transfer Program is composed of numerous components that incorporate a variety of activities, including:

- Alternative Hazardous Waste Treatment Technologies Clearinghouse.
- SITE Brochures, Publications, Reports, and Videos.
- Pre-Proposal Conferences on SITE Solicitations.
- Public Meetings and Demonstration Site Visits.
- Seminar Series.
- SITE Exhibit at Major Conferences.
- Innovative Technologies Program Exhibition.
- Networking with Forums, Associations, the Centers of Excellence, Regions, and States.
- Technical Assistance to Regions, States, and Cleanup Contractors.

The various activities that have occurred and publications that have been prepared under each of these components of the Technology Transfer Program are described in Section IIIB.

4. Measurement and Monitoring Technologies Development Program

This component of the SITE Program is designed to support Superfund site characterization efforts by furthering the development of innovative measurement and monitoring technologies. EPA laboratories are exploring new and innovative technologies that will permit improved assessment of the extent of contamination, characterization of contaminants, and evaluation of remedial/removal activities at hazardous waste sites. The four goals for effective measurement and monitoring technologies at Superfund sites include: (1) to accurately assess the degree of contamination at a site, (2) to provide data and information to determine impacts to health and

the environment, (3) to supply data for the selection of the most appropriate remedial action, and (4) to monitor the success/failure or effectiveness of a selected remedy. Through the enactment of SARA, EPA has been provided with a mechanism specifically aimed at supporting monitoring technologies at Superfund sites. The Measurement and Monitoring Technologies Development Program has focused on two major research areas—immunoassays for toxic substances and fiber optic sensing for in-situ analysis. The progress and accomplishments of the research in these two areas are discussed in Section IIIC.

5. Innovative Technologies Program

Prior to initiation of the SITE Program in 1986, EPA's Office of Research and Development had supported research on several technologies for the onsite destruction and cleanup of hazardous wastes. Formerly called the Innovative Development and Evaluation Program, the Innovative Technologies Program is an outgrowth of these early R&D efforts. The objective of the program is to encourage private sector development by firms that are willing to commercialize these EPA technologies for use at Superfund sites. The program's goal is to facilitate and accelerate the development of these technologies from pilot-scale to full-scale demonstration and then to commercialization.

Commercial firms are currently being sought to enter into an agreement with EPA to commercialize some of the technologies. These agreements are now authorized by the Federal Technology Transfer Act of 1986, which makes possible the EPA-industry partnership necessary to bring these technologies to commercialization. It is expected that the marketing risk in commercializing these technologies will be reduced and development accelerated.

There are currently seven technologies in the Innovative Technologies Program. In an effort to promote commercialization of three of these innovative technologies, EPA sponsored an Innovative Technologies Program Exhibition in January 1989, where participants were invited to view videos of the technologies in operation, inspect the equipment, and obtain information on the assistance available in commercializing these technologies. The three innovative technologies featured at the exhibition were the Mobile Carbon Regeneration System, the Mobile Soils Washer, and the Mobile In-Situ Containment/ Treatment System. Descriptions of these and the other four innovative technologies in the program are included in Section IIID.

II. THE SITE DEMONSTRATION PROGRAM

Based on the emphasis placed on demonstrations in Section 311(b) of CERCLA, the Demonstration Program has been the primary focus of the SITE Program. Now in its third year, the SITE Program is providing data on alternative treatment technologies necessary to implement new Federal and State cleanup requirements that are aimed at permanent remedies rather than land disposal.

EPA has developed implementation procedures to ensure that the SITE Demonstration Program encourages developer participation, gathers required data, and provides adequate safeguards for human health and the environment. This process includes the following major steps:

- Selection of technologies for participation.
- Selection of sites for the demonstrations.
- Development and implementation of community relations activities.
- Preparation of detailed plans for the demonstration.
- Establishment of Cooperative Agreements with developers.
- Demonstration of the technology.
- Preparation of reports on the demonstration results.

A. SITE IMPLEMENTATION PROCESS

The procedures developed and the activities that have been performed under each of these major steps of the SITE demonstration process are briefly discussed in the following sections.

1. Selection of Technologies

Technologies are accepted into the program through an annual solicitation published in the *Commerce Business Daily*. In response to the solicitation, technology developers submit proposals to EPA addressing the following selection criteria:

- *Technology Factors*. Description of the technology and its history; identification of effective operating range; materials handling capabilities; application to hazardous waste site cleanup; mobility of equipment; capital and operating costs; advantages over existing comparable technologies; previous performance data; and identification of health, safety, and environmental problems.
- *Capability of the Developer*. Development of other technologies; completion of field tests; experience, credentials, and availability of key personnel; and capability to commercialize and market the technology.
- *Approach to Testing*. Operations plan; materials and equipment; range of testing; health and safety plan; monitoring plan; quality assurance plan; assignment of responsibilities; backup treatment system plan; and regulatory compliance plan.

Three solicitation cycles have been completed. These have been titled SITE-001, SITE-002, and SITE-003. The SITE-004 solicitation was released on January 6, 1989. A list of the technologies that have been accepted into the SITE Program under the three solicitations is presented in Exhibit II-1.

Selection of SITE-001 Demonstration Projects

In response to the first solicitation in the *Commerce Business Daily* in February 1986, EPA received approximately 450 requests for the SITE Program Request for Proposal (RFP). The RFP was made available on March 15, and the deadline for responses was April 25. EPA reviewed a total of 20 proposals by May 1986.

In early July 1986, EPA notified the developers of the status of their proposals. Some were asked to provide additional information or clarification of proposal elements in August. After reviewing the responses, seven technologies were considered acceptable.

A second method used by EPA to identify SITE Program participants focused on planned or ongoing use of alternative technologies at Superfund sites during response actions associated with both removal and remedial activities. Six additional technologies were brought in under SITE-001 through this method.

Selection of SITE-002 Demonstration Projects

On January 15, 1987, EPA sent out approximately 400 SITE-002 RFPs to private developers who expressed an

interest in becoming involved with the program. The SITE-002 solicitation differed from that of SITE-001 in that the SITE-002 program included requests for pilot-scale technologies as well as those at field demonstration scale. Responses to the RFP were due by March 13, 1987. Twenty-nine proposals were received and were reviewed by a panel of EPA experts.

On June 29, 1987, a letter was sent to all 29 developers notifying them of the results of the review. Seventeen applicants were asked to address specific questions or provide information pertaining to their technologies. Twelve proposals were rejected because they involved technologies that were already proven as viable alternatives or technologies that did not meet the definition of an "alternative technology." As a result of this process, 11 technologies were selected for participation in the SITE Program, and the developers were notified in September 1987.

Selection of SITE-003 Demonstration Projects

On January 16, 1988, EPA sent out approximately 800 SITE-003 RFPs to technology developers. Like the SITE-002 solicitation, the RFP was open to technologies at the pilot- or demonstration-scale. Responses were due by March 8, 1988. Preproposal conferences were held in Cincinnati, Ohio, on January 29, 1988; San Francisco, California, on February 1, 1988; and Crystal City, Virginia, on February 3, 1988. Thirty-one proposals were received and reviewed. Eleven technologies were considered acceptable, and those developers were notified in May 1988. Meetings were held with developers to address specific questions on their technologies. Presently, two of the SITE-003 technologies have been accepted in the program on an accelerated basis.

Selection of SITE-004 Demonstration Projects

The RFP for the SITE-004 solicitation was announced in the October 17, 1988, issue of the *Commerce Business Daily*. The SITE-004 RFP is the first SITE solicitation to be advertised in trade journals, and the announcement was published in approximately 80 journals. The RFP was made available on January 6, 1989. The solicitation emphasizes technologies that address the following problem areas: (1) treatment of soils and sludges containing organic and inorganic constituents, (2) materials handling as a preprocessing operation, (3) unit processes used in combination to create treatment trains, (4) treatment of large volumes with relatively low concentrations of organics and/or inorganics, (5) biological technologies for treating organic contaminants in soils and sludges, (6) in-situ treatment processes for soils and groundwater that serve as alternatives to conventional pump and treatment approaches to remediation, and (7) separation/extraction of low-level radioactive waste material.

Technologies that address leachates, wastewater, groundwater, aqueous material, and air may also be submitted in response to the SITE-004 solicitation, but these are of lower priority to the Agency at the present time.

2. Selection of Demonstration Sites

Once EPA has evaluated the technology proposals and notified the developers of their acceptance into the SITE Program, the demonstration site selection process is initiated. Potential SITE demonstration locations include Federal and State Superfund removal and remedial sites, sites from other Federal Agencies, and developers' sites. The criteria used to screen and select candidate sites for target demonstrations include the following:

- Compatibility of waste with the technology.
- Volume of waste.
- Variability of waste.
- Availability of data characterizing the waste.
- Accessibility of waste.
- Applicability of the technology to site cleanup goals.
- Availability of required utilities (i.e., power and water sources, sewers).
- Support of community, State and local governments, and potentially responsible parties.

The process for selecting sites for demonstration of the technologies begins with the Regional Offices submitting information on the type of waste(s) and additional applicable site characteristics. This information is screened and potential sites are given to the developers for comments.

The strengths and weaknesses of each site are compiled based on considerations and preferences provided by the

developer and four principal program goals. These goals are:

- Production of the most useful information on each technology's capabilities.
- Expeditious implementation.
- Production of information relevant to the specific site cleanup goals.
- Involvement of EPA Regions and States in the SITE Program.

Selection of SITE-001 Demonstration Sites

In October 1986, EPA's Regional Offices nominated 19 Superfund sites to be considered for the demonstration of SITE-001 projects. EPA staff worked extensively with the technology developers to obtain additional information needed to match potential sites with the technologies. During the spring 1987, as sites were tentatively selected, a series of kick-off meetings were held for each project to acquaint the technology developer with appropriate EPA and State officials. Visits were made to inspect and confirm site access, physical layout, and other factors. Eleven site selections resulted from this process and are described in further detail in Sections IIA and B.

Selection of SITE-002 Demonstration Sites

In November 1987, the Regional Offices were asked to nominate Superfund sites for the demonstration of 11 waste treatment technologies selected under SITE-002. The 11 technologies for which sites were requested are described in Sections IIB.1 and IIB.2.

Nine Regional Offices nominated 21 sites for review. After careful consideration of the advantages and disadvantages for demonstrations at different Superfund sites, meetings with Regional and State staff, and site visits, site nominations were made for technologies ready for demonstration.

Selection of SITE-003 Demonstration Sites

In an effort to expedite the technology/site matching process for the technologies accepted under the SITE-003 solicitation, new procedures were incorporated. Rather than seeking site nominations for specific technologies, information was collected on potential sites prior to the acceptance of technologies into the program. Evaluation and matching occurs from this inventory of information as technologies are selected. In addition, the developers were encouraged to suggest sites.

For technologies in the SITE-003 cycle, candidate sites have been discussed with the developers and efforts are underway to find acceptable sites.

3. Negotiation of Cooperative Agreements

In order to implement the SITE Demonstration Program, SARA has authorized the Agency to enter into grants, contracts, and Cooperative Agreements with technology developers. Applicants whose technologies are selected through the solicitation process enter into Cooperative Agreements with the Agency and determine the roles and responsibilities of both parties to carry out specific projects. Usually, the developer bears the cost of locating the technology onsite, operating the equipment during the test period, and demobilizing the equipment following the demonstration. EPA assists the developer with project planning and site preparation, and pays the costs associated with sampling and analysis, quality assurance and control, evaluating the data, and preparing summary reports.

Section 311(b)(5) permits EPA to fund up to 50% of the developer's cost of a SITE demonstration project, if the developer shows that it cannot obtain appropriate private financing on reasonable terms sufficient to carry out the project without Federal assistance. EPA can provide no more than $3 million total for any single project and no more than $10 million total in any one year for such assistance. EPA's guidelines for financial assistance were announced in January 1988 in the SITE-003 solicitation. Developers selected for the SITE Program that desire assistance are required to demonstrate that an earnest effort has been made to obtain financing and that a financial need exists. To date, EPA has not encountered a demonstrated need for providing financial assistance.

4. Community Relations Activities

A well-planned community relations effort is an integral part of the Superfund program, as well as the SITE Program. In fact, Section 311(b)(5) requires the establishment of a public notice and comment period prior to the final selection of a demonstration site. The objective of this community relations program is to actively encourage two-way communication between affected

communities and government Agencies responsible for cleanup actions. The program enables local citizens to have input to decisions regarding demonstration activities so that the demonstration plan reflects and responds to public concerns. At the same time, the community relations program ensures that the community is provided with accurate and timely information about the demonstration and its progress.

In designing a community relations program for a particular SITE demonstration, EPA focuses on the special concerns of the community. EPA has prepared and distributed site-specific technology fact sheets, and has sponsored public meetings. Each Regional or State Community Relations Office has been encouraged to hold at least one informational briefing or public meeting in the community. Communication with the local community is emphasized during the actual demonstrations. It may include site tours, workshops, an on-scene information office, community meetings, and status reports.

Specific activities have varied for each of the demonstrations. A more detailed description of community relations activities associated with the completed demonstration projects is included in the technology demonstration descriptions in Section IIB.1.

5. Demonstration Planning Process

After technologies and sites are selected, the next step in the process is development of a detailed technology demonstration, testing, and evaluation plan. The plan includes specification of all activities needed to ensure that the information objectives of the program are met and is included in the Cooperative Agreement between EPA and the developer. For each demonstration, the following must be addressed by the developer and EPA:

- Evaluation program duration and schedule.
- Site preparation requirements.
- Detailed evaluation design.
- Sampling and analysis program.
- Quality assurance/quality control (QA/QC) program.
  - Preparation and implementation of a QA/QC Project Plan.
  - QA/QC field and laboratory audits.
- Health and safety requirements.
  - Provisions for medical monitoring of operating and management personnel, if necessary.
  - Safety training for personnel who will be in a restricted zone.
  - Determination of the level of required worker protection (classification of outergarments as a function of the type of exposure).
  - Establishment of zones of safety; "clean area" establishment and movement restrictions in various zones.
  - Decontamination of personnel outergarments and equipment.
  - Emergency procedures.
  - Supervision responsibilities.
- Demobilization of equipment.

6. Reporting Results

There are two major reports for each demonstration. The first is a technical report documenting the performance data resulting from the demonstration, and the second is a report that evaluates the applicability of the technology to other sites and wastes.

The first report, entitled the Demonstration Report, includes testing, procedures, data collected, and QA/QC conducted. It summarizes the results in terms of performance (effectiveness and reliability) and cost. The report also addresses issues such as applicability, pre- and post-treatment requirements, and advantages/disadvantages compared with available technologies. EPA is responsible for distribution of the report following review and approval.

Successful demonstration of a technology at one Superfund site does not, by itself, imply that the technology can and will be adopted for use at other Superfund sites. To enable and encourage the general use of demonstrated technologies, EPA prepares a second report that evaluates all available information on the specific technology and the applicability of each technology to other site characteristics, waste types, and waste matrices. The report, entitled the Applications Analysis Report, also

provides cost estimates for these applications and identifies cost-controlling factors when appropriate.

Once results become available, the technology transfer component of the SITE Program will provide technical information to potential users in a timely manner. Details on the overall approach to technology transfer in the SITE Program are presented in Section IIIB.

B. DEMONSTRATION PROGRAM PROGRESS AND ACCOMPLISHMENTS

There has been a noticeable progression toward the selection of more innovative treatment technologies in the SITE Demonstration Program. Many of the technologies accepted under the SITE-001 solicitation cycle were modifications of available proven technological processes (especially thermal treatment systems). These modifications were designed to: (1) improve the destruction and removal efficiency of the existing technology, (2) decrease the operational cost of the existing technology, *and/or* (3) *increase the applicability of the existing* technology to various wastes. Although some treatment processes included in the SITE-002 cycle are conventional, they are innovative in their ability to treat complex organic waste streams. This trend toward new, more innovative technological processes (particularly biological and chemical processes) and the combining of technologies to form treatment trains is continued for the SITE-003 solicitation technologies. These include a number of innovative biological and physical treatment processes. In the SITE-004 solicitation, the Agency has started to target specific waste treatment problems at Superfund sites such as the treatment of soils and sludges contaminated with a mixture of wastes. The SITE-004 RFP solicited technologies that address the treatment of soils and sludges, the treatment of mixed wastes containing low-level radioactive material, materials handling, and unit processes used in treatment trains.

The 30 technologies presently active in the SITE Program represent five process categories. There are currently eight thermal, four biological, six solidification/ stabilization, three chemical, and six physical technologies in the program. In addition, there are three technologies that use combined treatment technologies to process wastes. The technologies and their categories are listed in Exhibit II-1, *along with a description of the status of the* demonstration project.

1. Completed Demonstration Projects

Field demonstrations for 8 of the 30 technologies active in the SITE Program have been completed to date. Descriptions of the demonstration activities and the results of the completed demonstrations are presented below.

American Combustion, Inc.

The PyretronTM oxygen-air-fuel burner, developed by American Combustion, Inc., of Norcross, Georgia, was demonstrated at EPA's Combustion Research Facility (CRF) in Jefferson, Arkansas, from November 1987 to January 1988. The primary objective of the demonstration was to compare the performance of the PyretronTM with a conventional air-based incineration system. For this demonstration, the conventional air burner of the CRF rotary kiln system was substituted with the PyretronTM oxygen burner. Eight comparison tests were conducted using contaminated soil from the Stringfellow Acid Pit Superfund site in California. Stringfellow is a remedial site that was used as a dump for industrial wastes from World War II to the early 1980s. Soils on the site are contaminated with waste acids containing organics and metals.

For the conventional system, the optimum feed rate was 21 lbs at a charging interval of 12 minutes. Higher feed rates served to destabilize the process. Oxygen depletion in the conventional kiln resulted in flameouts, excessively high CO levels exiting the kiln, and CO breakthroughs from the afterburner. While attempts were made to increase air flows to provide additional oxygen, residence times were reduced below levels necessary for complete combustion. In addition, gaseous emissions were observed on several occasions due to the loss of negative pressures in the conventional kiln.

During testing of the PyretronTM, the mass charge size was maintained at 21 lbs. However, the throughput rate was doubled by reducing the charge interval from 12 to 6 minutes. Test results show that at this rate, the temperature control was maintained in both the kiln and afterburner. Oxygen levels at the kiln exit were maintained at sufficiently high levels, and CO levels were kept to a minimum, with no indication of CO in the stack. In another test, the size of the batch charge was increased by 60% to determine the capability of the system to handle the so-called "puffs" that are often experienced immediately following a batch charge. Results from this test show that the sufficient oxygen concentration was maintained in the kiln. CO levels at the kiln exit were well within the capacities of the afterburner system, and once again there was no CO emitted from the afterburner. In addition, destruction and removal efficiencies (DREs) exceeded 99.99% for all tests.

EXHIBIT II-1. STATUS OF TECHNOLOGIES IN THE SITE PROGRAM

SITE-001 PROJECTS

(SOLICITATION DATE: MARCH 1986)

DEVELOPER	TECHNOLOGY	PROPOSED LOCATION OF DEMONSTRATION	STATUS	Technology Selected	Site Proposed	Demonstration Plan Completed	Cooperative Agreement Signed	Demonstration Completed	Final Reports Completed
1) American Combustion Technologies, Inc. Norcross, GA	Pyretron Oxygen Burner (Thermal)	Combustion Research Facility (CRF) Jefferson, AR (Region 6)	The draft Demonstration Report and Applications Analysis Report have been prepared and are being reviewed by EPA and the developer.	●	●	●	●	●	
2) DETOX Industries, Inc. Sugarland, TX	Biological Degradation Process for Organics (Biological)	United Creosote Superfund Site Conroe, TX (Region 6)	Soil samples were collected from a wood treatment site in Texas. A bench-scale treatability study is under way. Review of the demonstration plan and the QAPP is under way. The demonstration is scheduled to begin in early 1989.	●	●				
3) HAZCON, Inc. Katy, TX	Solidification/ Stabilization	Douglassville Superfund Site Reading, PA (Region 3)	The final Demonstration Report is in clearance. Draft Applications Analysis Report is in review,and will be revised by December 19, 1988.	●	●	●	●	●	●
4) Haztech/Shirco Atlanta, GA	Infrared Incinerator (Thermal)	Peak Oil Superfund Site Brandon, FL (Region 4)	The final Demonstration Report has been published and is available. The Applications Analysis Report is expected to be completed by March 1989.	●	●	●	●	●	●
5) International Waste Technologies Wichita, KS	In-situ Solidification (Solidification/ Stabilization)	G.E. Facility Hialeah, FL (Region 4)	The draft Demonstration Report has been revised and the developer's comments are being incorporated into the revised draft.	●	●	●	●	●	●
6) Ogden Environmental Services San Diego, CA	Circulating Fluidized Bed Combustor (Thermal)	McColl & Stringfellow Waste at Ogden Facility and at McColl Superfund Site San Diego, CA. (Region 9)	After an extended holding time on this project, favorable legal action will now permit this demonstration to resume. A new schedule is being developed.	●	●				
7) Resources Conservation Co. Bellevue, WA	Solvent Extraction (B.E.S.T.)™ (Chemical)	None selected	Five possible demonstration sites are under consideration.	●					
8) Shirco Infrared Systems, Inc. Dallas, TX	Infrared Incinerator (Thermal)	Rose Township Demode Road Superfund Site Rose Township, MI (Region 5)	The Demonstration Report is being reviewed and is scheduled for publication and distribution in February1988. A draft of the Applications Analysis Report has been completed and is undergoing review.	●	●	●	●	●	
9) Terra Vac, Inc. Dorado, PR	In-situ Volatilization (Physical)	Valley Manufacturing Groveland Wells Superfund Site Groveland, MA (Region 1)	The first draft of the Applications Analysis Report will be completed November 1989. The draft Demonstration Report is undergoing EPA review.	●	●	●	●	●	
10) Westinghouse Electric Corporation Madison, PA	Pyroplasma System (Thermal)	Westinghouse Facility Waltz Mill, PA (Region 3)	EPA and Westinghouse will perform the demonstration under the Westinghouse RCRA RD&D permit at their Waltz Mill facility in Waltz Mill, Pennsylvania.	●	●				
11) New York State Department of Environmental Conservation Albany, NY	Plasma Arc (Thermal)	Love Canal, NY (Region 2)	Requested to withdraw from the program in May 1988 due to contractual issues with the developer.						
12) Waste-Tech Services, Inc. Golden, CO	Fluidized Bed Combustor (Thermal)	None selected	Requested to withdraw from the program in its letter of July 1987 due to indemnification issues.						
13) Westinghouse Electric Corporation Madison, PA	Electric Pyrolyzer (Thermal)	Westinghouse Facility Waltz Mill, PA (Region 3)	Classified as removed from the program on September 7, 1988. Status will remain unchanged unless Westinghouse meets the following two conditions: 1) successful completion of DOE test and 2) demonstration of the readiness of the technology.						

EXHIBIT II-1. STATUS OF TECHNOLOGIES IN THE SITE PROGRAM (CONTINUED)

SITE-002 PROJECTS

(SOLICITATION DATE: JANUARY 1987)

DEVELOPER	TECHNOLOGY	TENTATIVE LOCATION OF DEMONSTRATION	STATUS	Technology Selected	Site Selected	Demonstration Plan Completed	Cooperative Agreement Application	Demonstration Completed	Final Reports Available
14) C F Systems Corporation Waltham, MA	Solvent Extraction (Chemical)	New Bedford Harbor New Bedford Harbor, MA (Region 1)	The demonstration at New Bedford Harbor, MA, has been completed	●	●	●	●	●	
15) Chemfix Technologies, Inc Metairie, LA	Chemical Fixation/ Stabilization (Solidification/ Stabilization)	Portable Equipment Salvage Co Site Clackamas, OR (Region 10)	The demonstration is planned for March 1989	●	●				
16) GeoSafe Corporation Kirkland, WA	In-situ Vitrification (Thermal, Solidification/ Stabilization)	Parsons Chemical Works, Inc Site Grand Ledge, MI (Region 5)	A Michigan site has been selected for the demonstration The demonstration is expected to occur some time between March and November 1989. This is a joint project with State of Michigan	●	●				
17) MOTEC, Inc Mt Juliet, TN	Liquid/Solid Contact Digestion (Biological)	L A. Clarke & Son's Superfund Site Spotsylvania County, VA (Region 3)	A two-week treatability study on wastes is underway The demonstration is expected to start in April 1989 and continue for 4 months	●	●				
18) Retech, Inc Ukiah, CA	Plasma Heat (Thermal)	Montana Pole/Silver Bow Creek Superfund Sites Butte, MT (Region 8)	A Montana DOE research facility (and NPL site) in Butte, MT has been identified as a candidate site for the demonstration Preparation of the demonstration plan is proceeding Treatability tests are scheduled for January in Ukiah, Ca.	●	●				
19) Sanitech, Inc Twinsburg, OH	Ion Exchange (Chemical, Physical)	Chisman Creek Site York County, VA (Region 3)	Preliminary negotiations are being made to acquire groundwater samples from this site to conduct a treatability study. Two possible sites have been proposed for the demonstration and are under review	●					
20) Separation and Recovery Systems, Inc Irvine, CA	Solidification/ Stabilization	None identified	Efforts to identify a demonstration site are under way	●					
21) Soliditech, Inc Houston, TX	Solidification/ Stabilization	Imperial Oil Co , Inc Superfund Site Morganville Township, NJ (Region 2)	The draft demonstration plan has been reviewed by NJDEP, EPA technical staff, and IOC The demonstration is under way at IOC and is expected to be completed in December1988 Four samples of waste from this site have been laboratory tested	●	●	●	●	●	
22) Zimpro/Passavant, Inc Rothschild, WI	Powdered Activated Carbon Treatment (PACT)TM (Biological, Physical)	None selected	The demonstration plan has been drafted Treatability tests are on hold pending final decisions on the site. A sitehas been identified in Region 2 for the demonstration and planning is underway	●	●				
23) Air Products and Chemicals, Inc Allentown, PA	Fluid Bed Biological System (Biological)	None selected	Requested to withdraw from the program in its letter of September 20, 1988 due to indemnification and site selection issues. A report of the treatability study results will be prepared						
24) Waste Chem Corporation Paramus, NJ	Volume Reduction Solidification	Woodland Route 532 Site Woodland Township, NJ (Region 2)	Requested to withdraw from the program in its letter dated October 1988 due to its inability to compete economically with applicable technologies						

EXHIBIT II-1. STATUS OF TECHNOLOGIES IN THE SITE PROGRAM (CONTINUED)

SITE-003 PROJECTS

(SOLICITATION DATE: JANUARY 1988)

DEVELOPER	TECHNOLOGY	TENTATIVE LOCATION OF DEMONSTRATION	STATUS	Technology Selected	Site Selected	Demonstration Plan Completed	Cooperative Agreement Application	Demonstration Completed	Final Reports Available
25) Biotrol, Inc Chaska, MN	Biological Degradation (Biological)	MacGillis & Gibbs Co Bell Lumber & Pole Site New Brighton, MN (Region 5)	A PCP-contaminated site in Washington is being considered for the demonstration site	●	●				
26) Biotrol, Inc Chaska, MN	Soils Washing (Physical)	MacGillis & Gibbs Co Bell Lumber & Pole Site New Brighton, MN (Region 5)	A wood-preserving facility in Minnesota is being considered for the demonstration site	●	●				
27) CBI Freeze Technologies, Inc Plainfield, IL	Physical Separation (Physical)	None selected	Four candidate sites have been proposed for the demonstration and are under review The demonstration plan is in preparation	●					
28) Chemical Waste Management, Inc Riverdale, IL	Rotary Thermal Desorber (X*TRAX)™ (Thermal)	None identified	The demonstration plan is in preparation The Cooperative Agreement has been submitted The demonstration is expected to occur in June 1989 This technology was accepted into the program as a "fast-track" project	●					
29) Detox, Inc Dayton, OH	Fixed-film Biological Treatment (Biological)	None selected	EPA sent a letter requesting that treatability studies be initiated by December 1 Four candidate sites have been identified and are under review	●					
30) E I DuPont de Nemours, Inc Newark, DE	Microfiltration (Physical)	None selected	The developer is preparing a Cooperative Agreement application Two candidate sites have been identified for the demonstration and are under review	●					
31) Freeze Technologies Corporation Raleigh, NC	Physical Separation/ Concentration (Physical)	Stringfellow Superfund Site Stringfellow, CA (Region 9)	Four candidate sites have been proposed for the demonstration and are under review The demonstration plan is being developed and discussions with Region 9 are under way regarding the use of Stringfellow	●	●				
32) Silicate Technology Corporation Scottsdale, AZ	Stabilization/ Fixation for Organics/ Inorganics (Solidification/Stabilization)	Tacoma Tar Pits Tacoma, WA (Region 10)	A tentative site has been selected Treatability studies are planned on site wastes during October-December 1989	●	●				
33) Toxic Treatments, Inc San Mateo, CA	In-Situ Air/Steam Stripping (Physical)	Annex Terminal Site San Pedro, CA (Region 9)	A San Pedro, CA site has been chosen, and a preliminary demonstration plan will undergo review The Cooperative Agreement application has been submitted The demonstration is scheduled for February 1989	●	●	●			
34) Ultrox International, Inc Santa Ana, CA	Oxidative Destruction Using UV Radiation and Ozone (Chemical)	Lorentz Barrel and Drum Site San Jose, CA (Region 9)	The draft demonstration plan is under review and the public comments that were received are being reviewed	●	●	●			
35) Weston Services, Inc West Chester, PA	Low-Temperature Thermal Treatment (LT^3) (Thermal)	Tinker Air Force Base Oklahoma City, OK (Region 6)	This technology was accepted into the program as a "fast-track" project	●	●				

The Demonstration and Applications Analysis Reports are expected to be completed by early 1989.

C.F. Systems Corporation

One of the SITE-002 project participants, C.F. Systems Corporation of Waltham, Massachusetts, has developed a solvent extraction technology. The technology uses liquified gases (propane or carbon dioxide) as solvents to remove organic constituents from sludges, solids, and liquid wastes. The system uses vapor recompression and conventional distillation to recycle the solvents and concentrate the organic constituents.

During the month of September 1988, C.F. Systems' pilot-scale unit was tested on polychlorinated biphenyl-contaminated harbor sediments from the Massachusetts New Bedford Harbor Superfund site. Public meetings were held on June 13 and July 11, 1988, to discuss the demonstration. The major objective of the demonstration was to evaluate the ability of the extraction system to remove and concentrate polychlorinated biphenyls (PCBs) from the sediments. Visitors' Days, held on August 26-27, 1988, were attended by 135 visitors who viewed the technology in progress.

The demonstration began on September 6, 1988, and continued through October 7, 1988. During the demonstration, PCB concentrations and residence times were varied for each of four tests. Each test consisted of a number of passes, or runs, through the pilot-scale unit. These data were necessary for design of the full-scale unit and for projection of final concentration of PCBs for the full-scale unit. During the 30-day demonstration, 300 lbs of harbor sediment containing PCBs and heavy metals were treated. Preliminary data analyses indicated that after six passes, or runs, a 96% reduction in PCBs in the 3,000-4,000 ppm concentration range occurred. The primary objective of this demonstration was to evaluate the extraction of the organic constituents, including PCBs; the heavy metals were not removed by the process, and the developer did not claim any metal removal by this process.

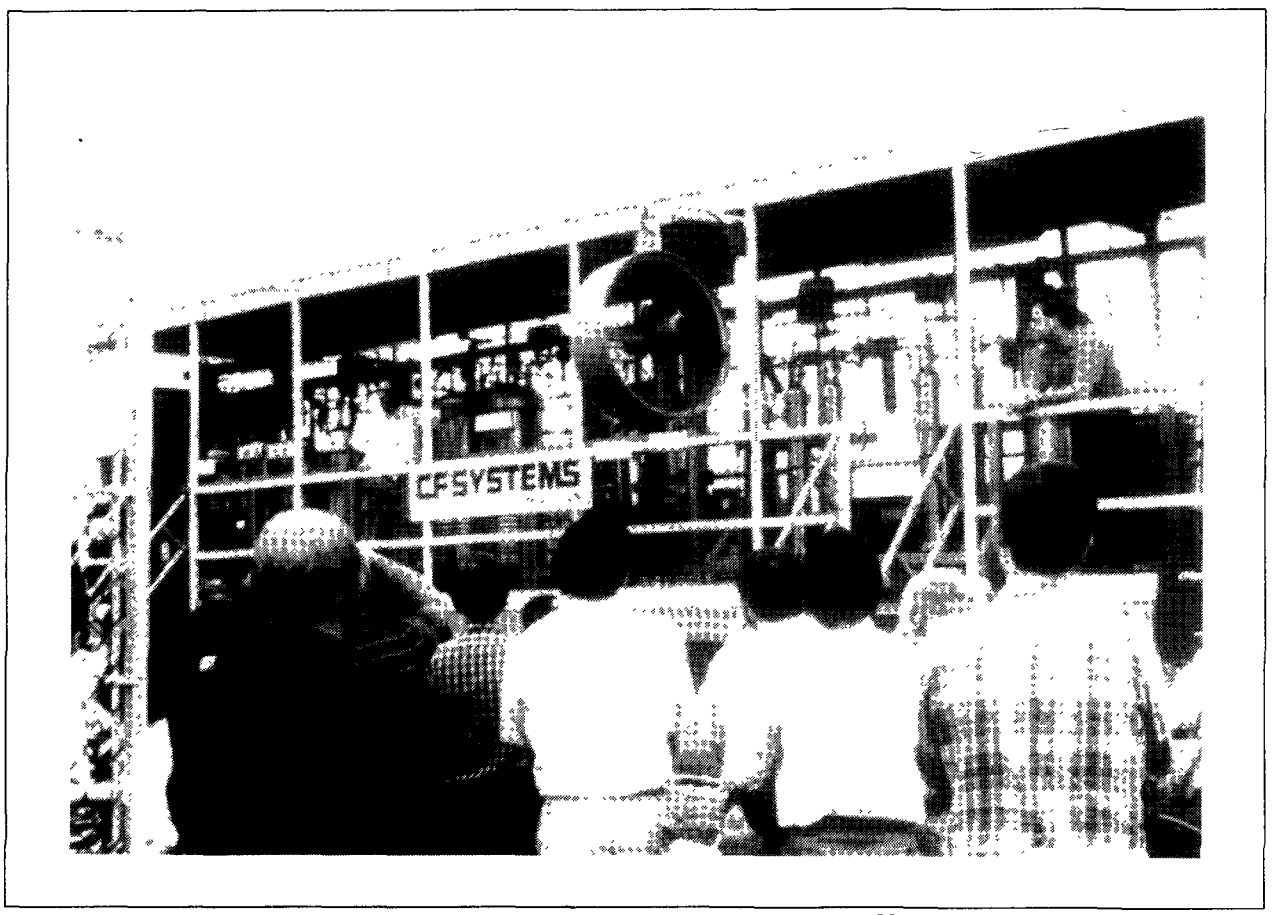


Exhibit II-2. Visitors' day activities at CF Systems Corporation demonstration site at New Bedford Harbor, Massachusetts.

If necessary, such residual metals could be processed through solidification/stabilization, a proven technology for the metals (cadmium, chrome, lead, copper, and zinc) at this site. Although these initial results are encouraging, it should be noted that they are preliminary. It is anticipated that all analytical samples will be processed by December 1988.

The Demonstration Report is expected to be completed by March 1989, and the Applications Analysis Report is scheduled to be completed by April 1989.

HAZCON, Inc.

The solidification/stabilization process developed by HAZCON, Inc., of Katy, Texas, was demonstrated in October 1987 at the Douglassville Superfund site, near Reading, Pennsylvania. This process blends contaminated soil or sludge with cement (or other pozzolans) and a proprietary ingredient called Chloranan. The result is a concrete-like mass that immobilizes the contaminants. The demonstration site was selected on March 3, 1987. A public meeting was held on September 9, 1987, following a 30-day public comment period, to discuss the demonstration project. The demonstration began on October 12 and was completed on October 16. A Visitors' Day was held on October 14, 1987, and 30 visitors viewed the demonstration. Approximately 50 cubic yards of contaminated soil were treated during the five-day demonstration.

The contaminated soil wastes at the Douglassville site came from six sources: one each from two large lagoons once filled with waste oil sludges and subsequently drained and backfilled with soil; an oily filter cake disposal area; an oil drum storage area; an oil reprocessing area; and a waste land farm. Samples were taken from the untreated waste, the blended (treated) slurry after seven days of curing, and core samples from the 28-day-old blocks. The samples were analyzed for soil characteristics, leachability, permeability, unconfined compressive

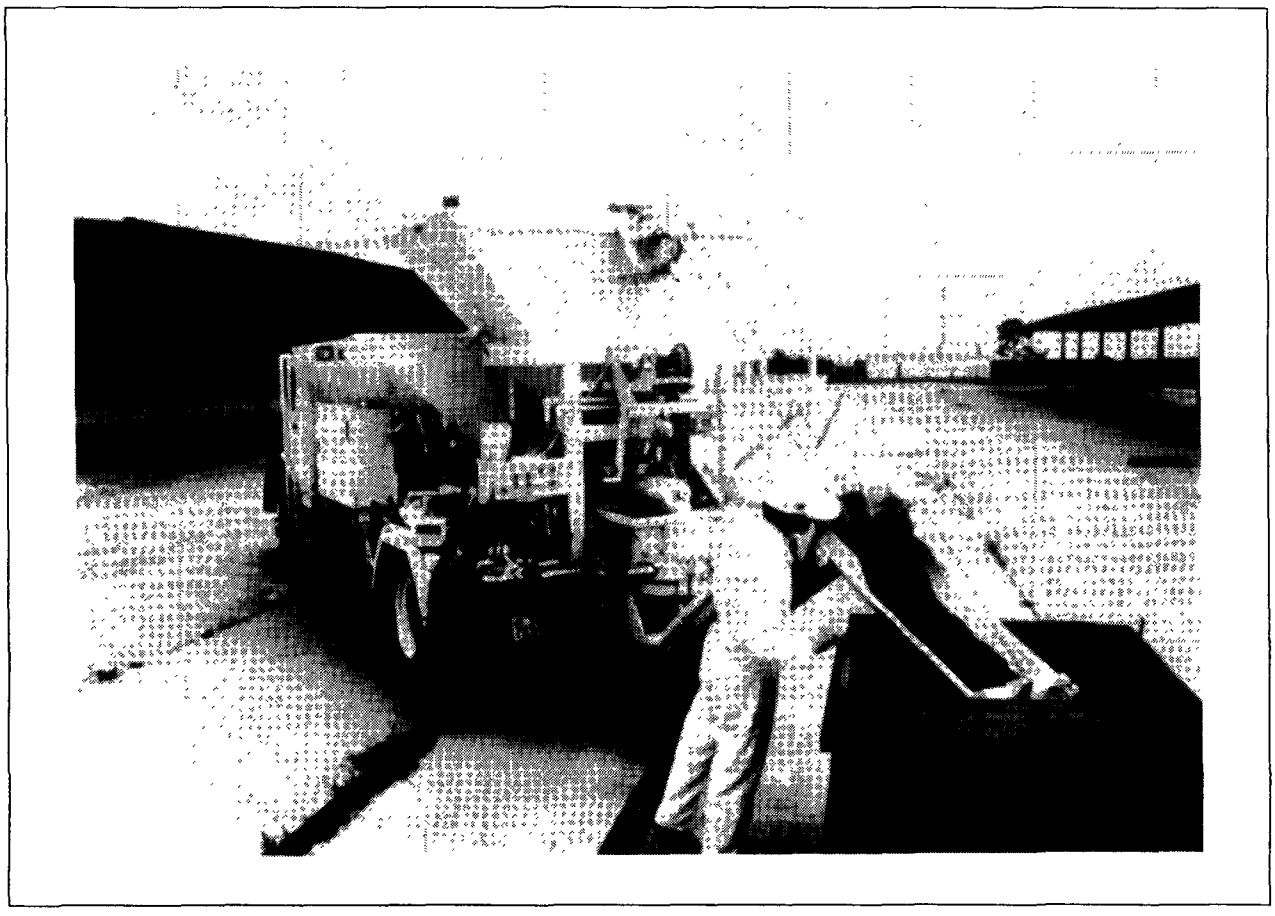


Exhibit II-3. Casting of a concrete-like mass using the solidification/stabilization process developed by HAZCON.

strength (UCS), microstructure changes, and contaminant levels. Results of the demonstration indicated the following:

- The physical characteristics of the treated wastes were very good. The UCS of the solidified waste ranged from about 200-1500 psi. Short-term durability test results were also very good, but the microstructural analysis seemed to indicate possible sample degradation in the future. Permeabilities of the solidified waste were very low, in the range of 10^{-8} to 10^{-9} cm/sec, and considered excellent. There was a large increase in the volume of the solidified waste to approximately double that of the waste feed.

- Stabilization of metals in the waste was successful, with reductions of metal leachate concentrations greater than a factor of 100. Even with high concentrations of organics that interfere with the stabilization process, the metals were effectively treated. According to test procedures, the solidified mass was subjected to a grinding process prior to leach tests; the leaching concentrations of organics (volatile, semivolatile, and oil and grease) were little changed before and after treatment.

The Demonstration Report was completed in December 1988, and the Applications Analysis Report is scheduled to be completed by March 1989.

Haztech, Inc.

A 100-ton per day Shirco Infrared Incineration System operated by Haztech, Inc., was demonstrated at the Peak Oil Superfund site in Brandon, Florida. During the 1950s, oily wastes from the Peak Oil Recycled Oil Refinery were deposited into a natural lagoon at the site that is located in sandy soils with a shallow water table. The site was placed on the National Priorities List (NPL) primarily because of PCB and lead contamination of the local groundwater, in addition to other hazardous materials that were suspected to be present in the lagoon.

The demonstration took place during a removal action conducted under contract to Haztech, Inc., of Atlanta, Georgia. The testing began on August 1, 1987, and was completed on August 4, 1987, near the end of the removal action. During the four-day demonstration test, approximately 360 tons of recycled oil refinery sludges

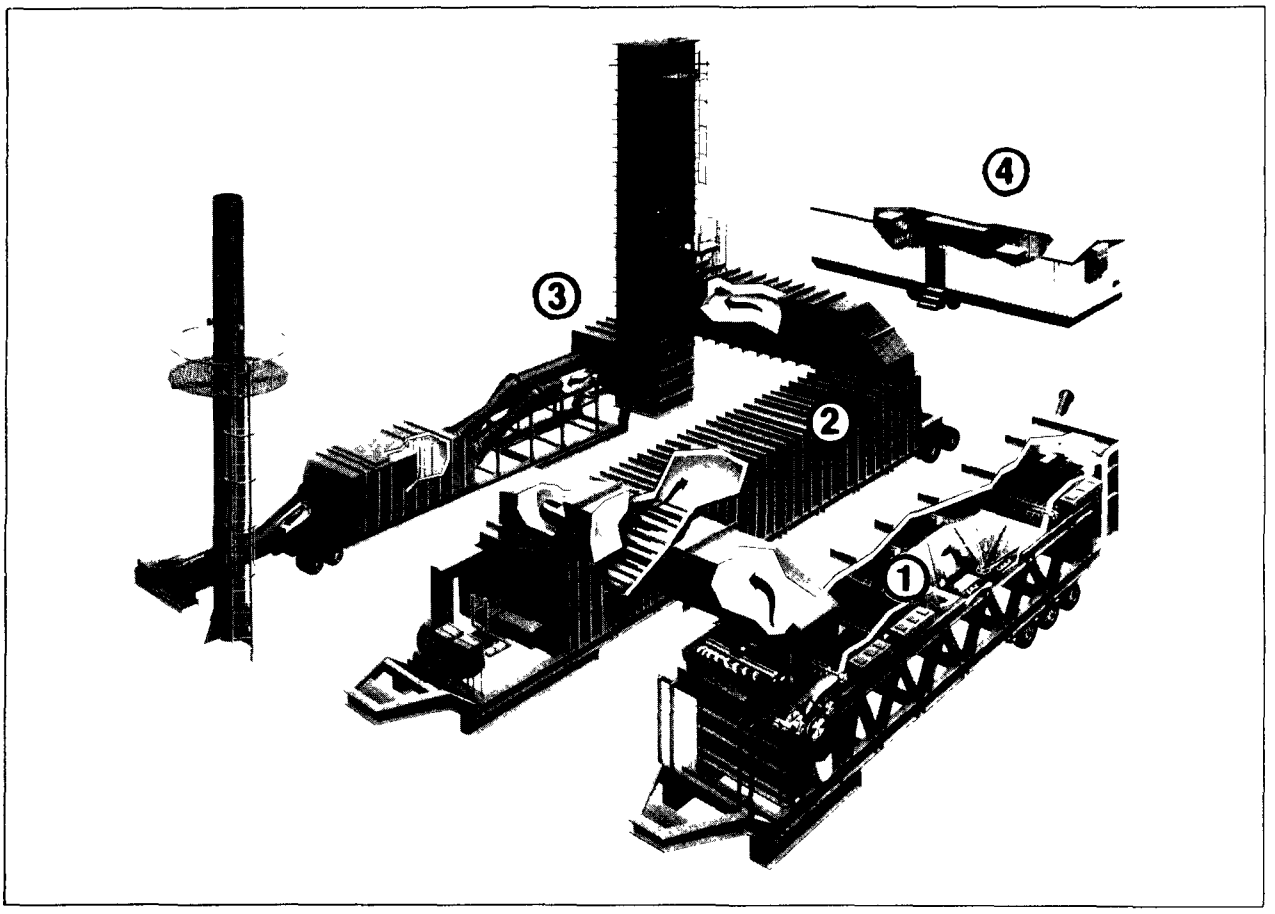


Exhibit II-4. Shirco's Mobile Infrared System operated by Haztech. The system consists of (1) infrared primary furnace, (2) infrared secondary furnace, (3) emissions control system, and (4) process management and monitoring center.

were treated. The DRE evaluation included a determination of toxic materials in the feed waste as well as analyses of all the effluent streams, including ash, wastewater, and air emissions. These streams were analyzed for heavy metals, organics, PCBs, dioxins, furans, NOx, and inorganic acids. Leaching tests were also performed on the ash. The analytical results of the work indicate the following:

- The PCB content of the waste feed was reduced from about 5 ppm to less than 1 ppm.
- Although bench-scale research had indicated that the lead compounds in the ash would become insoluble because they would be complexed with carbon, the ash could not be considered nonleachable, based on EP toxicity tests.
- Particulate emissions ranged from 171-358 mg/dscm, corrected to 7% 02. This compares with RCRA standards of 180 mg/dscm. Although it exceeded RCRA pollution standards during the tests, the air pollution control equipment can be modified to meet RCRA requirements.
- An economic analysis indicated that during this remediation action, the cost ranged from $196/ton (when unit was operating at 80% capacity) to $795/ton (when unit was operating at 19% capacity).

The Demonstration Report was published on November 10, 1988, and the Applications Analysis Report is expected to be completed by March 1989.

International Waste Technologies

In cooperation with General Electric, Inc., International Waste Technologies (IWT) demonstrated its in-situ stabilization/solidification process at a closed electric service shop in Hialeah, Florida. At that site approximately 13,000 square feet of ground is contaminated with PCBs and lead. IWT used Geo-Con, Inc.'s Deep Soil Mixing system to drill and blend waste material with IWT's patented bonding agent. The IWT process bonds organic and inorganic compounds, creating "macromolecules," that are highly resistant to acids and other deteriorating factors.

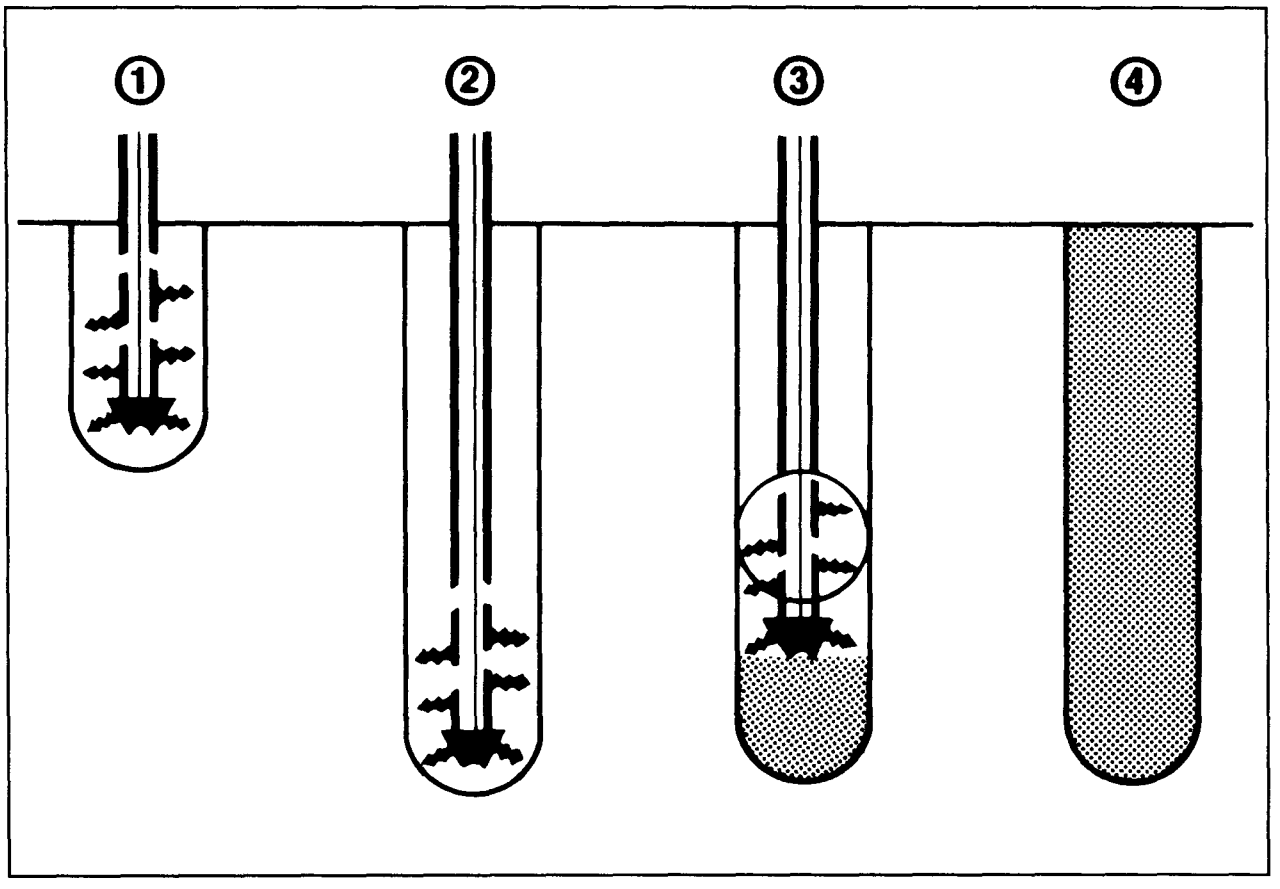


Exhibit II-5. Illustration of four construction steps in International Waste Technologies' *in-situ* stabilization technology. (1) Auger initiates boring; (2) Boring is completed at a pre-determined depth; (3) Bonding agent is injected as the auger is withdrawn; (4) Process results in stabilized treated soil column.

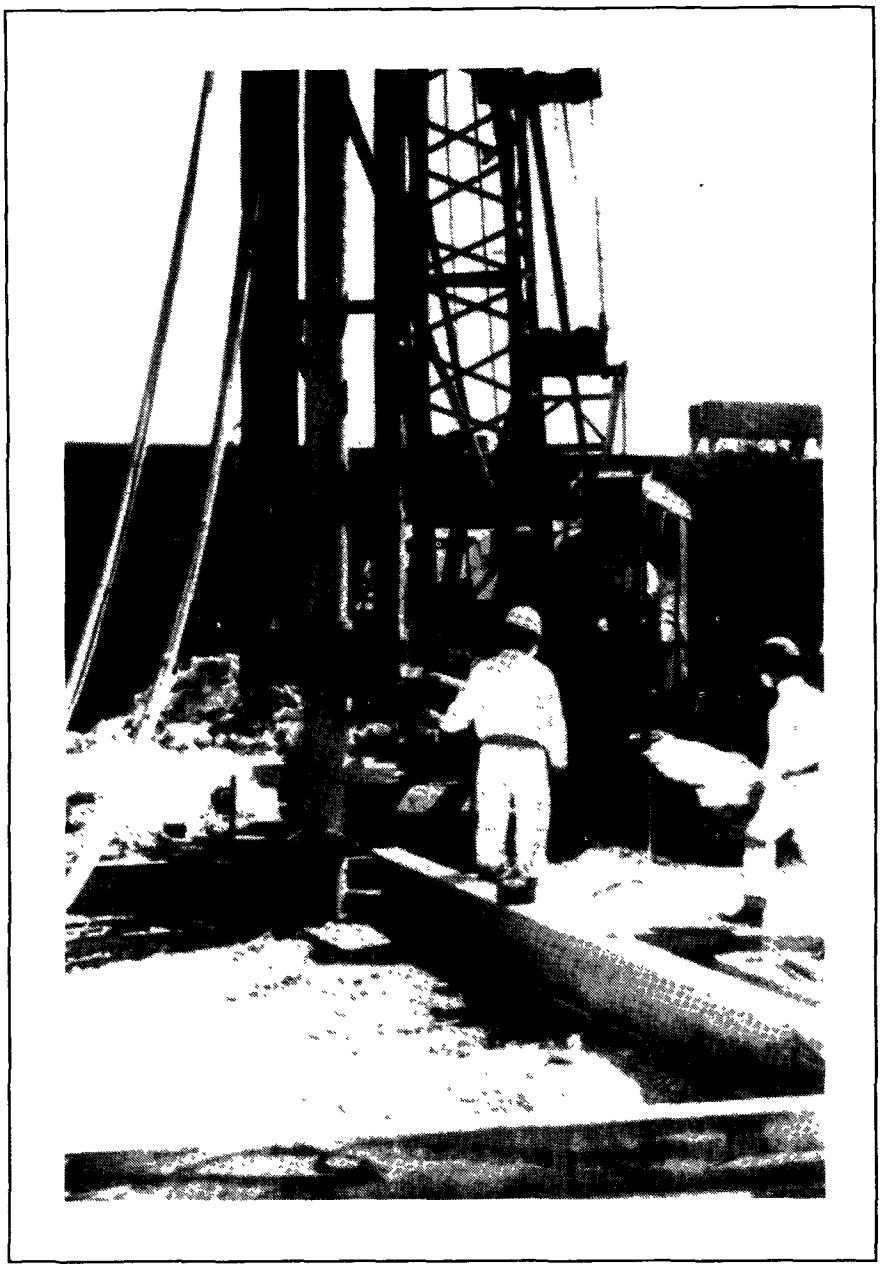


Exhibit II-6. Geo-Con, Inc.'s deep-soil mixing system used by International Waste Technologies' stabilization/solidification process.

The demonstration site was selected in September 1986. The major objectives of the demonstration were to evaluate the ability of the process to immobilize PCBs in the soil; determine the level of performance and reliability of the mechanical equipment being used; assess the effectiveness of the process for land stabilization; and to observe the integrity of the solidified soil over a period of five years. The demonstration began on March 21, 1988, and was completed on June 6, 1988. There were 80 attendees to view the demonstration at the Visitor's Day held on April 14, 1988. During this two-week demonstration, the stabilization/solidification process was tested on two sectors of ground measuring 200 square feet each. The soil was blended and stabilized in depths of 14-18 feet.

The Demonstration Report is expected to be completed by April 1989, and the Applications Analysis Report should be completed by August 1989.

Shirco Infrared Systems, Inc.

To further test the effectiveness of the Shirco Infrared Systems, Inc.'s Infrared Incineration System, a portable pilot (one-ton per day) unit was evaluated at the Rose Township-Demode Road Superfund site in Michigan. The remaining contaminated soils tested contained high concentrations of PCBs and metals, including lead. The primary objectives of the project were to determine whether treatment (1) destroys the PCBs, and (2) reduces the potential for lead to leach from the ash. The unit was operated at the site for approximately two weeks in November 1987 and treated about 10 cubic yards of contaminated soil. The overall program consisted of three extended test burn runs conducted under the normal operating conditions of the unit and a series of 14 shorter tests conducted under several operating conditions. These tests investigated the unit's thermal destruction effectiveness under various parameters. Preliminary results from the tests indicate that:

- Estimated destruction and removal efficiencies of PCBs exceeded 99.99%.
- Acid gas removal efficiencies approached 99% and particulate emissions were below the RCRA standard.

- Under none of the operating conditions of those tests was there any evidence of a decrease in leaching potential for lead after treatment.

- The system may be more economical if the BTU or the waste feed is augmented by fuel oil, and if primary combustion chamber temperature is optimized.

- Some PCBs and very low levels of tetrachlorodibenzofurans (TCDFs) were detected in the furnace ash when the primary combustion chamber operated at 900°F instead of the design temperature of 1600°F, indicating that 900°F is not sufficient to fully decontaminate the test soil matrix.

- Some semivolatile and volatile organics were detected in the stack gas at near detection levels. These compounds may be byproducts of incomplete combustion.

The Demonstration Report is scheduled to be completed by February 1989, and the Applications Analysis Report should be completed by March 1989.

Soliditech, Inc.

Soliditech, Inc., of Houston, Texas, has developed a solidification and stabilization process to chemically and physically immobilize hazardous constituents contained in slurries. During the process, the proprietary reagent URRICHEMTM is dispersed throughout the waste in order to achieve complete blending of all ingredients (waste, pozzolan, aqueous phase, and other additives). The multiphase cementation process immobilizes hazardous compounds by cross-linking organic and inorganic particles, coating large particles, and sealing small pores and spaces. This sealing process significantly reduces leaching potential. This technology can be applied to a broad range of organic and inorganic slurries and to bulk hazardous liquids prior to disposal.

The Imperial Oil Co., Inc., site, an abandoned oil recycling facility in New Jersey, was selected as the demonstration site. Soliditech conducted treatability studies and drafted a demonstration plan that was distributed to the responsible party, New Jersey Department of Environmental Protection, and other interested parties. The field demonstration was completed in December 1988.

Terra Vac, Inc.

From January to April 1988, an in-situ vacuum extraction process developed by Terra Vac, Inc., of Dorado, Puerto Rico, was used to extract volatile contaminants from soils at the Groveland municipal water supply in Groveland, Massachusetts. In that area of the site, waste oils and degreasing solvents have contaminated the subsurface soils with volatile organic compounds (principally trichloroethylene) and with lesser concentrations of 1,2-dichloroethane and tetrachloroethylene. Most of the contamination occurs beneath a concrete slab that is used as a storage platform and above the water table.

The demonstration site was selected in April 1987, and a public meeting to discuss the demonstration was held on July 29, 1987, following a 30-day public comment period. The demonstration began on December 1, 1987, and was completed on May 2, 1988. Seventy-five visitors attended the demonstration Visitors' Day held on January 15, 1988. Four extraction wells were drilled at the edge of the contaminated area. Three of the wells acted as a sink intercepting volatile organic compounds (VOCs) that would normally be drawn to the fourth well. The fourth well was used to measure the cleanup. Samples of the soil gas, process gas, stack gas emissions, and liquid from the vapor/liquid separator were collected. Initial results indicate:

- A total of approximately 1,300 lbs of volatile organic compounds were extracted.

- Some shallow soil gas concentrations were reduced by more than 95%.

- The extraction process seemed to work most successfully in wet clay soils.

The potentially responsible party has selected Terra Vac to cleanup the Groveland site after the demonstration has been completed. The Demonstration Report is expected to be completed by April 1989, and the Applications Analysis Report will be completed by November 1989.

2. Other Demonstration Projects

SITE-001 Technologies

This section describes the progress of those SITE-001 technologies whose demonstrations have not yet been completed.

DETOX Industries, Inc. (Texas)

DETOX Industries, Inc., of Sugarland, Texas, has developed a process for degrading targeted organic

contaminants in a water/sludge/soil matrix through the application of proprietary naturally occurring non-pathogenic organisms. This process involves the accelerated growth of these microorganisms and inoculation into the waste matrix. The result is a systematic biodegradation of the contaminants over a relatively short period of time, usually two to four months.

This technology is capable of treating liquids, sludges, and soils. Microorganisms have been developed to biodegrade the following organic contaminants: PCBs, pentachlorophenols (PCPs), creosote, oil, phenolics, polycyclic aromatic hydrocarbons (PAHs), chlordane, and myrex.

Soil samples were collected from a wood treatment site in Conroe, Texas, and a bench-scale treatability study is planned. This site contains sludge pits that were used to dispose of creosote wastes and has been selected for DETOX's demonstration.

Ogden Environmental Services

A circulating-bed combustor, developed by Ogden Environmental Services, destroys a variety of waste materials at temperatures near 1560°F (850°C). The unit employs simultaneous limestone injection, which captures acid gases and eliminates the need for a scrubber. The unit may be used to recover heat as steam or to produce electricity, hot water, or air.

This technology may be applicable to hydrocarbon wastes, soils and lagoons containing hazardous and nonhazardous wastes, oily sludges, and munitions and chemical agents. It is said to be capable of treating feedstock contaminated with PCBs, PCPs, halogenated wastes, chlorinated sludges, aniline still-bottoms, and oily and solvents sludges, among others. It has also been applied, during trial tests, to wastes such as carbon tetrachloride, freon, malathion, trichloroethylene, dichlorobenzene, aromatic nitrate, and PCBs.

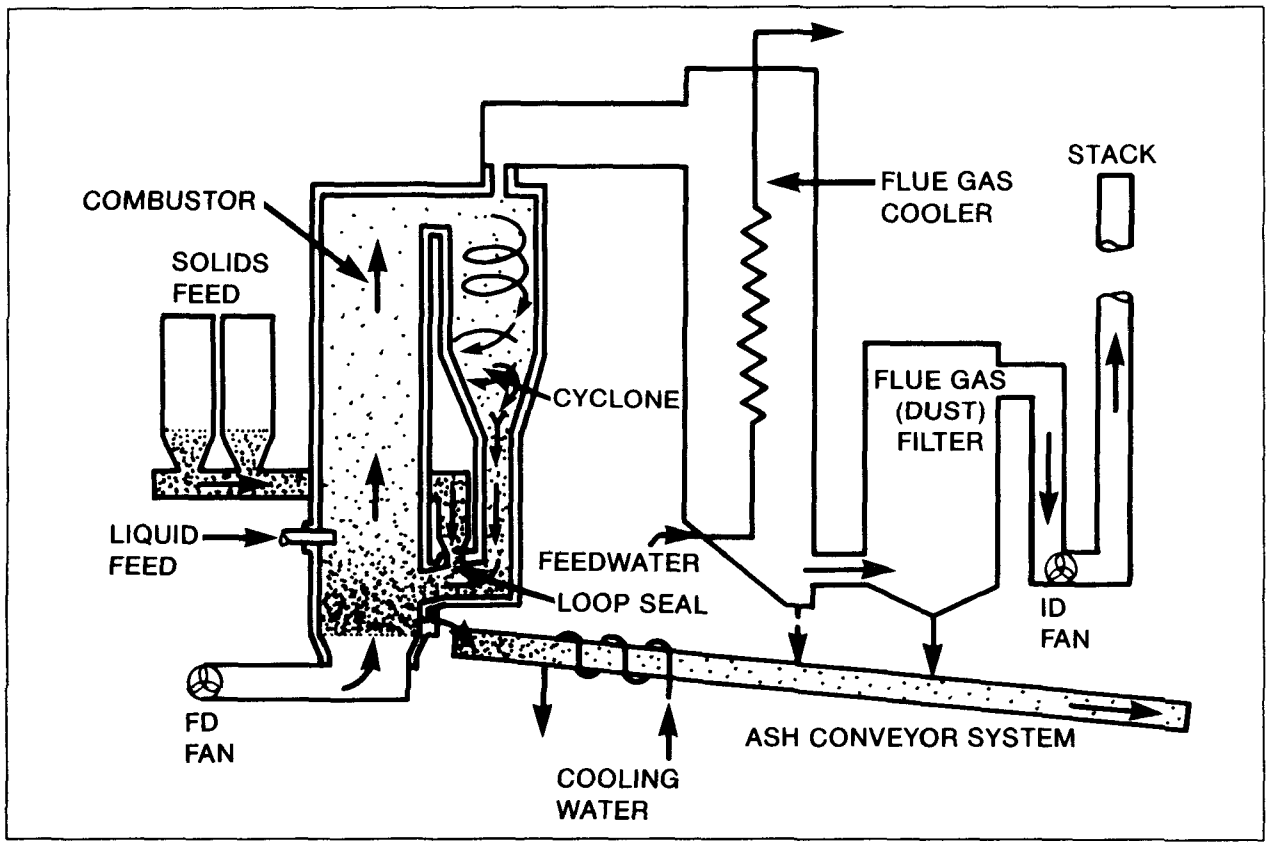


Exhibit II-7. Process diagram of Ogden Environmental Services' transportable fluidized circulating bed combustor.

This technology is one of only seven incinerators nationwide permitted to burn PCBs. Currently, EPA is preparing with Ogden to transport their 16-inch field-scale unit to the McColl Superfund site in Fullerton, California, for demonstration. Ogden would first treat PCB-contaminated soil samples from McColl using a stationary pilot-scale unit located in La Jolla, California. Legal proceedings caused an 18-month delay in the demonstration. Following the pilot- scale demonstration, a one-month field-scale demonstration at the McColl site using a 100-ton per day transportable unit will take place.

Resources Conservation Co.

The Basic Extraction Sludge Treatment (B.E.S.T.) process, developed by Resources Conservation Co. in Bellevue, Washington, is used to de-water and de-oil contaminated sludges and soils, including those containing PCBs. The process uses differences in chemical solubility of triethylamine (TEA) in water at different temperatures to break waste into three constituents: dischargeable water, oil and organics, and dry oil-free solids. Heavy metals are isolated by conversion to hydrated oxides which precipitate out and exit the process with the solids fraction.

This technology has application to difficult-to-handle oily sludges, oils, or PCB-contaminated soils and sediments. There are no special climatic restrictions to the B.E.S.T. system, although some system modifications may be required in extremely cold climates.

The system has been used as part of a removal action in Region 4 near Savannah, Georgia, and suitable sites for a formal demonstration are under evaluation, but the developer is seeking a site with accompanying funds for remedial or removal action, and this has resulted in a delay in site selection.

Westinghouse Electric Corporation

Westinghouse Electric Corporation has developed a transportable pyroplasma arc unit that treats pumpable waste at a rate of three gallons per minute. This technology uses an electric arc in an oxygen-deficient atmosphere to produce plasma gas at temperatures from 9,000°F to 36,000°F (5,000°C-15,000°C). These high temperatures break down chemicals in the waste to their atomic state. The atoms then recombine into hydrogen, carbon monoxide, hydrogen chloride, nitrogen, particulate carbon, and carbon dioxide. The product gas is scrubbed with caustic soda to neutralize and remove acid gas and to remove particulate carbon. The system is computer controlled, and the entire unit is contained in a 48-foot trailer.

Westinghouse has applied for an R&D permit for the Waltz Mill facility near Pittsburgh, Pennsylvania, and will conduct a demonstration at their facility. Wood preservative waste from a Superfund site in Maryland will be transported to the Waltz Mill facility for a demonstration in 1989.

Withdrawn SITE-001 Technologies

In July 1987, Waste-Tech Services, Inc., withdrew its fluidized bed combustor from the SITE Program due to liability issues. Westinghouse Electric Corporation received a letter in August 1988 from the EPA, informing them that their pyrolyzer technology would be removed from the program because it was not ready for a field demonstration. New York State Department of Environmental Conservation withdrew its plasma arc technology from the program in May 1988 because New York State cancelled its plans to develop this technology for use at Love Canal.

SITE-002 Technologies

Site selection is nearly completed for all of the SITE-002 projects. Preliminary sites have been selected for the projects, and treatability studies are completed or planned for most. Treatability studies test small samples of waste from the selected sites to verify that the waste has characteristics appropriate to the technology being demonstrated and to establish operational parameters.

Chemfix Technologies, Inc.

Chemfix Technologies, Inc., of Metairie, Louisiana, has developed a proprietary process (CHEMFIX) that stabilizes high-molecular-weight organic and inorganic constituents in waste slurries. This fixation/stabilization process uses soluble silicates, silicate setting agents, and additives to crosslink with waste components to produce a stable, solid matrix. The polymeric matrix displays properties of good stability, high melting point, and a rigid, friable texture similar to that of a soil. This technology is suitable for base, neutral, or acid extractable organics of high molecular weight such as refinery wastes, creosote, and wood-treating wastes.

Treatability studies performed on the synthetic soil matrix and site soils have shown promising results. A Superfund site in Oregon has been selected for a demonstration scheduled in early 1989.

GeoSafe Corporation

GeoSafe Corporation of Kirkland, Washington, will demonstrate a technology developed by Battelle Pacific Northwest Laboratory. The technology is an in-situ vitrification (ISV) process that thermally destroys organic constituents and converts contaminated soil or sludge into a glass and crystalline product. Organic pollutants are destroyed by pyrolysis and inorganic pollutants are immobilized within the vitrified mass. Both the airborne organic and inorganic combustion by products are collected in a negatively pressurized hood which draws the contaminants into an off-gas treatment system that removes particulates and other pollutants of concern. The basic configuration of the ISV process consists of an electrical network with four electrodes driven/pushed into or placed in drilled augered holes in the soil or sludge, a capture hood to collect fumes or gases from the setting and direct it to an off-gas treatment system, and the off-gas treatment system itself.

This process has been demonstrated at full-scale on radioactive wastes at the Department of Energy's Hanford Nuclear Reservation; pilot tests have also been performed on PCB wastes, industrial lime sludge, dioxins, metal plating wastes, and other solid combustibles and liquid chemicals.

The site currently under consideration is a former pesticide formulator plant, Parsons Chemical Works, Inc., in Grand Ledge, Michigan. This project is a joint effort by EPA and the State of Michigan. The surface and subsurface soils of the site are contaminated with dioxins, pesticides, and inorganic and organic compounds. It is estimated that 1,000 cubic yards of soil will be treated during the demonstration, which is expected to start in April 1989, and operate for approximately two weeks. Monitoring efforts are expected to continue for one year.

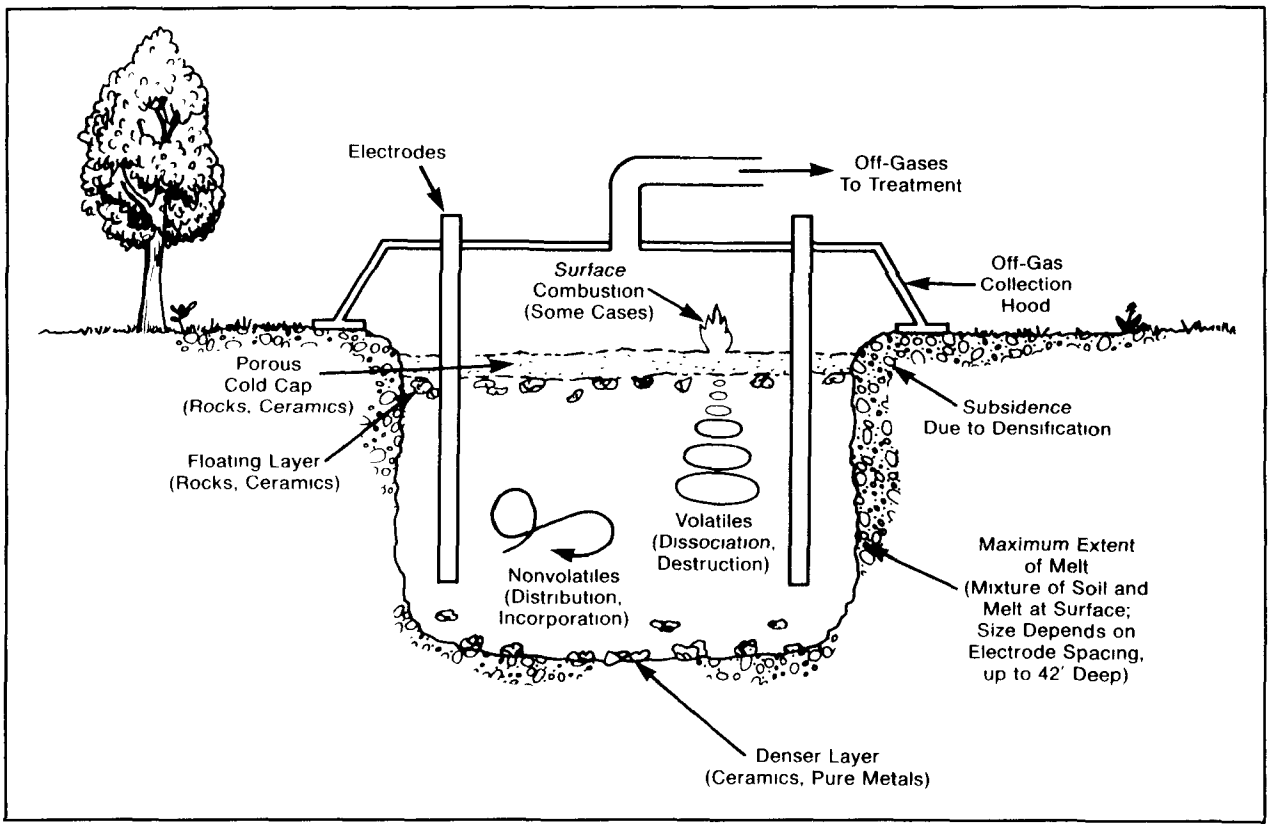


Exhibit II-8. Schematic illustration of Geo-Safe Corporation's *in-situ* vitrification process developed by Battelle Pacific Laboratory.

MOTEC, Inc.

MOTEC, Inc., of Juliet, Tennessee, has developed a portable high-energy method of organic waste biodegradation, referred to as Liquid-Solid Contact Digestion (LSCD). During this process, sludges or soils contaminated with organic compounds are first mixed with water and emulsifiers. The waste then undergoes aerobic biological treatment in a batch digester and is transferred to a polishing cell for final treatment. Following the completion of the process, the supernatant from the polisher is recycled to the primary contact tank, and the sludge is treated in land farms or reactors onsite. This technology is applicable for treating halogenated and nonhalogenated organic compounds, PCBs, dioxins, and pesticides. However, it is not suitable for inorganic-laden wastes.

Recently, treatability studies were conducted by MOTEC on soil samples from a wood-preserving site. A three-month demonstration is planned for April 1989 and will process 50-100 cubic yards of contaminated soil.

Retech, Inc.

Retech, Inc., of Ukiah, California, has developed a thermal treatment centrifugal reactor that uses plasma heat to decompose organics in a mixed solid and liquid feed. The solid components are melted and cast or granulated for disposal, while the volatile compounds are vaporized and decomposed in an afterburner.

Liquid and solid organic compounds can be treated by this technology. It is most suitable for soils and sludges contaminated with metals and hard-to-destroy organic compounds.

A Department of Energy (DOE) facility in Butte, Montana, is being considered for a demonstration of this technology in mid-1989. Plans are being made for the treatability testing, which will use a standard soil matrix. During the demonstration, the reactor will process approximately 4,000 lbs of waste at 100 lbs/hour.

Sanitech, Inc.

The Waste Processing Unit developed by Sanitech, Inc., of Twinsburg, Ohio, uses ion-exchange-like materials to selectively remove toxic heavy metals from contaminated groundwater or surface water. During the process, aqueous waste passes through a filter bed that consists of coated compounds that are attached to an inert carrier. Acid treatment of the bed recovers the captured metal ions and regenerates the bed material. This technology can be used to treat contaminated groundwaters or surface waters laden with toxic heavy metals such as zinc, chrome III and IV, nickel, cadmium, lead, copper, and mercury.

This technology is very waste-specific and as a result, six potential demonstration sites have been rejected to date. Additional candidate sites are currently under review.

Separation and Recovery Systems, Inc.

This limestone-based technology has been developed by Separation and Recovery Systems, Inc., of Irvine, California. In this process, sludge is removed from the waste pit and mixed with lime in a separate blending pit. The fixation reactions occur over a 20-minute period and are exothermic. The temperature of the material in the blending pit rises for a very brief time to around 100°C, and some steam is evolved. After 20 minutes, almost all of the material has been fixed. The reactions are completed over the next few days. The fixed material is stored in a product pile until the waste pit has been cleaned, and then the product is returned to the pit. Permeabilities of the solidified waste are expected to be low, around 10^{-10} cm/sec. The volume of the waste is only increased by 30%. This process uses conventional earth moving equipment and is, therefore, highly mobile. This technology is applicable to acidic sludges containing at least 5% hydrocarbons. It can also stabilize waste containing up to 80% organics.

This separation technology results in a sandy granular material and has been used previously in Sands Springs, Oklahoma, as part of a private responsible party evaluation of nonthermal technology alternatives. Efforts to identify a site are under way.

Zimpro/Passavant, Inc.

The wastewater treatment process developed by Zimpro/Passavant, Inc., of Rothschild, Wisconsin, combines biological treatment, powdered activated carbon treatment (PACT™), and wet air oxidation to treat aqueous waste. This technology is applicable to both municipal and industrial wastewater containing organic pollutants.

Treatability studies of the initially selected site indicated that the waste components were not amenable to biological treatment. A site in Region 2 has been tenatively selected, and planning efforts are underway.

Withdrawn SITE-002 Technologies

Air Products and Chemicals, Inc., withdrew from the SITE Program in September 1988, due to liability and indemnification issues. In October 1988, Waste Chem Corporation notified EPA of its intent to withdraw from the program.

SITE-003 Technologies

Information has been solicited from Superfund Division Directors, SITE coordinators, and technology developers on Superfund sites suitable for the SITE-003 technologies. Demonstration sites have been identified for many of these projects, and initial planning activities are underway.

Biotrol, Inc.

Biotrol, Inc., of Chaska, Minnesota, has developed a soil washing process for soils contaminated with organic wood treating chemicals. A mobile, 500 lb/hr pilot-scale unit has been tested at a wood-preserving site in Minnesota. The system is applicable to soils that are predominantly coarse silts, sands, and gravel, with a majority of the soil particles greater than 20 to 70 microns.

The process is based on a series of physical separation and washing steps using water as a carrier for the soil. It achieves a significant volume reduction by separating washed soil from a concentrated contaminant stream (clays and organic residue). For the washed soil fraction, contaminant removal efficiencies of 90 to 95 percent have been achieved.

There are two major waste streams: process water and fine solids (less than 20 to 70 microns). The process water is treated in a fixed-film biological reactor. Treatment alternatives for the fine solids could include biological treatment, stabilization, solvent extraction, or incineration.

The technology is designed to treat soil contaminated with PCP up to 5,000 ppm; oil, grease, and creosote up to 5%; and hydrocarbon petrochemicals up to 5 to 10%. A wood-preserving facility in Minnesota contaminated with PCP is being considered for the demonstration.

Biotrol, Inc.

Biotrol, Inc., has also developed a system for the treatment of toxic organics in wastewater streams. The organics are degraded by microorganisms which are immobilized in a submerged, fixed-film bioreactor. Compounds which may be successfully treated include PCP, PAHs, and petroleum hydrocarbons.

The degradation is accomplished primarily by indigenous microorganisms; however, the system can be amended with specific microorganisms with special metabolic capabilities. For example, a bioreactor treating a waste stream containing PCP -- a compound normally resistant to microbial degradation -- can be amended with an organism with the specific capability to degrade PCP. Biotrol has previously demonstrated treatment of wastewater containing up to 90 ppm PCP. Removals from 95 to 99% were achieved with a one hour hydraulic retention time.

The system is primarily applicable to treatment of groundwater; however, treatment of process and lagoon waters has also been demonstrated. Biotrol has built a mobile system with a nominal capacity of 5 gal/min. The bioreactor and all ancillary equipment are mounted in an enclosed trailer. A PCP-contaminated site in the State of Minnesota is being investigated for the demonstration.

CBI Freeze Technologies, Inc.

CBI Freeze Technologies, Inc., of Plainfield, Illinois, separates contaminants from aqueous waste by freezing the waste. This new technology operates on the principle that when water freezes, the ice crystal structure naturally excludes all contaminants from the water molecule matrix. Thus, when water containing hazardous waste is cooled below its freezing point, pure water crystallizes out and may be physically separated from the hazardous constituents. This technology uses a secondary freezing concept, i.e., the refrigerant does not come into direct contact with the contaminated solution and, therefore, does not have to be separated from the waste stream.

CBI Freeze hopes to demonstrate that its trailer-mounted, 1,500-gallon/day unit may be used to treat aqueous wastes containing from 1-10% dissolved solids. Liquid wastes containing ions, metals, organic compounds, and pesticide rinse waters are suitable for this technology. Four potential sites for the CBI Freeze demonstration are under review.

Chemical Waste Management, Inc.

Chemical Waste Management, Inc., of Riverdale, Illinois, has developed a mobile thermal desorption system, called X*TRAX™, that has been designed to treat waste

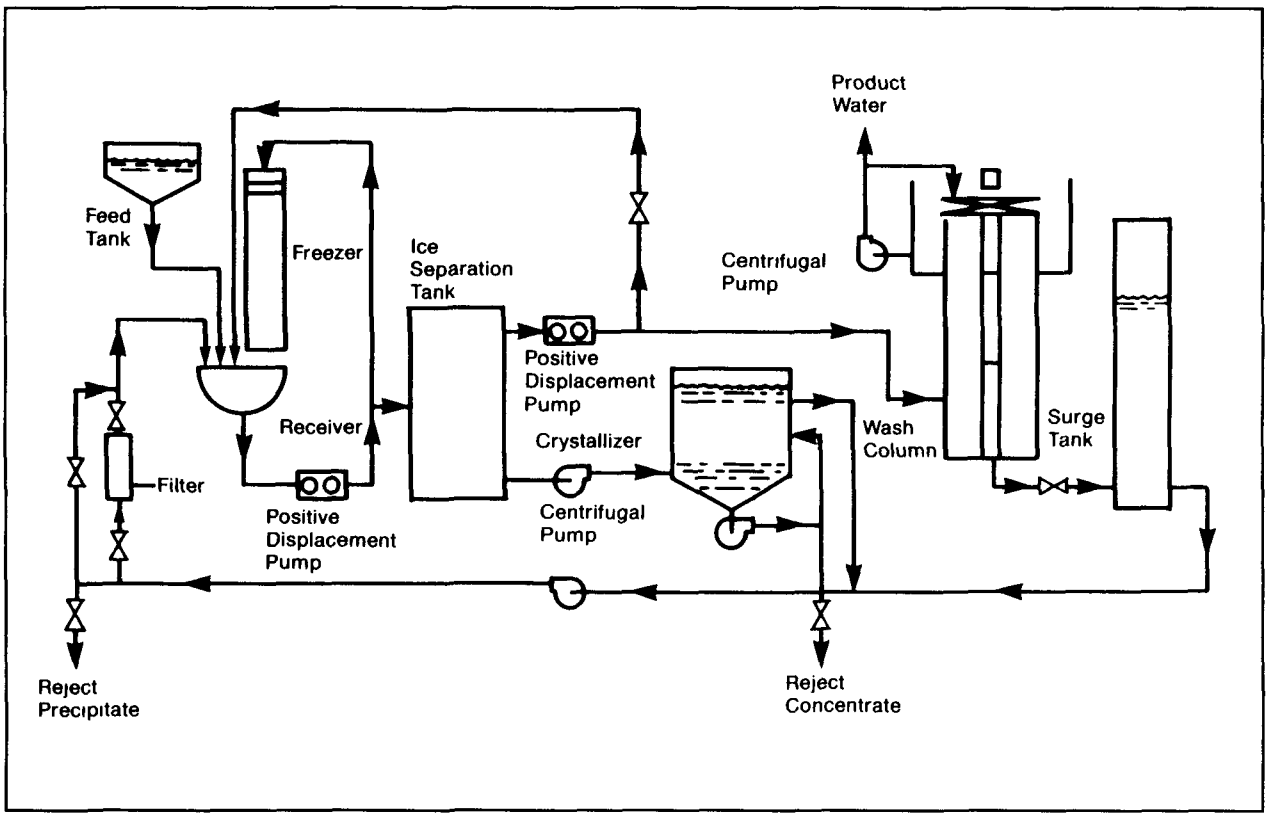


Exhibit II-9. CBI Freeze Technologies, Inc.'s physical freeze concentration process.

solids or sludges containing organics. The X*TRAX™ system employs a process in which solids with organic contamination are indirectly heated, driving off the water and organic contaminants and producing a dry solid containing trace amounts of organic residue. The system consists of two parts: the dryer trailer and off-gas trailer. The dryer is an indirectly-fired rotary kiln. An inert nitrogen carrier gas is recirculated through the kiln to transport the volatilized water and organics to the off-gas handling system. In the off-gas handling system, the volatilized materials are condensed in a three-stage cooling and condensing train, removing most of the water and most of the volatile and semivolatile organics. The nitrogen is then passed through a carbon adsorption system to remove the remaining organics.

The X*TRAX™ is designed to remove organic contaminants from solids and sludges with a pH between 5 and 11 and that contain less than 10% organics and 60% moisture.

Detox, Inc. (Ohio)

Detox, Inc., of Dayton, Ohio, has developed a new biological process that treats aqueous wastes that have low concentrations of organics. The submerged fixed-film bioreactor relies on aerobic microbial processes to metabolize contaminants that are present in a liquid waste stream. The design of the system allows for the biological treatment of liquids containing low concentration of readily biodegradable materials to discharge concentrations in the low ppb range. A typical Detox system consists of an above ground fixed-film reactor, supplemental nutrient storage tank and pump, pump tank with pump, cartridge filter, and an activated carbon filter. This technology is typically used to treat groundwater and industrial process waters but is also applicable to lagoon and/or pond waters. The treatment is particularly effective in treating alcohols and ketones that are not amenable to carbon adsorption.

Detox is working with EPA to develop a demonstration plan and a health and safety plan. Efforts are underway to find a suitable site for a demonstration project using this technology.

E.I. DuPont de Nemours, Inc.

E.I. DuPont de Nemours, Inc., of Newark, Delaware, has developed a microfiltration process that removes heavy metals and suspended solids from aqueous wastes. The treatment involves a new automatic filtration

technology based on DuPont's new Tyvek microfilter media and an Oberlin automatic pressure filter for unattended submicron filtration. Wastes are treated as necessary by a basket strainer or bag filter to remove debris and solids, by polymer flocculants and coagulants to increase particle size, and by chemical or powdered activated carbon treatment to remove soluble constituents. The system may be used to treat any liquid waste that contains hazardous solids or soluble constituents that can be precipitated or removed by powdered activated carbon (e.g., heavy metals, metal oxides and hydroxides, radioactive constituents, organic precipitates, waste catalysts, and cyanide waste) and to treat wastes with total concentrations of 25-25,000 ppm. Solids are usually limited to less than 5,000 ppm and particle sizes greater than 0.1 microns.

Two candidate sites for the demonstration are being reviewed, and DuPont has applied for a Cooperative Agreement with the Agency.

Freeze Technologies Corporation

Freeze Technologies Corporation of Raleigh, North Carolina, uses freeze crystallization to separate organics and inorganics from aqueous and liquid wastes. The ice crystals may then be recovered and washed with pure water to remove adhering brine contaminants. Residuals generated by this process include treated water and concentrated waste sludge, typically 10% of the original waste volume. Freeze Technologies currently has a mobile pilot system that will process up to 1,000 gallons/day, and a 15,000-gallons/day unit is under construction. This technology will remove both organic and inorganic, and ionic and non-ionic species from contaminated aqueous streams. It works on both surface waters and groundwaters as well as directly on process wastes.

Four candidate sites have been identified for the demonstration and are under review. In addition, Freeze Technologies is working with the State of California to locate a demonstration site under the State's Innovative Technologies Demonstration Program.

Silicate Technology Corporation

Silicate Technology Corporation of Scottsdale, Arizona, has developed a method to stabilize metals and high-molecular-weight organics in soils and sludges. This new technology uses a proprietary reagent, FMS silicate, to selectively adsorb organic contaminants prior to mixing the waste with cementing material to form a solid, high-strength mass. The process can use standard debris screening and mixing equipment (such as cement trucks) and has already been used at hazardous waste sites.

According to Silicate Technology, this process may be used to treat the following contaminants in unlimited concentrations: metals, cyanides, fluorides, arsenates, and ammonia, and other organics as well as higher weight organics, such as halogenated, aromatic, and aliphatic compounds.

The Tacoma Tar Pits in Tacoma, Washington, is the Superfund site that tentatively has been selected for this demonstration and extensive treatability tests are being conducted.

Toxic Treatments (USA), Inc.

Toxic Treatments, Inc. (TTUSA), of San Mateo, California, has developed the Detoxifier, an in-situ method of removing volatile and some semivolatile organics from soil, using steam and heated air to strip the contaminants. The transportable unit uses drills that have been modified to allow for the expulsion of steam and air through the cutting blades. First, the soil is made permeable by the blades on the drills. Then steam and air are injected to strip the organic contaminants and carry them to the surface. A shroud covers the treatment area to trap and transport the stripped volatiles to the treatment trailer. The water and organics in the gases are condensed and the water and organics separated and recovered.

The system is most practical for contaminants with boiling points of less than 300-350°F. Thus, semivolatiles with some vapor pressure at these temperatures will be removed to some extent. The remediation depth must be less than 27 feet, and the ground should contain no obstacles larger than 14 inches in diameter.

Work is proceeding toward using the Annex Terminal site in San Pedro, California, for demonstrating the Toxic Treatments technology in February 1989. The field treatability study at this site has been completed and a report submitted to the State of California.

Ultrox International

Ultrox International of Santa Ana, California, has proposed the use of its UV/oxidation technology and equipment to oxidize organic compounds found in groundwater. Ultrox's process uses combinations of ultraviolet

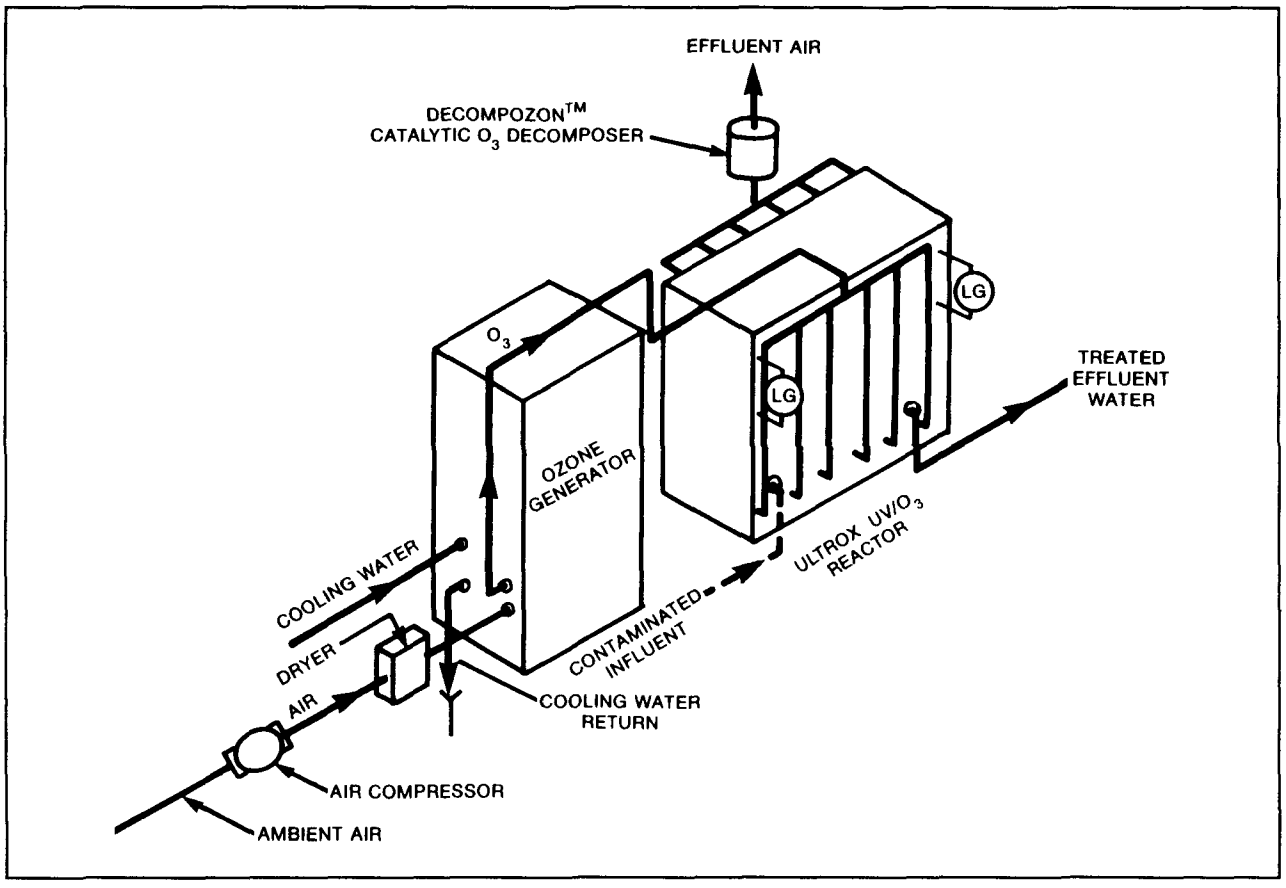


Exhibit II-10. Ultrox International's U/V Oxidation process.

radiation, ozone, and hydrogen peroxide to oxidize organic compounds in water. The final products of the reaction are salts, water, carbon dioxide, and possibly some organic degradation products. The reactor is the center of the process, where UV radiation and oxidants are brought into close contact with contaminated water. The approximate UV intensity and ozone/hydrogen peroxide dosages are determined from pilot-scale studies. The high reaction rate and treatment efficiency are attributed to the direct photolysis of certain organics by the UV light and the generation of hydroxyl radicals which have a high oxidation potential. The system has been developed and used to destroy explosives, pesticides, VOCs, PCBs, and other organic compounds in wastewater and groundwater.

Ultrox has various size units available for bench-, pilot-, and full field-scale commercial use. A proposed demonstration project on a Superfund site with contaminated groundwater is scheduled to begin in early 1989.

Weston Services, Inc.

Weston Services, Inc., of West Chester, Pennsylvania, has developed the LT3 (Low-Temperature Thermal Treatment) process used to decontaminate soil using a low-temperature (indirect heat) process to volatilize the contaminants from the soil, followed by high temperature incineration of the exhaust fumes in an afterburner. The Weston unit can process eight tons/hour and is designed to remove organic contaminants with high volatility. Much of the research work on the technology was provided by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA).

The demonstration will be conducted at Tinker Air Force Base, Oklahoma City, Oklahoma. At this site, leakage occurred where fuel and solvent storage handling and transfer operations were located, and surface soil in this area is contaminated from spills and leakage. At Tinker Air Force Base, jet propulsion fuel (JP-4) and

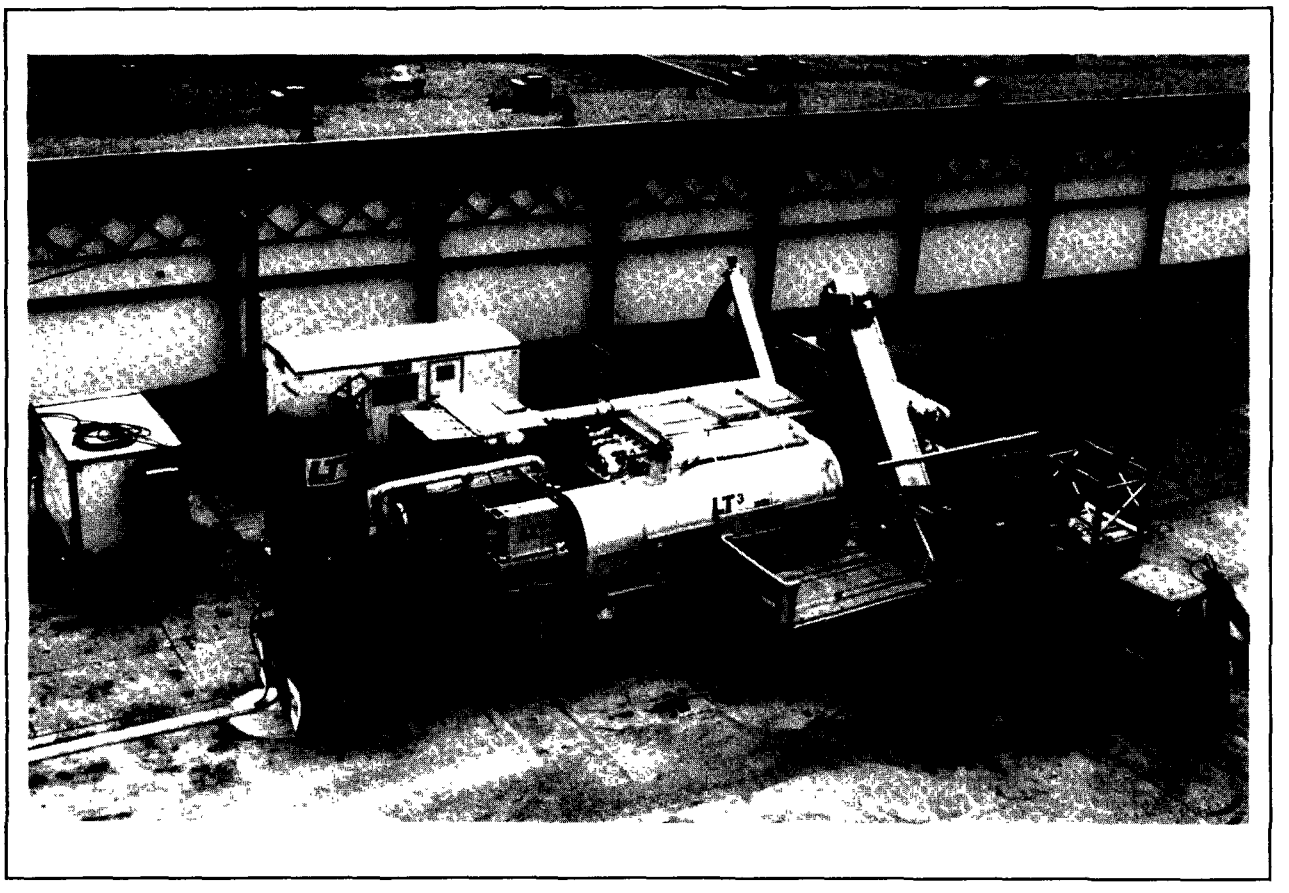


Exhibit II-11. Weston Services, Inc.'s Low-Temperature Thermal Treatment (LT3).

chlorinated organics such as trichloroethene (TCE) have caused a contamination problem. Since the LT3 has low-energy requirements, its innovation and commercialization should provide a cost savings in processing soils that contain volatile organic compounds.

3. Future Activities of the Demonstration Program

A major challenge of the SITE Program is to gain the participation of firms that are innovators in the field of hazardous waste treatment. The program is interested in evaluating individual technologies that are representative of generic groups of technologies. The program is not interested in distinguishing between individual vendors. Efforts will continue to inform new technology innovators of the program and to encourage their participation. For example, a status brochure is prepared prior to selected conferences and is widely distributed through a SITE program exhibit in an effort to reach new technology developers. The announcement of the annual solicitation for new technologies was published in 80 trade journals, and sent directly to 800 potential developers.

The next solicitation will be the program's fourth and will specifically request those technologies that will address the following problem areas:

1. Treatment of solids (including soils and sludges) containing either organic or inorganic constituents, or both.

2. Material handling techniques that improve pre-processing and post-treatment operation.

3. Unit operations used in combination to create treatment trains for specific wastes.

4. Treatment of large volumes of soils with relatively low concentrations of organics and/or inorganics.

5. Biological technologies for treating organic contaminants in soils and sludges.

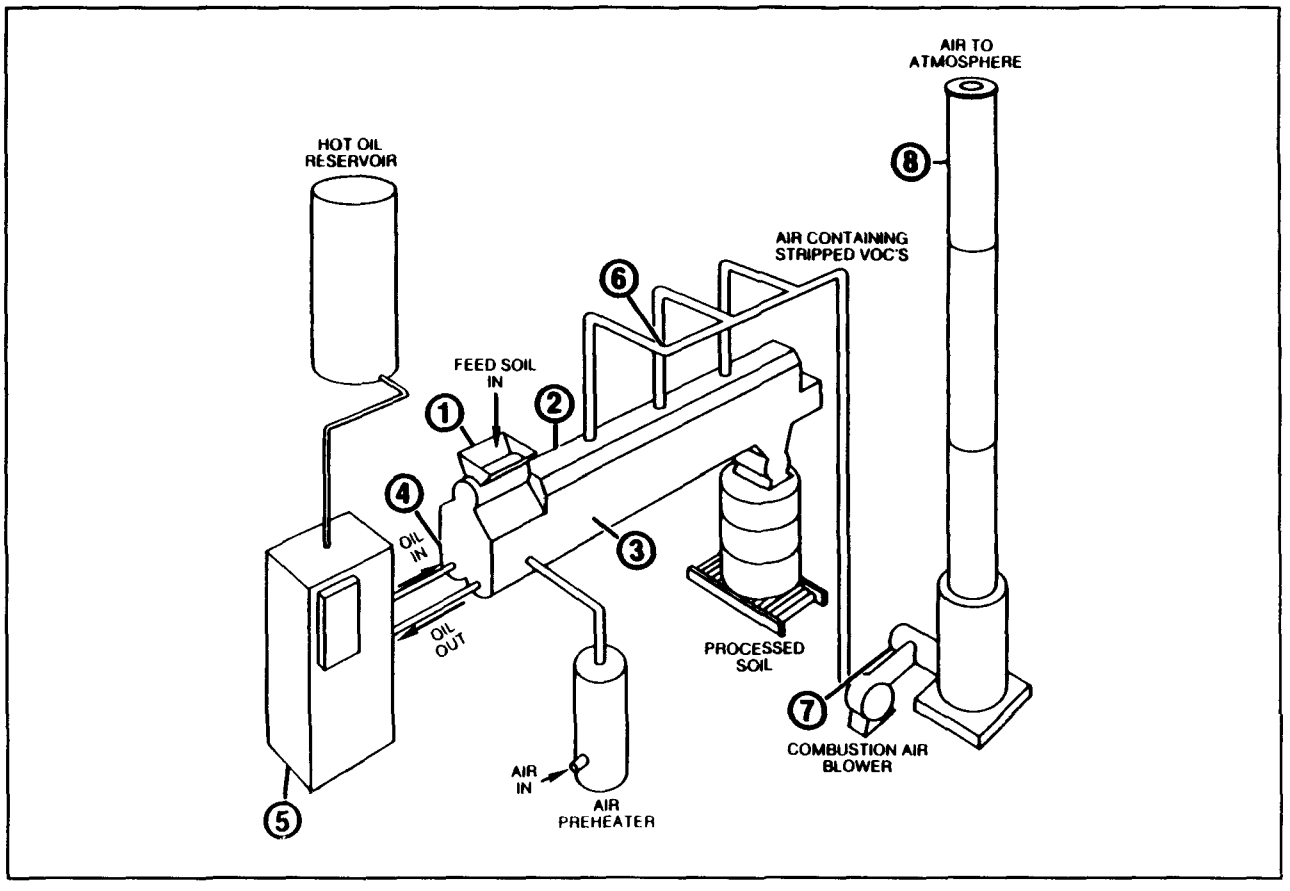


Exhibit II-12. Schematic illustration of Weston Services, Inc.'s Low-Temperature Thermal Treatment (LT^3) process. Components include: (1) soil feed hopper; (2) thermal processor; (3) Holo-Flite screw; (4) trough jacket; (5) oil heating system; (6) off-gas emission monitoring system; (7) afterburner; and (8) stack testing system.

6. In-situ treatment processes for soils and groundwater that serve as alternatives to conventional pump and treatment approaches to remediation.

7. Separation of radioactive materials from wastes.

A major focus in the upcoming year will be the field demonstration of approximately 17 technologies that are currently in the SITE Program. Efforts will be directed to expediting the report preparation process and providing interim results through the Clearinghouse.

4. Estimating Implementation Costs

SARA requires the SITE Program to determine whether or not each demonstrated technology is "effective and feasible." The selection of a cleanup solution involves trade-offs among alternative criteria, including cost. Thus, SITE demonstrations must be concerned with both the engineering and economic aspects of implementing a technology. Estimating the range of each technology's implementation cost is a critical aspect of the SITE Demonstration Program.

Implementation costs include capital, and operating and maintenance costs. An economic model for estimating the costs (dollars per ton) will be prepared for each SITE demonstration evaluation treatment technology. For example, in Section B.1, "Completed Demonstration Projects" for the Haztech/Shirco Transportable Infrared Incinerator Unit, an economic analysis indicated that during the remedial action, the costs ranged from $196/ton (when the unit operated at 80% capacity) to $795/ton (when the unit operated at 19% capacity). These two costs represent the upper and lower ranges of the possible costs per ton for the overall operations of the Shirco Unit during this cleanup action. Details on the assumptions that were used in preparing these cost estimates are provided in the EPA report, Technology Evaluation Report SITE Program Demonstration Test, Shirco Infrared Incineration System, Peak Oil, Brandon, Florida.

The SITE Applications Analysis Report will provide more information on projected costs for applying a specific treatment technology to a potential Superfund removal or remedial action, and a more comprehensive picture of the technology's potential for Superfund applications. To provide a completely objective perspective (or projection) on unit cost estimates, a special section within the report (unimpeded by the Agency's review process) has been set aside to allow the vendor an opportunity to present claims regarding the process, including the vendor's own cost projections.

Implementation Costs Methodology

An estimated range of potential costs is necessary to compare the effectiveness of one technology with another. While cost alone will not be the sole criteria for accepting or rejecting any technology, relative costs will be critical. The foundation for the SITE economics methodology is based on standard cost engineering approaches used for developing cost estimates of industrial processes.

The most important part of the cost estimating process is selecting those assumptions that will serve as the basis for the final estimate. It is essential that the basis for the cost estimates and the assumptions made in deriving these estimates are clearly stated. One approach to estimating implementation costs would be to standardize each of the SITE cost analyses around a typical cleanup scenario. However, this method was ruled out due to the tremendous variability in the size and composition of Superfund sites. No economic analysis can hope to provide cost figures that take into account all of the operating parameters that ultimately impact cost, but good economic analysis insures that those assumptions that form the basis for the estimate are explicitly (and clearly) stated.

Implementation costs will be presented in a format that offers a simple framework for presenting assumptions. Costs will be partitioned into categories, each reflecting typical cleanup activities encountered on Superfund site. This forces key assumptions within each category to be explicitly stated. The ultimate goal is to provide the reader with sufficient background information to allow an independent reconstruction of the estimates. Individual analysts can easily modify the assumptions and tailor the economic analysis to fit their own unique site and waste conditions. More important, readers will be able to use the framework as a tool to enhance technology comparisons.

The 12 cost categories presented below represent costs within specific activity-related groups.

- *Site Preparation Costs* --including site design and layout, surveys and site investigations, legal searches, access rights and roads, preparations for support facilities, decontamination facilities, utility connections, and auxiliary buildings.

- *Permitting and Regulatory Costs*--including permit(s), system monitoring requirements, and development of sampling and analytical protocols and procedures.

- *Equipment Costs* --by subsystems, including all major equipment items such as process equipment, materials handling equipment, and residual handling equipment. Also included are design considerations such as equipment specifications, and throughput and utilization rates.

- *Startup Costs*--including mobilization, shakedown, testing and initiation of environmental monitoring programs.

- *Labor Costs*--including dollars, labor rates, and level of effort for supervisory and administrative staff, professional and technical staff, maintenance personnel, and clerical support.

- *Supplies and Consumable Costs*--including chemicals and other raw materials, maintenance materials, and expendable material (listed with quantities consumed).

- *Utilities*--including electricity, fuel, process steam and water, and compressed air (listed with quantities consumed).

- *Effluent Treatment and Disposal Costs*--both onsite and offsite facility costs, including air treatment, wastewater disposal and monitoring activities.

- *Residuals and Waste Shipping, Handling, and Transport Costs* --including the preparation for shipping and actual waste disposal charges.

- *Analytical Costs*--including laboratory analyses for operations and environmental monitoring.

- *Facility Modification, Repair, and Replacement Costs*--including design adjustments, facility modifications, scheduled maintenance, and equipment replacement.

- *Site Demobilization Costs*--including shutdown, site cleanup and restoration, permanent storage costs, and site security.

While these categories encompass the typical operations associated with Superfund cleanups, they may not be applicable to all SITE technologies. Data regarding a given cost category may be unavailable, unsubstantiated, or even irrelevant. By focusing on these 12 specific categories, the analyst must make a conscious effort to note the omission of data within any one category. Thus, the reader will not be led to false conclusions and will be able to make appropriate adjustments when conducting relative cost comparisons.

This approach differs from traditional cost engineering practice in that costs are no longer placed into strict capital and operating cost categories. While that has proven to be a useful approach for conducting design-level cost estimates, it is an approach that makes it more difficult to detect the omission of critical cost components. In addition, grouping of related cost items into logical categories facilitates the comparison of implementation costs among different technologies.

The final step in estimating implementation costs for a technology is to return to the information derived from the engineering evaluation and critically review those data from the prospective of process economics. This means determining the cost implications arising out of deviations from typical operating parameters. The goal is not to provide a precise cost analysis for each and every scenario, but rather to alert the reader to those conditions that experience suggests are likely to have a major impact (positive or negative) on costs.

C. REFINEMENT OF THE DEMONSTRATION PROCESS

The primary focus of the SITE Program is the demonstration and evaluation of alternative technologies for treating hazardous wastes. One of the major accomplishments of the program during 1988 is the completion of eight technology field demonstration projects. There are currently 30 different technologies, representing five separate process categories (i.e., thermal, biological, solidification/stabilization, chemical, and physical), being evaluated in the SITE Program. The EPA SITE Project Managers have learned a great deal from their experiences with the previous technology demonstrations. The demonstration process has been refined to reflect the lessons learned during the past two years and has remained a dynamic process to facilitate improvements that will enhance the success of the program. Demonstration process refinements that have been implemented to date include establishing policies, guidelines, and procedures to streamline and improve: (1) acceptance into and removal from the SITE Program, (2) matching of demonstration sites for specific technologies, (3) demonstration planning and implementation, (4) preparation of the Demonstration Report and Applications Analysis Report, and (5) overall management of the SITE demonstration projects.

1. Technology Selection

EPA implemented three major refinements to the technology selection process during Fiscal Year 1988. The first refinement is the establishment of a "fast- track" policy for streamlining the acceptance of technologies ready for demonstration into the SITE Program. The second is the establishment of project status categories and an "exit policy." The third refinement is improvement of the solicitation and proposal review process.

"Fast-Track" Process

The "fast-track" process is designed to encourage technologies that are scheduled for field application to participate in the SITE Demonstration Program. The "fast-track" process supplements the conventional solicitation process to ensure that valuable opportunities for evaluating these innovative technologies are not prohibited by delays that can result from the annual solicitation schedule. Technologies considered for "fast-track" entry into the program must meet the following criteria:

- The technologies must be ready for demonstration.

- An appropriate site must be available for demonstration of the technology.

- A failure to initiate activity quickly would result in a lost opportunity for the SITE Program.

- Meet the evaluation criteria contained in the solicitation.

Candidate technologies are reviewed and evaluated according to these criteria, and if deemed acceptable, an EPA investigative team is immediately sent to the demonstration site to collect information that would normally be submitted in response to the SITE solicitation. EPA then initiates a Cooperative Agreement with the developer and begins to develop a work plan. To date, two SITE-003 projects have been accepted under the "fast-track" process, including Chemical Waste Management, Inc.'s Rotary Thermal Desorber (X*TRAX™) and Weston's Low-Temperature Thermal Treatment (LT3) technology. EPA has also taken steps to shorten the review period for these proposals in order to streamline the technology selection process.

Project Status Categories and "Exit Policy"

In the first two years of the SITE Program, it became apparent that acceptance of a technology into the program did not ensure that an acceptable demonstration site, agreed upon by both EPA and the developer, could be quickly identified. Problems encountered by some participants in developing their technologies and preparing for demonstration have led to the identification and definition of four SITE project status categories.

All technologies accepted into the SITE Demonstration Program are assigned a project status by EPA. Project status is identified under one of the four following categories: ACTIVE, COMPLETED, REMOVED, or REENTRY.

- ACTIVE. This denotes that a project is progressing satisfactorily. Generally this means that the project remains within six months of scheduled milestone dates and will be finished within two years of acceptance into the program.

- COMPLETED. This denotes that the field demonstration has been finished, equipment has been decontaminated, any residuals have been properly disposed of, the final Demonstration and Applications Analysis Reports have been reviewed and accepted by EPA, and the Cooperative Agreement has been closed out. Once the project has been completed, no further work by EPA or the developer is required.

- REMOVED. Sufficient progress has not been made toward the eventual completion of the project. By removing a project from the program EPA can eliminate further expenditures of manpower in implementing a demonstration. Although EPA reserves the right to unilaterally remove a project from the SITE Demonstration Program, the Agency recognizes that this decision can have possible implications for the developer and for the commercialization and implementation of the technology. Thus, EPA will carefully consider and consult with the developer before action is taken. Since the inception of the SITE Program, only one project has been classified under REMOVED status.

It is essential that the technologies accepted into the SITE Program be demonstrated and evaluated as soon as possible. Longer-term delays in conducting the technology demonstration may result in the technology being classified as "removed" from the program, either voluntarily or involuntarily. Concerning the latter, EPA has developed an "exit policy" that assists EPA in deciding to remove technologies from the program when there are serious reservations concerning the developer's capability and/or willingness to conduct a demonstration project. These reservations may include such issues as technology readiness (for field-scale demonstration), inability to find a waste stream for the demonstration that is mutually agreeable to both EPA and the developer, or that the technology is not applicable to treatment of Superfund wastes.

- REENTRY. Developers that have been removed from the program, either voluntarily or involuntarily, will be able to request that EPA reconsider ACTIVE status for their technology if the conditions that warranted removal are corrected and no other conditions that may cause removal are present. The designation of the project status is determined and revised by EPA.

However, prior to changing the status of any project, EPA must provide written notice to the developer citing the reasons for the proposed change.

Solicitation and Proposal Review

EPA has refined and improved each SITE solicitation that has been issued since SITE-001. For the selection of SITE-003 projects, EPA met with the developers during the proposal review process to allow developers to clarify confusing issues or add any information required by the Agency to better understand the proposed technology treatment process. EPA streamlined the solicitation process by reducing the technical details required in the proposal and providing more experienced reviewers to evaluate the proposals (especially with the institutional experience gained in the SITE-001 and SITE-002 reviews).

2. Site Selection

The Agency recognizes impediments in the initial process of selecting the most appropriate site for a demonstration and has taken efforts to streamline it for the SITE-003 technologies. Screening of sites before technologies enter the SITE Program will hasten both the site selection process and initiation of the demonstration. It is preferable to identify sites early in the demonstration planning process to minimize delays to the demonstration if problems are encountered. SITE Project Managers will be working more closely with the Regional Offices and the developers to identify demonstration sites for the technologies. These efforts have reduced the time required for the selection of demonstration sites for SITE-003 projects by 50%.

EPA has refined the site selection process by:

- Categorizing the information requested in the SITE-003 solicitation responses concerning required demonstration sites and wastes so that the information is immediately available when the project is accepted in the SITE Program.
- Requesting suggestions for demonstration sites from the developers in the proposals.
- Increasing the involvement of the SITE Project Manager, developer, Regional staff, States, and OSWER staff in the entire site selection process.

To hasten the site selection process and initiation of demonstrations, States that are testing the same or similar technologies as in the SITE Program are actively participating in the site selection process. The Regions will be invited to contribute to the review process for the SITE-004 proposals. Certain states, including Delaware, New Jersey, Louisiana, Michigan, Oklahoma, Illinois, and California, have expressed an interest in helping the Agency to identify appropriate sites for demonstrations. California has implemented a program very similar to the SITE Program and has expressed an interest in inviting the Agency to evaluate the technologies demonstrated under its program.

In November 1988, EPA established an agreement with Region 3 to provide research and technical assistance to the Region for the selection of alternative technologies remediation and removal actions. Region 3 has also agreed to assist EPA in identifying potential sites for the demonstrations conducted under the SITE Program. EPA entered into an agreement with the State of New Jersey Department of Environmental Protection to undertake a program of cooperation in the testing and demonstration of technologies for the treatment of radiologically contaminated materials. One of the objectives of this cooperative effort is to assist in the identification of sites for the demonstration of technologies for the treatment of radiologically contaminated materials.

3. Demonstration Planning and Implementation

There have been two major refinements of the SITE demonstration planning and implementation process during Fiscal Year 1988. The first refinement concerns the use of extramural experts to review demonstration plans, QA/QC plans, and demonstration results. The second is the establishment of a treatability policy that allows limited laboratory testing of waste at non-permitted offsite facilities.

Extramural Reviews

The progress of some of the demonstrations has been delayed by the necessity for engineering modifications to field units. Most of these problems were foreseeable but unpredictable in their specific nature and are inherent in implementing innovative, complex engineering technologies in the field for the first time. To help predict these kinds of problems before startup, EPA has initiated the practice of using recognized extramural experts to critically review demonstration plans and QA/QC plans before initiating the field demonstration. These reviewers have expertise in materials handling and in thermal, chemical, physical, and biological treatment technologies and analytical techniques as appropriate for the technology being reviewed. In addition to evaluating demonstration and QA/QC plans, extramural experts are used to review Demonstration Reports and Applications Analysis Reports.

The SITE Project Manager is responsible for coordinating review activities. To date, this review procedure has been used to contribute to the Terra Vac, HAZCON, C.F. Systems, Soliditech, and International Waste Technologies demonstration projects.

Guidelines for Treatability Testing

Another refinement of the demonstration planning process, to avoid delays in initiating field demonstrations, was the establishment of guidelines for bench-scale treatability tests. It is usually preferable to conduct laboratory bench-scale treatability tests, where possible, to screen the potential applicability of a technology prior to the actual field demonstration. These guidelines allow the use of non-permitted offsite facilities for the laboratory testing of limited quantities of waste. Laboratories conducting treatability tests are required to submit a test plan and have a health and safety plan. However, EPA prefers to use permitted facilities to conduct the bench-scale treatability tests where practical.

4. Reporting Activities

A number of impediments have been encountered in preparing the final reports following completion of the demonstration. Although the delay in the production of the final reports did not impede the transfer of information to decision-makers, the Agency has taken steps to accelerate the production of the final reports. Significant improvements should be possible by concurrently generating the Demonstration and Applications Analysis Reports. The Agency is also encouraging meetings between the developer and SITE Project Manager to address and resolve reporting issues prior to initiating review of the reports. A tracking system has also been instituted so that program management can monitor progress on report development as well as other aspects of the program. As a result of these efforts, it is anticipated that significant reductions will occur in the time to produce the Demonstration and Applications Analysis Reports.

Evaluation of the performance and identification of the costs associated with each technology demonstrated under the SITE Program are essential components of the final reports. To facilitate the comparison of costs among different technologies, EPA developed standardized cost categories. The Agency has been striving to standardize specifications for the Applications Analysis Report to ensure consistency and comparability among the variety of data and cost categories for the demonstrated technologies. The standardized cost categories enable the comparison of costs from one type of technology (e.g., incineration) with another (e.g., stabilization).

In addition, EPA has developed five categories of standardized soils, each contaminated with different types of simulated wastes. These standardized soil samples are used, when appropriate, to test the applicability of the technology to handle a variety of wastes as well as to compare results between similar treatment technologies within a category. EPA expects that the data generated from these treatability tests, as well as from the demonstration, will be utilized to prepare the Applications Analysis Reports.

5. Management of SITE Projects

One of the most significant refinements in the management of the SITE Program during the past fiscal year was the establishment of the SITE Demonstration and Evaluation Branch (SDEB) at the Risk Reduction Engineering Laboratory (RREL) on July 1, 1988. This branch, staffed with 20 full-time professionals, has responsibility for managing all of the SITE Program activities. Formation of the SDEB within the Superfund Technology Demonstration Division (STDD) was a major step in focusing the management and staffing structure for the SITE Program, enabling SITE Project Managers to devote their efforts exclusively to the management of the SITE Program.

During the past two years, SITE Project Managers have learned a great deal concerning the problems that can be encountered in managing a SITE demonstration project. EPA has prepared a Guidance Document on Conducting SITE Projects that is designed to provide guidance in managing a demonstration project to those individuals who are selected to be SITE Project Managers. The guidance document also contains a generic project schedule for a typical demonstration project, the process for establishing a Cooperative Agreement with a developer, and guidance on general management and administrative issues (e.g., work assignments, quality control, demonstration planning and implementation, and community relations activities).

In addition to the Guidance Document on Conducting SITE Projects, EPA has implemented a number of activities to improve the SITE management process. Monthly meetings are held with SITE Project Managers to discuss each component of the program and the progress of the individual projects. During these meetings, Project

Managers can solicit advice, comments, and guidance from other Project Managers and SITE Program Directors. It is through these monthly meetings that SITE Program improvements and policy changes are discussed and evaluated.

6. Financial Impediments

Another lesson learned by the Agency during the first two years of the SITE Program is that there are some impediments that EPA cannot change or control to further enhance the program. One such problem is the issue of indemnification. Indemnification concerns have led not only to delays in the progress of demonstrations, but also to the withdrawal of two qualified developers from the SITE Program in 1988. Similarly, the cost of the demonstrations can be intimidating to small firms that have developed innovative technologies, and SARA sets exact and stringent limits on the Agency's ability to underwrite the developers' costs in conducting the demonstration.

Indemnification

Section 119 of CERCLA authorizes EPA to indemnify response action contractors, including persons conducting SITE demonstrations against third party liability that may result from the project. However, there are a number of limitations on the indemnification. EPA does not indemnify for all liability that may arise but only where the developer's negligence causes a release of hazardous substances, pollutants or contaminants that results in harm or damage. Moreover, while developers are not subject to a standard of strict liability under Federal law, Section 119 does not preempt strict liability under state law. EPA's indemnification applies only if the developer cannot obtain adequate insurance at a fair and reasonable price and the developer must pay the first $100,000 of any liability costs.

Financing the Demonstration

Demonstration start-up costs can exceed $1 million for complex technologies that require extended field trials, and many small developers are not in a financial position to risk this large of an investment on a demonstration project. Section 311(b)(5) of SARA places stringent limits on EPA's ability to underwrite the developer's cost in conducting a demonstration. SARA permits EPA to fund up to 50% of the developer's cost of a SITE demonstration project, only if the developer shows that it cannot fund the demonstration from its own assets and that it cannot obtain appropriate private financing on reasonable terms sufficient to carry out the project without Federal assistance. The Agency's contribution to underwriting developers' costs that meet these criteria is limited to $3 million total for any single project and $10 million total in any one year for such assistance.

Although EPA has published guidelines and procedures for obtaining Federal funds for the demonstrations, no demonstration financing has been requested from EPA. Some developers in the program are seeking sites where a third party is willing to underwrite the demonstration costs for the firm. Financial concerns have led to significant delays in some demonstrations, and may be deterring some developers from entering the program because of the substantial costs required for the demonstration.

The refinements that have been implemented during the first two years of the SITE Program reflect the knowledge gained from experience. EPA is utilizing the knowledge gained from the demonstrations conducted to date to reshape and improve the SITE Program.

III. OTHER SITE PROGRAM COMPONENTS

A. EMERGING TECHNOLOGIES PROGRAM

Technologies considered for cooperative funding under the Emerging Technologies Program are required to show promise at the bench/laboratory-scale. The emerging technologies are expected to "feed" into the SITE Demonstration Program for full-scale demonstration. Selected technology developers receive a maximum of two years' funding to enable them to move their technologies toward commercialization. The program provides awards of up to $150,000 per year, for a maximum of $300,000 over two years. However, second-year funding depends on the achievement of significant progress during the first year.

On September 17, 1987, EPA published the first solicitation of the Emerging Technologies Program (E-01). The E-01 solicitation applied to technologies showing definite promise in reducing the contaminant level in the waste or altering the contaminants' constituents to inhibit their environmental mobility. Eligible technologies were those that featured engineering solutions to problems encountered at waste sites, such as handling and treatment of contaminated air emissions, liquids (surface and groundwater and leachates), sludges, and solids (soils, debris, and sediments). The E-01 solicitation resulted in a total of 84 preproposals for consideration. Following a technical review of these preproposals, 15 offerors were invited to submit full proposals and to enter into the Cooperative Agreement application process. Twelve offerors entered the program and three declined. In September 1988, seven projects were awarded first-year funding totalling approximately $1,000,000. Projects were selected that offered solutions to critical disposal and treatment problems at Superfund sites, had high potential for the successful transition from proven concept to demonstration stage, and showed a major commitment or capability by the developer to commercialize the technology. The following seven projects received funding under the Emerging Technologies Program in Fiscal Year 1988:

- **Atomic Energy of Canada Ltd.**, Chalk River, Ontario, is preparing a laboratory-scale demonstration technology to extract dissolved toxic metals from groundwater. The technology involves the use of ultra- iltration in combination with water-soluble macromolecular compounds to selectively remove heavy metal ions from aqueous waste solutions.

- **Battelle Memorial Institute**, Columbus, Ohio, is preparing a bench-scale test of the Electroacoustic Soil Decontamination (ESD) process for in-situ treatment of soils contaminated with fuel oil, hazardous organic compounds, and heavy metals.

- **Bio-Recovery Systems, Inc.**, Las Cruces, New Mexico, is testing AlgaSORB™, a new technology for the removal and recovery of heavy metal ions from groundwaters. AlgaSORB™ is a biological sorption process based on the affinity of algae cell walls for heavy metals. Immobilized algae cells in a silica gel polymer are used in much the same way as ion-exchange resins.

- **The Colorado School of Mines**, Golden, Colorado, is experimenting with a constructed, wetlands-based treatment technology predicated on the concept of using natural geochemical and biological processes inherent in a wetland ecosystem to remove and accumulate metals from influent waters.

- **Energy & Environmental Engineering, Inc.**, Somerville, Massachusetts, is investigating a technology designed to photochemically oxidize aromatics to non-toxic species. A laser beam is used to contact and oxidize toxic organic waste particulates filtered and washed from groundwater.

- **Envirite Field Services, Inc.**, Atlanta, Georgia, is conducting a series of laboratory tests on a soil washing process that uses a blend of solvents to cleanse contaminated soils. The solvents are then removed from the soil by steam stripping. The tests will determine how different soils separate from solvents using pressure filtration and centrifugation.

- **The Western Research Institute**, Laramie, Wyoming, is conducting several tests to recover oil and water from soil using conventional oil recovery technology and controlled injections of steam and hot and cold water. Residual organic pollutants in the soil are biodegraded to remediate the hazardous oily waste.

Future Activities

Five of the E-01 emerging technologies are rapidly progressing toward bench-scale testing and work is beginning on pilot-scale units. The E-01 projects will be applying for second year funding.

EPA issued its second solicitation of the Emerging Technologies Program (E-02) on July 8, 1988. The E-02 solicitation focused on technologies that can handle complex mixtures of hazardous organic and inorganic contaminants in sludge and soils by either in-situ or surface processes that separate, remove, destroy, detoxify, or stabilize the contaminants or provide for improved solids handling and pretreatment. Technologies that are applicable to only treating aqueous or air streams were considered but were of less interest. Likewise, technologies applicable to problems that exist at only a few Superfund sites were considered less desirable than those applicable to numerous Superfund sites.

Sixty preproposals were received in response to the E-02 solicitation. These preproposals were reviewed by EPA on October 18-19, 1988. Invitation and rejection letters were sent out on November 23. Seventeen offerors were invited to submit proposals and participate in the Fiscal Year 1989 Cooperative Agreement application process to be completed by January 17, 1989. Approximately $1,000,000 will be available to fund the first year of the selected E-02 emerging technology projects. Extramural reviewers will be utilized to review applications for second year funding for the E-02 projects.

There is a progressive trend in the SITE Program toward emphasizing in-situ technologies that address the treatment of soils and sludges, the treatment of mixed wastes containing low-level radioactive material, materials handling, and unit processes used in treatment trains. The future Emerging Technologies Program solicitations will continue to emphasize technologies that are applicable to treating complex mixtures of hazardous organic and inorganic contaminants in sludges and soils, as well as those technologies that are applicable to remediating numerous Superfund sites.

B. TECHNOLOGY TRANSFER PROGRAM

The Technology Transfer Program component of the SITE Program involves all of the community relations, information dissemination, and technical assistance activities that support the other four components of the SITE Program. The technology transfer strategy focuses on compilation and dissemination of SITE Program results to various audiences. The purpose of the technology transfer activities is the development of an interactive information exchange network that consolidates information on existing hazardous waste treatment technologies to assist those making hazardous waste remediation decisions. The primary audience of SITE Program data is Regional and State managers of Superfund cleanup activities, who often supervise the work of contractors and potentially responsible parties. Additional audiences include other Federal Agencies, the engineering community, the pollution control industry, and the interested public.

The Technology Transfer Program encompasses a variety of public outreach and information dissemination programs and activities, including:

- *Alternative Hazardous Waste Treatment Technologies Clearinghouse*. The Clearinghouse was initiated in November 1987, and is presently composed of three major components: (1) a hotline, (2) an electronic bulletin board, and (3) a reference library. The Clearinghouse was designed to be implemented in three successive phases. Phase I of the Clearinghouse consists of these three components and has been in operation since November 1987.

  Under the current Clearinghouse format, a user with a technical information request can contact the hotline or access the bulletin board and is directed to a contact person at a Regional Office or research laboratory and an existing data source. These data sources, resident at different geographic locations, exist in various formats (hard copy and automated) which are not directly compatible. To access a particular data source requires the user to be knowledgeable about the structure and retrieval capabilities of that source or to interact with an individual at the facility who has this understanding and experience. This process must be repeated for each data source. Phase II, under development since March 1988, involves expanding the Clearinghouse to serve as an interactive information retrieval system. Implementation of Phase II will involve expanding the role of the Clearinghouse to serve as a true information retrieval system through the development of a centralized computer database network. This network will include key word search capabilities as well as two-page abstracts on technical information from each database. An operator will utilize the existing Clearinghouse components and will integrate the existing hazardous waste data sources and SITE Program data into a comprehensive searchable resource. The Clearinghouse, under Phase II, will enable a user to access a central source of information on hazardous waste treatment technology that can search existing data sources, provide comprehensive searches of online

databases, conduct technical evaluations of existing data, and serve as an interface with the various EPA research laboratories.

A working prototype of the Clearinghouse database was developed in August 1988. This prototype contains information from a variety of data sources, including the SITE Program, industry, and several State agencies. Ongoing activities include further development of the computerized database and evaluation and acquisition of new data sources. It is anticipated that the Clearinghouse database network will be available to respond to user requests by January 1989. The Regions and States have expressed interest in becoming actively involved in the Clearinghouse network.

- *Technical Assistance to Regions, States, and Cleanup Contractors*. EPA SITE Project Managers are available to assist technology users in the evaluation of technologies for specific remedial/removal measures. In conducting SITE demonstration projects, the Project Managers receive operational and process information that allows them to provide quick-response technical assistance to Regions, States, and cleanup contractors.

- *SITE Brochures, Publications, Reports, and Videos*. SITE brochures are prepared twice each year, one for the annual RREL Symposium and the other for the Superfund Conference and Exhibition. The brochures provide a brief background of the SITE Program and its components. It contains brief technology descriptions for the SITE Program projects and the progress and accomplishments of the program to date. In addition, the brochures identify ways to obtain information on the SITE Program, who should apply, how to apply, what occurs under the program, and when the next solicitation will be issued. These brochures are widely disseminated at these conferences.

  EPA has recently prepared *The Superfund Innovative Technology Evaluation Program: Technology Profiles* (EPA/540/5-88/003). The *Technology Profiles* document includes an overview of the SITE Program, a list of the program participants, and profiles on each of the technologies, including a description of the technology, a discussion on waste applicability, the status of the project, and an EPA and technology contact for further information. The purpose of the *Technology Profiles* is to provide Regional decision-makers and other interested individuals with a ready reference on those technologies in the SITE Demonstration and Emerging Technologies Programs.

  SITE reports, specifically, the Demonstration and Applications Analysis Reports, are prepared following the completion of each demonstration and laboratory analyses. The Demonstration Report is a technical report documenting the performance data resulting from the demonstration, including the process description, sampling and analysis procedures, performance data, and QA/QC program. The Applications Analysis Report evaluates available information on the technology and presents the applicability of each technology to other site and waste characteristics. Copies of these reports and summaries of these reports will be disseminated by EPA, and additional copies will be available through the National Technical Information Service. The first Demonstration Report, *Technology Evaluation Report SITE Program Demonstration Test, Shirco Infrared System, Peak Oil, Brandon, Florida* (EPA/540/5-88/002a), was published and available on November 10, 1988. Fourteen more reports are expected to be completed by spring 1989.

  Press releases are issued by EPA to announce the selection of new technologies into the SITE Program, the selection of sites for demonstrations, and the results of the demonstrations. Program status memoranda are sent regularly to the Regional Offices and States, and the Technology Transfer Newsletter, published quarterly by the Center for Environmental Research Information (CERI), lists available SITE reports. Site-specific Technology Fact Sheets are prepared for each technology prior to the field demonstration. Sample Technology Fact Sheets are provided in Appendix 1. The fact sheets are distributed in the local community and among developers, State, and Regional staff. Videos of the technology demonstrations are also produced to supplement the other informational materials describing the demonstrations.

  EPA has prepared reports that present information generated by the SITE Program and other programs to identify alternative technologies that can be used to clean up Superfund sites. For example, EPA has prepared the *Technology Screening Guide for Treatment of CERCLA Soils and Sludges* (EPA/540/2-88/004). This is a guide for screening feasible alternative treatment technologies for soils and sludges at Superfund sites, and it provides a screening

methodology to identify treatment technologies that may be suitable for the management of soils and sludges containing CERCLA wastes. EPA has also prepared the *Assessment of International Technologies for Superfund Applications* (EPA/540/2-88/003). This document identifies and assesses technologies applicable to hazardous waste site remediation in the United States. A report entitled *Technological Approaches to the Cleanup of Radiologically Contaminated Superfund Sites* (EPA/540/2-88/002) identifies technologies that may be useful in removing or stabilizing radiological contamination at uncontrolled Superfund sites that contain radionuclides. Information on SITE and Superfund Programs publications is available through the SITE Clearinghouse electronic bulletin board and hotline (800-424-9346 or 382-3000 in Washington, D.C.).

- *Preproposal Conferences on SITE Solicitations.* Preproposal conferences were held in Washington, D.C., Cincinnati, Ohio, and San Francisco, California, prior to the release of the SITE-003 solicitation. The purpose of these conferences is to allow potential offerors the opportunity to gather information concerning the SITE Program, the types of technologies in which EPA is interested, and the requirements for and benefits of entering the program. These conferences are designed to give potential responders the opportunity to discuss the purpose, scope, and process of the SITE Program with EPA personnel. The conferences are intended to encourage developers to participate in the program and allow EPA the opportunity to respond to developers' questions. Similar conferences will be conducted prior to the dissemination of the SITE-004 solicitation. These conferences are scheduled to be held in Washington, D.C., on January 30, 1989; Cincinnati, Ohio, on January 31, 1989; and San Francisco, California, on February 2, 1989.

- *Public Meetings and Demonstration Site Visits.* Each Regional and/or State Community Relations Officer is encouraged to hold at least one informational briefing or public meeting in the community on each demonstration site. In addition, Section 311(b)(5) of CERCLA requires the establishment of a public notice and comment period prior to final selection of a demonstration site. Following the comment period, a responsiveness summary is prepared and a formal decision is made on whether to proceed with the demonstration at the proposed site. A Visitors' Day is sponsored by EPA during each SITE demonstration to allow first-hand observation of the technology during field use and discussions with the developers. Visitors' Days have been held for the demonstrations listed in the following table.

DEVELOPER/ DEMONSTRATION LOCATION	DATE OF VISITORS' DAY
HAZCON, Inc. Douglassville Superfund Site Reading, PA	October 14, 1987
Shirco Infrared Systems, Inc. Rose Township Demode Road Superfund Site Rose Township, MI	November 4, 1987
Terra Vac, Inc. Groveland Wells Superfund Site Groveland, MA	January 15, 1988
International Waste Technologies Hialeah Service Shop Hialeah, FL	April 14, 1988
C.F. Systems Corporation New Bedford Harbor New Bedford Harbor, MA	August 26-27, 1988
Soliditech, Inc. Imperial Oil Co., Inc. Superfund Site Morganville, NJ	December 7, 1988

Attendance at the sites on Visitors' Days have ranged from 30-135 visitors. Public participation in the SITE Program is of major importance to EPA. The Agency recognizes the impact of public opinion on the remediation actions of Superfund sites and is working to identify those hazardous waste treatment technologies that offer more permanent protection of human health and the environment.

- *Seminar Series.* EPA has initiated seminars to further the transfer of information on alternative technologies. The seminars include modules in CERI's ongoing alternative technology series, as well as special technical seminars on completed SITE demonstrations. The first

seminar was held on November 16 at RREL in Cincinnati, Ohio. The topic of this seminar was separation technologies for extracting contaminants. The seminars are held the third Thursday of each month, and the topics are posted on the Clearinghouse electronic bulletin board.

- *SITE Exhibit at Major Conferences*. The SITE exhibit is displayed at major conferences each year. SITE brochures are available at the exhibit. The most recent conference at which the SITE exhibit was displayed was the Superfund Conference held November 28-30, 1988. The SITE exhibit is designed to provide information concerning the SITE Program, the demonstrations, and the technologies in the program.

- *Innovative Technologies Program Exhibition*. EPA is sponsoring a technology transfer exhibit at Edison, New Jersey, on January 25-26, 1989, for three mobile technologies developed by the Agency — the Mobile Carbon Regeneration System, the Mobile Soils Washer, and the Mobile In-Situ Containment/Treatment System. Following presentations of video and slide shows of the technologies in operation, visitors will be allowed to inspect the actual equipment. Information will be available on the process for acquiring one of these systems, the assistance available to commercial developers, and the responsibilities accruing to the government. This exhibition marks the beginning of an EPA initiative to move technologies developed by the Federal government into commercialization and applications that will benefit both the hazardous waste industry and the general public.

- *Networking with Forums, Associations, the Centers of Excellence, Regions, and States*. SITE staff will network with engineering forums, associations such as the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) and the National Governors' Association (NGA), and the EPA Centers of Excellence, as well as Regional and State personnel, to disseminate information on the SITE Program and to encourage the use of these alternative technologies in the field.

- *Cooperative Efforts with States and Regions*. EPA established an agreement in mid-November with Region 3 to provide research and technical assistance to the Region for the selection of alternative technologies for remediation and removal actions. The agreement includes the exchange of personnel to provide opportunities to actively participate in the SITE Program activities and to assist the Region in identifying SITE technologies for its sites. On October 26, 1988, EPA entered into an agreement with the State of New Jersey Department of Environmental Protection to work cooperatively to conduct testing and demonstration projects applicable for the treatment of radiologically contaminated soil. The purpose of this EPA-NJ cooperative effort is to improve and assist in the commercialization and availability of new and innovative technologies for the treatment of radiologically contaminated materials at uncontrolled waste sites in New Jersey and throughout the nation.

One of the most significant measures of the success of the SITE Program is the impact of the program on the use of alternative, innovative technologies in the cleanup of hazardous waste sites. Technology transfer activities are extremely important to ensure that the information available on the technologies following the demonstration is disseminated to remedial project managers. Following completion of the successful SITE demonstration of Terra Vac's in-situ volatilization process, Terra Vac was selected by a potentially responsible party in Pennsylvania for remediation of another Superfund site. Terra Vac will also be conducting the remediation efforts at the Groveland, Massachusetts, site where the demonstration took place.

Technology transfer activities for the Measurement and Monitoring Technologies Development Program component of the SITE Program have included the formulation and distribution of a list of target compounds to industry and academia and the possible inclusion of Agency guidelines for evaluating immunoassays into studies by the U.S. Department of Agriculture and the Association of Official Analytical Chemists (AOAC). Presentations describing the accomplishments of the program were made at national professional meetings, including the American Chemical Society and the AOAC.

Future Activities

Most of the activities and programs of the Technology Transfer Program are continuous throughout each year of the SITE Program. These efforts will continue for the technology projects that are currently in the program and will be initiated for the new technologies entering the program under the SITE-004 and E-02 solicitations. EPA Project Managers will provide technical assistance on their completed demonstrations as results become available.

The future activities for the Clearinghouse are to proceed with the implementation of Phase II of the plan. Effort will continue on the development of the computerized database network with the goal of completing it in 1990. This interactive, or expert, system will provide immediate response to multiple users throughout the country simultaneously.

As SITE demonstration project results become available, there will be increased efforts in the area of technology transfer. Project summaries will be prepared to make assimilation of information easier and to help reviewers determine what is relevant to their individual needs. These summaries will be widely distributed to EPA, State, and contractor personnel through a mailing list where names will be added upon request. The Demonstration and Applications Analysis Reports will receive a more limited distribution and will be available on request through the hotline or directly through CERI in Cincinnati.

A continued major focus of Clearinghouse activities in 1989 will be publicizing the availability of the Clearinghouse to potential users. Information concerning the Clearinghouse will be available and disseminated through brochures, seminars, newsletters, and presentations. In addition, EPA will implement a feedback system to ensure that the information provided by the Clearinghouse meets users' needs, is timely, and is accurate.

C. MEASUREMENT AND MONITORING TECHNOLOGIES DEVELOPMENT PROGRAM

The EPA Environmental Monitoring Systems Laboratory in Las Vegas, Nevada (EMSL-LV), has been supporting the development of improved measurement and monitoring techniques in conjunction with the SITE Program. Research is focused on two areas: immunoassays for toxic substances, and fiber optic sensing for in-situ analysis at Superfund sites.

The Las Vegas laboratory's research in immunoassays for toxic substances actually began prior to the enactment of SARA in 1986. The initial interest was the use of biomarkers in exposure and risk assessment. In Fiscal Year 1987, the application of immunoassays to environmental monitoring received considerable support from the SITE Program and has resulted in significant advances during Fiscal Year 1988. Immunoassays for toxic substances offer a less costly measurement and monitoring alternative to conventional GC/MS analytical techniques and implementation in the field and could result in a significant cost savings.

Through cooperative and interagency agreements with the University of California at Davis and Berkeley, the California Department of Food and Agriculture, and Westinghouse Bio-Analytic Systems (WBAS), work has been initiated on immunoassays for benzene, toluene, ethyl benzene, phenol, chlorobenzene, and nitroaromatic compounds. Haptens have been synthesized, and antisera have been produced for many of these compounds. Laboratory evaluation of the WBAS immunoassay for PCP has been completed, and the results of interlaboratory comparisons and gas chromatography methodology comparisons all look favorable. A final report of the evaluation study is near completion.

Other Cooperative Agreements with the University of Nevada Environmental Research Center have resulted in additional immunoassay personnel in the program. To expand methods development capabilities and increase sample throughout, additional instrumentation has been obtained. Other laboratory activities include the development of sample preparation techniques for analyzing soils for triazine herbicides by immunoassay, and ongoing laboratory evaluations for various immunoassays for soil extracts.

In support of the Innovative Technologies Program, requests for information regarding the development and availability of specific antibodies for environmental contaminants were issued both in the *Commerce Business Daily* and in *Science*. This request resulted in the receipt of six proposals.

Significant advances were also reported for the fiber optics development program. The field performance of the portable fiber optic fluorimeter developed in Fiscal Year 1987 was outstanding. Capable of measuring chloroform, oxygen, CO2, and pH, the instrument design spurred the development of a commercially produced instrument for an underground storage tank (UST) leak detector system. Fiber optic sensing devices offer the convenience of in-situ analysis and are easily transported to hazardous waste sites. These types of sensing devices can be utilized for field monitoring at potentially lower cost and higher reliability.

The innovation phase of the fiber optics program was transcended with demonstrations of precommercial, field-

hardened prototypes of trihalomethane and gasoline sensors applied to actual environmental monitoring programs. The operational range of these sensors promises to exceed that of others currently available for UST leak detection at potentially lower cost and higher reliability.

Development of other sensors, funded by groups like the American Water Works who have benefitted from the laboratory's collaboration and guidance, will continue for the measurement of benzene, cyanide, iron, nitrate, phosphate, toluene, and xylene.

EMSL-LV has been successful in providing the technical definition, concepts, and guidance necessary that has attracted firm commercial commitments for the production of fiber optic sensors for environmental monitoring. Its position in this emerging technology was demonstrated by its being invited to author a chapter on sensors for environmental monitoring in the "CRC Handbook on Fiber Optic Chemical Sensors," which was completed in Fiscal Year 1988.

Future Activities

In further supporting Superfund site characterization efforts, the Measurement and Monitoring Technologies Development Program will continue to develop the emerging technologies of fiber optic sensing for in-situ analysis and immunoassays for environmental monitoring.

The fiber optics development plans for Fiscal Year 1989 include:

- A field demonstration of the PCP immunoassay for water samples at a Superfund site.
- Continuation of the evaluation of the immunoassay for benzene, toluene, and xylene for soil samples. Depending on the results of the evaluation study, there are plans for demonstration of the assay at a Superfund site.
- Development of immunoassays for nitroaromatic compounds for environmental samples.
- The compilation of a listing of specific immunoassay reagents that have already been developed and the utilization of them to help solve Agency monitoring needs.

Additionally, due to the outcome of the field tests of the redesigned trihalomethane sensor and to the fact that the sensitivity attained approached the drinking water compliance requirements, in-situ chloroform measurements in water have been scheduled for demonstration in Fiscal Year 1989.

D. INNOVATIVE TECHNOLOGIES PROGRAM

Prior to the initiation of the SITE Program in 1986, EPA's Office of Research and Development supported research on several technologies for the on-site destruction and cleanup of hazardous waste, emphasizing the treatment of excavated soils. This effort has led to the establishment of the Innovative Technologies Program (ITP) component of the SITE Program. The objective of the ITP is to encourage private sector development by firms that are willing to commercialize these EPA technologies for use at Superfund sites.

To achieve this, the program is divided into four major areas of activity. They are (1) characterization of the problems, (2) evaluation of the state-of-the-art, (3) design and demonstration of promising viable systems, and (4) technology transfer to Federal and State government decision-makers and the private sector.

EPA's ongoing contaminant characterization efforts have focused on the physio-chemical properties of metallic and organic contaminants and determination of their interrelationships with solid particles. This research has contributed to the development of protocols for treatability studies.

Evaluation of commercially available technologies is being conducted using information collected through literature searches and treatability studies performed in support of site-specific problems. EPA has designed and demonstrated a number of innovative technologies that can be used to treat hazardous wastes at Superfund sites. The following seven technologies are included in the SITE Innovative Technologies Program.

- **The Mobile Incineration System (MIS)** consists of specialized equipment mounted on four trailers and on free-standing modules. The first element is a rotary kiln, in which organic wastes are vaporized and partially oxidized. Incombustible treated soil/ash is discharged directly from the kiln. The volatile organic compounds or gases from the primary unit pass through a high temperature cyclone and into a secondary combustion chamber (SCC) where oxidation is completed. The flue gas exits from the SCC, is cooled, and is then passed into air pollution control equipment. There, submicron-sized particulates are removed by a

wet electrostatic precipitator, and byproduct acid gases are neutralized in an alkaline scrubber. Gases are drawn through the system by an induced draft fan, which maintains an overall vacuum to ensure that no toxic gases are discharged from the system. The cleaned gases are discharged from the system through a 40-foot high stack. The incinerator can process up to 5,000 lbs of contaminated soil or 75 gallons of liquid per hour. The actual feed rates are dependent upon the heat content and/or moisture content of the feed materials, and other variables.

Upon request from EPA Region 7, the MIS was transported to the James Denney Farm site in McDowell, Missouri, where in 1985 it was used by EPA to demonstrate greater than 99.9999% destruction and removal efficiency at a trial burn on liquids and solids contaminated with dioxins. A subsequent trial burn in 1987 successfully demonstrated destruction of PCBs and a variety of other compounds. It has been operated over the past four years for cleanup of dioxin-contaminated liquids and soils from the Denney Farm site and from seven other dioxin sites in southwest Missouri. To date, over 9 million lbs of liquids and solids have been processed. It is currently processing the remainder of the dioxin-contaminated materials at the Denney Farm site and may soon be processing EPA's Office of Pesticide Programs' cancelled pesticides, including 2,4,5-T/Silvex liquids and solids. It is anticipated that EPA will complete this effort in mid-1989. As a direct result of the MIS, commercial units have been developed and are being utilized in the field.

- **The Mobile Soils Washing System** was designed for the separation/segregation and volumetric reduction of spilled hazardous materials and chemicals from soils at cleanup sites. It will be transferred by EPA to the commercial sector in early 1989 under the authority of the Federal Technology Transfer Act. This system separates contaminants from excavated soil by high energy contacting and mixing of soils with water supplemented with additives, including surfactants, chelants, acids, and bases. It consists of a drum washer, a counter current extraction chamber, and a dewatering unit and will (1) vigorously mix the contaminated soils with treatment agents, (2) separate/segregate the highly contaminated fines (clay, silt) from the cleanable soils fractions for further processing and/or disposal, and (3) treat volatile organic contaminants that have been stripped from the soils through the use of vapor phase carbon canisters. The drum washer, which treats course sand and gravels, has a maximum throughput capacity of 18 cubic yards per hour; the countercurrent trailer, which treats finer particles, is limited to 2 cubic yards per hour. The Mobile Soils Washing System is one of three innovative technologies that will be featured at the Innovative Technologies Program Exhibition in January 1989 to encourage the commercialization of innovative technologies. Participants will be invited to view videos of the technologies in operation, inspect the actual equipment, and obtain information on the assistance available in commercializing these technologies.

- **KPEG** is a chemical process for onsite destruction of halogenated waste (including PCBs) in soils or as liquids. In this process, potassium polyethylene glycolate (KPEG) reagents are used to strip the halogen atoms of halogenated hydrocarbon waste to produce a detoxified waste. In some KPEG reagent formulations, dimethylsulfoxide is added as a patented co-solvent to enhance reaction rates. Chemicals used to prepare KPEG reagents are stable in air, are easily stored, and can be safely transported to waste sites.

  In July and August 1986, a 2,700 gallon KPEG mobile unit was used in Butte, Montana, and Kent, Washington, to successfully treat 16,200 gallons of oily PCP waste, reducing polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) to non-detectable levels (<0.3 ppb). In May 1988, a pilot-scale test was conducted in Guam on 17 cubic yards of soil contaminated with PCBs (1600-3200 ppm). PCBs were successfully reduced to < 2.0 ppm detection limit prescribed by the Toxic Substances Control Act (TSCA). The unit was a 21-cubic-yard horizontal reactor specially modified for field operation.

- **The Mobile In-Situ Containment/Treatment System** is designed to isolate and treat spills of hazardous materials. The system is mounted on a 43-foot drop deck trailer and includes a diesel electric generator and air compressor, mixing tanks, hoses, a solids feed conveyor, pipe injectors, soil testing apparatus, and accessory items. In-situ containment is accomplished by direct injection of grouting material into the soil around the contaminated area to isolate the spill and then treatment of the hazardous materials in place by oxidation/reduction, neutralization, or precipitation. When necessary, contaminated water can be withdrawn from wet wells and treated by other means. The Mobile In-

Situ Containment/Treatment System is another of the innovative technologies that will be displayed at the Innovative Technologies Program Exhibition.

- **The Mobile Spent Activated Carbon Regenerator** is designed for field use in detoxifying/regenerating spent granular activated carbon (GAC) used in spill or waste site cleanup operations. GAC is used to remove residual hazardous organic substances from water that has been contaminated by a spill or release, or from the aqueous leachate in uncontrolled dumpsites. During the treatment process, the GAC binds the contaminants, accumulating relatively high levels of hazardous organic chemicals. When the carbon reaches its adsorptive limit, it must be discarded or regenerated in an approved manner. The Mobile Carbon Regenerator is intended to process the spent GAC for reuse at the site. Wet GAC is screw-fed to a direct-fired countercurrent rotary kiln where the contaminated organic substances are desorbed and volatilized. All vapors and gases from the kiln flow through a duct into the secondary combustion chamber where the hazardous organic substances, including chlorinated hydrocarbons, are oxidized and detoxified. Off-gases are water-quenched and scrubbed with an alkaline solution before being vented into the atmosphere. Stack gases and used process water are monitored. The Mobile Spent Activated Carbon Regenerator is one of the innovative technologies featured at the Innovative Technologies Program Exhibition to encourage the commercialization of this technology.

- A process for the **Electrokinetic Removal of Contaminants** from the ground was designed to be used in conjunction with pumping to expedite ion migration and removal from a saturated soil system. A series of wells is used as anodes and cathodes across which a direct current is applied. The current density results in an accelerated movement of charged ions. The effect of ion migration is greater with pulse pumping.

- A hydromechanical debris decontamination technology has been evaluated at laboratory-scale and pilot-scale. It was evaluated during the week of September 6, 1988, at the pilot-scale at a PCB-contaminated Superfund site in Detroit, Michigan. The technology, **Experimental Debris Decontamination Module** (EDDM), consists primarily of a series of tanks that contain a solution of deionized water and sodium metasilicate mixed in a ratio of 7 to 1. It is a closed-loop system, with a 300-gallon cleaning unit, an oil/water separator, and a solution recovery system coupled with a carbon filter to remove PCBs from the contaminated wastewater generated by the process. The EDDM is trailer mounted.

The fourth area of the ITP involves the transfer of engineering, performance, and waste applicability information to firms interested in commercializing such technologies. The partnerships necessary to transfer these technologies to the private sector have been authorized by the Technology Transfer Act of 1986. EPA has conducted a variety of technology transfer activities designed to encourage and maintain technical dialogue among representatives of Federal and State governments, academia, and the private sector. One such activity was held in December 1988 in Edison, New Jersey, on the subject of extraction treatments of excavated soils, sludges, and sediments. This event marked the beginning of a series of small, highly focused technical exchanges in this technology area.

Future Activities

With the commercial capability for providing alternative technologies for cleanup now rapidly expanding, the need for developmental work on the part of EPA is diminishing. The future needs are (1) to provide guidance and assistance to firms interested in commercializing these innovative technologies, (2) to identify alternative technologies with widespread application that are not currently under development by the private sector, and (3) to transfer technology-related information to EPA Remediation Project Managers and pollution control contractors.

Demonstration and evaluation of alternative technologies in the Innovative Technology Program will continue in the next fiscal year. The results of these efforts will be published and disseminated to government, academia, and commercial sectors. Additionally, automated information systems will be developed and maintained to facilitate access to the large amount of data and relevant information that is being generated under the SITE Demonstration Program and the ITP, and other sources of treatability information. In addition, EPA will continue to sponsor meetings, workshops, and other technology transfer activities.

As more technologies become available, the demand to objectively evaluate pilot-scale commercial systems

and to perform numerous, simultaneous treatability studies in support of specific cleanup problems will increase. To meet this demand, ORD will provide a testing and evaluation facility in Edison, New Jersey, to be available for use in 1991. This facility will be instrumental in evaluating pilot-scale treatment technologies and in performing numerous treatability studies in support of specific cleanup problems. The prototype Mobile Spent Activated Carbon Regenerator, Mobile Soils Washer System, and the Mobile In-Situ Containment/Treatment System, which have been developed and tested, will be transferred for commercial development and application in early 1989.

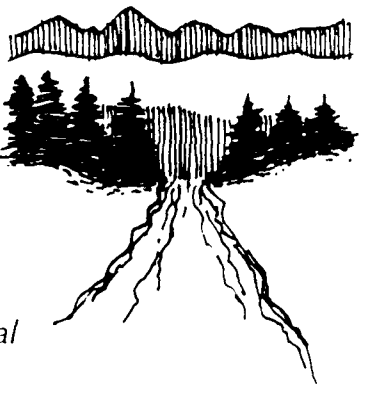
APPENDIX 1. SAMPLE TECHNOLOGY

FACT SHEETS

NOVEMBER 1988

PROGRESS

Silver Bow Creek Superfund Site Report



By Montana Department of Health and Environmental Sciences & Environmental Protection Agency

INTRODUCTION

Butte has been chosen as the site for the testing of a new technology to treat various types of Superfund site contaminants. Montana Department of Health and Environmental Sciences will first seek public comments about the proposed project. This progress report will describe the project, the opportunity for public comment and the future of the program.

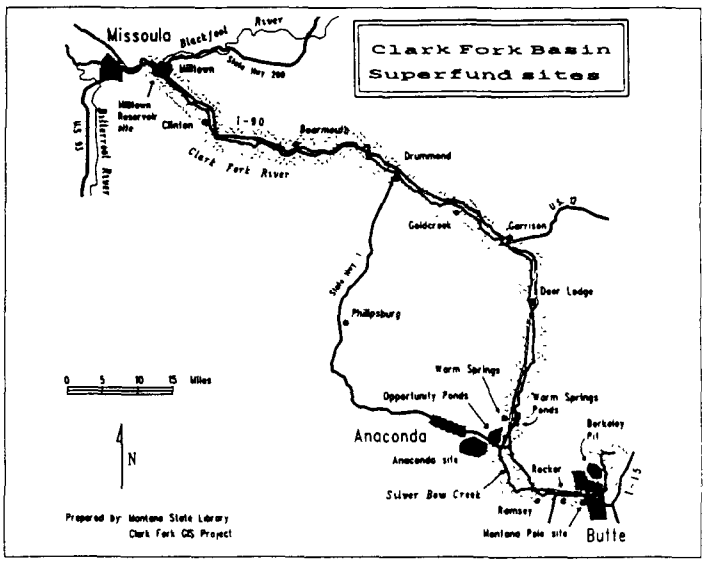
The project is being run by the U.S. Environmental Protection Agency, with cooperation from the U.S. Department of Energy and the Montana Department of Health and Environmental Sciences. The treatment technology these agencies plan to test in Butte is called a "plasma furnace" (in this usage, "plasma" refers to a gas which is so hot it can conduct electricity). Contaminated soils will be thermally oxidized by extremely high temperatures in the plasma furnace to destroy their toxicity. The plasma furnace is explained in more detail later in this report.

The contaminated soils to be tested during the demonstration will be taken from the Montana Pole and Silver Bow Creek Superfund sites. The Montana Pole site is located on the south side of Butte. It is a defunct pole-treating operation with contamination consisting primarily of organic wastes such as pentachlorophenol. The Silver Bow Creek site begins in Butte and continues down the Silver Bow Creek and Clark Fork drainages to the Milltown Reservoir, about five miles east of Missoula. Contaminants on this site are mostly the result of mining and smelting operations.

The public will be given the opportunity to comment on this project for 30 days, from Nov. 15 - Dec. 15, 1988. (See section on Public Comment).

TESTING TO TAKE PLACE IN BUTTE

The proposed plan for the demonstration includes testing to be conducted at the Department of Energy's Component Development and Integration Facility (CDIF) on the south edge of Butte, which primarily has been used to test magnetohydrodynamics (MHD). The project will begin in late spring or early summer 1989, lasting approximately seven months. The project will be broken into two phases. The first phase, lasting about a month, will involve testing the unit on organic and heavy metal contaminants from Butte area Superfund sites — the Montana Pole and the Silver Bow Creek sites. The second phase will last six months and will help DOE researchers determine the endurance and reliability of the system. During the second phase, DOE will also determine how effective the process is for materials which resemble contaminants found at some DOE sites. All samples to be tested will be from the Butte area. No samples will be brought into the state for the second phase.



Throughout both phases, the three involved agencies will work closely with each other and Retech, Inc., the owners and makers of the furnace, to evaluate its efficiency in terms of time, money, and destruction of contaminants.

WHAT IS THE "SITE" PROGRAM?

SITE is an abbreviation, or acronym, for Superfund Innovative Technology Evaluation. Under this program, EPA is trying to find better solutions for hazardous waste cleanup. The SITE program at Butte includes carefully planned demonstrations of the plasma arc furnace technology developed by Retech, Inc., of California.

EPA started the SITE program in 1986 so they could take positive steps to provide more information on new or innovative treatment technologies that will be needed in the future. The SITE program's objective is to develop, demonstrate, and encourage the use of successful alternative technologies.

PLASMA FURNACE IS SAFE

The Retech Plasma Furnace is an innovative heat treatment system, or furnace, which is currently being tested at the Retech home office in Ukiah, California. The furnace will be brought to Montana to help EPA determine how effective it will be at destroying contamination often found at Superfund sites.

The plasma furnace destroys toxic organic molecules and ties up heavy metals in a non-leaching glass. Toxic material to be heated in the furnace is placed in a feeder and then continues into the primary furnace at a rate of about 100 pounds per hour. The main furnace chamber and all parts of the system are kept sealed so that all material stays within the system until the toxic wastes are destroyed in either the primary or secondary furnace chamber. Hot gases from the furnace are cleaned and purified by a "scrubber"; contaminants in the gases are removed into water which is later disposed of after testing. After passing through the scrubber, the gas then passes through an activated charcoal system for added safety before being released into the atmosphere. (See diagram of plasma furnace).

The process will be continuously monitored during operation and all exhaust will be extensively sampled. If a problem occurs in the process, a safety back-up system goes into effect and collects the gases. No gases are released until the system is checked and/or fixed. Any gas temporarily stored during a breakdown is reprocessed through the reactor and gas cleaning system before being released.

Any residues will be disposed of at an approved solid waste or, if necessary, hazardous waste facility.

DEMONSTRATION TO BEGIN IN LATE SPRING 1989

The EPA phase one SITE demonstration will occur over a five-week period starting in late spring or early summer 1989. The furnace will be sent from California to Butte and will take approximately two weeks to set up at the CDIF facility. During the remaining three weeks, approximately 2,000 pounds of waste from the Montana Pole and Silver Bow Creek Superfund sites will be processed in the plasma furnace.

EPA plans to meet four objectives during phase one of the tests:

1. Determine the furnace's efficiency in removing organic contaminants from soils.

2. Determine how well the reactor can tie up heavy metals in a glass-type waste.

3. Determine costs of the process.

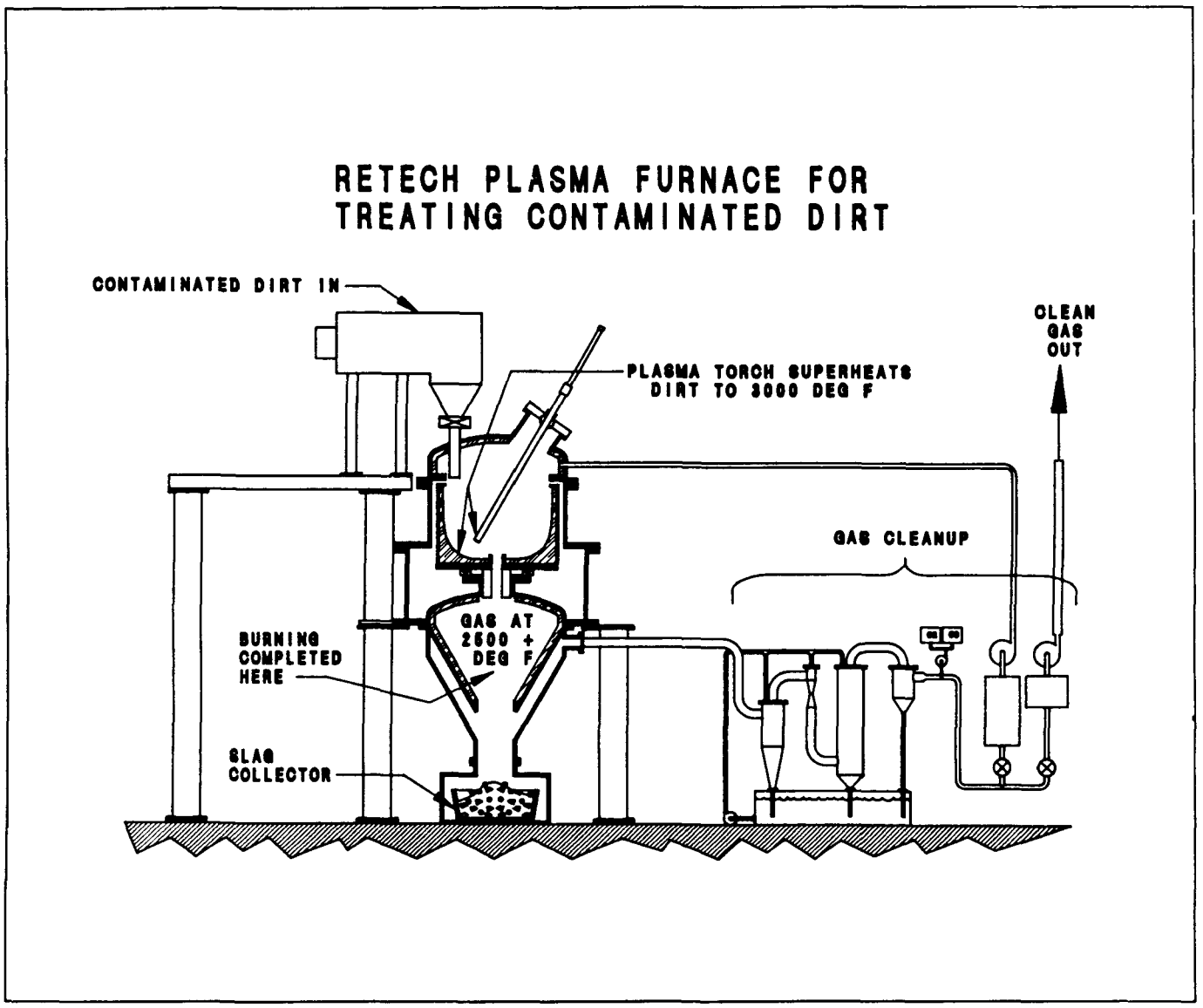
4. Evaluate how well the furnace performs and how reliable it is.

The U.S. Department of Energy will conduct the second phase of the demonstration and will build on what was learned during the EPA's first phase. This phase will last six months while DOE tests the system at higher feed rates and with other wastes. "Wastes" in this phase will primarily consist of clean soil with simulated contaminants mixed into it. The purpose of this second phase is for DOE to see how effectively the system can treat their wastes and to see how durable the system is. DOE hopes to determine whether the system can run for longer periods of time and with greater amounts of waste than in phase one. DOE will also evaluate the costs of the system.

CAN THIS TECHNOLOGY CLEAN UP BUTTE?

Although the plasma furnace system, if successful, will destroy organic contaminants and contain heavy metals, it will not be a practical cleanup remedy for the majority of wastes in Butte. With the many thousands of tons of contaminated soils in the Silver Bow Creek and Montana Pole sites, it would be too costly. However, if the plasma furnace proves successful, it may be helpful in cleaning up small, heavily contaminated areas in Butte, along the Silver Bow Creek site, and on the Montana Pole site.

In any case, if the plasma furnace is successful, it will benefit the Superfund program by providing us with one more way to clean up Superfund wastes.



WE ARE LOOKING FOR YOUR COMMENTS

A 30-day public comment period will begin Nov. 15 and will run through Dec. 15. During that time, the public is encouraged to comment on the plan and ask questions about it. Further information about the SITE program and the plasma furnace can be found at the Montana Tech Library in Butte. Anyone with comments or questions is encouraged to call or write to:

Janie Stiles
Montana Department of Health and Environmental Sciences
Room B201, Cogswell Building
Helena, MT 59620
1-800-648-8465 (in-state) or 406-444-2821.

Comments must be postmarked by Dec. 15 to be considered by EPA. Comments sent to the above address will be reviewed by the Montana Department of Health and Environmental Sciences and responded to by EPA.

United States
Environmental
Protection Agency

Region 1

New Bedford Harbor Site
Enseada de New Bedford
New Bedford, Massachusetts

June 1988
Junho de 1988

Região I

EPA

Superfund Update
Atualização do Superfundo

Introduction

The U.S. Environmental Protection Agency (EPA), the Massachusetts Department of Environmental Quality Engineering (DEQE), and the U.S. Army Corps of Engineers have completed plans to conduct a pilot dredging and disposal study to collect vital information on clean-up options for the New Bedford Harbor Superfund Site. In a separate, but related effort, the EPA has proposed to use the New Bedford Harbor Superfund site to demonstrate and evaluate a newly-developed treatment unit that can be used to clean up Superfund sites containing PCB-contaminated sediments, such as those found in the harbor. With the publication of this update, EPA is seeking public comments on the selection of this site for the pilot-scale treatment technology demonstration. This project will provide information on a new non-incineration technology for use in the New Bedford Harbor feasibility study. If this site is approved, the demonstration project will take place over a two-week period in the fall of 1988, concurrently with the Corps of Engineers Pilot Study and at the same location, north of Sawyer Street.

Workgroup Meetings

EPA, DEQE, and the developer of the technology attended the monthly meeting of the Greater New Bedford Environmental Community Workgroup, held on June 13, to solicit comments concerning the project. This is the same workgroup that was established in October 1987 to represent the community's interests and facilitate public education on the clean-up plans for the New Bedford Harbor Superfund Site. A community workgroup contact is listed in the back of this document for further information on workgroup activities. The next monthly workgroup meeting will be held on July 11; EPA, DEQE, and the developer of the technology will be available again to answer any questions on the demonstration of the treatment unit. A Portuguese translator will be at the meeting and members of the public are urged to attend.

Workgroup Meeting
Monday, July 11
7.00 p.m.
Buttonwood Library—West End
745 Rockdale Avenue

Introdução

A Agência de Proteção do Meio-Ambiente dos Estados Unidos (EPA), o Departamento de Engenharia de Qualidade do Meio Ambiente de Massachusetts (DEQE) e o Corpo de Engenheiros do Exército dos Estados Unidos concluíram planos para a realização de um estudo piloto de dragagem e remoção de poluentes, a fim de coligir informação crítica para as opções de limpeza da Enseada de New Bedford, financiada pelo Superfundo. Em trabalho separado mas correlato, a EPA propôs a utilização da Enseada de New Bedford para demonstrar e avaliar um tratamento recém-desenvolvido que poderá ser usado na limpeza dos locais financiados pelo Superfundo que contêm sedimentos poluídos por PCB, tais como os encontrados na enseada. Com a publicação desta atualização, a EPA procura receber comentários do público sobre a escolha da enseada para a demonstração piloto da tecnologia de tratamento. Este projeto proporcionará informação sobre uma nova tecnologia de não-incineração a ser usada no estudo de viabilidade da Enseada. Se este local for aprovado, o projeto de demonstração será realizado em duas semanas no outono de 1988, simultaneamente com o Estudo Piloto do Corpo de Engenheiros do Exército e no mesmo local ao norte da Sawyer Street.

Reuniões do Grupo de Trabalho

A EPA, o DEQE e o fabricante da tecnologia participaram da reunião mensal do Grupo de Trabalho da Comunidade sobre o Meio Ambiente da Grande New Bedford, realizada em 13 de junho, a fim de solicitar comentários relacionados com o projeto. Esse grupo de trabalho é o mesmo criado em outubro de 1987 para representar os interesses da comunidade e informar melhor o público a respeito dos planos de limpeza da Enseada de New Bedford. Os interessados poderão obter informações mais detalhadas sobre atividades do Grupo de Trabalho com o representante do mesmo, cujo endereço figura na contracapa deste documento. A próxima reunião mensal do grupo será realizada em 11 de julho. A EPA, o DEQE e o fabricante da tecnologia estarão novamente à disposição para responder a quaisquer perguntas sobre a demonstração da unidade de tratamento. Haverá interpretação ao português na reunião e o público, em geral, está convidado.

Reunião do Grupo de Trabalho
Segunda-feira, 11 de julho
19,00 horas
Buttonwood Library—West End
745 Rockdale Avenue

Why

The Superfund Innovative Technology Evaluation program, commonly known as the SITE program, is a nationwide program established for the purpose of evaluating new, promising technologies to determine if they can be used to address contamination problems at Superfund sites. As the name suggests, the program is focused on *new* technologies being developed *now* Because the technologies are not "tried and true", they must be carefully evaluated, to prove their effectiveness at actual sites. The New Bedford site was proposed for a SITE project because the technology to be tested is designed to strip PCBs from contaminated sediments and sludges. Because the Army Corps of Engineers is already engaged in dredging and disposal activities at the harbor, contaminated sediments to be used in the demonstration project will be easily obtained.

As in other stages of the Superfund program, the public must be allowed to comment on the project before it is approved. A 30-day comment period will extend from June 20 to July 19. Comments on the proposed treatment unit demonstration can be mailed to the address provided at the end of this update. (Public comments have already been accepted on the dredging and disposal pilot study.)

Por Que?

O programa de Avaliação de Nova Tecnologia do Superfundo, conhecido comumente pela sigla inglesa SITE, é um programa de âmbito nacional estabelecido para avaliar tecnologias novas e promissoras a fim de determinar se poderão ser usadas para resolver problemas de poluição nos locais financiados pelo Superfundo. Como sugere o nome, o programa enfoca *novas* tecnologias que estão sendo desenvolvidas *agora*. Como não são comprovadas, as tecnologias novas devem ser rigorosamente testadas, a fim de provar sua eficiência no próprio local. A Enseada de New Bedford foi proposta como local de projeto SITE porque o processo a ser testado se destina a extrair PCB de sedimentos poluídos e detritos. Como o Corpo de Engenheiros já realiza atividades de dragagem e remoção na Enseada, será fácil obter sedimentos poluídos a serem usados no projeto de demonstração.

Como em outras fases do programa do Superfundo, o público tem o direito de opinar sobre o projeto antes de ser aprovado. O prazo de 30 dias para comentários irá de 20 de junho a 19 de julho. Os comentários sobre a demonstração da unidade de tratamento proposta poderão ser remetidos ao endereço que figura no fim deste panfleto. (Já foram aceitos comentários do público sobre o estudo piloto de dragagem e remoção.)

Where

The New Bedford Harbor, Massachusetts Superfund site is a large area encompassing over 18,000 acres. The harbor received PCB-contaminated materials and solutions containing metals such as lead, cadmium, copper, and chromium, for several decades until the late 1970s. Currently, the Army Corps of Engineers is conducting a pilot study at the site to evaluate three dredging techniques and two disposal techniques for the contaminated sediments. Dredging activities are scheduled to begin in late August or early September. Construction of a Confined Disposal Facility (CDF) is underway now. The CDF will be used to contain contaminated sediments dredged from the harbor. The proposed treatment demonstration is essentially a new phase in the feasibility study being prepared for the site and will be coordinated with the Corps' activities.

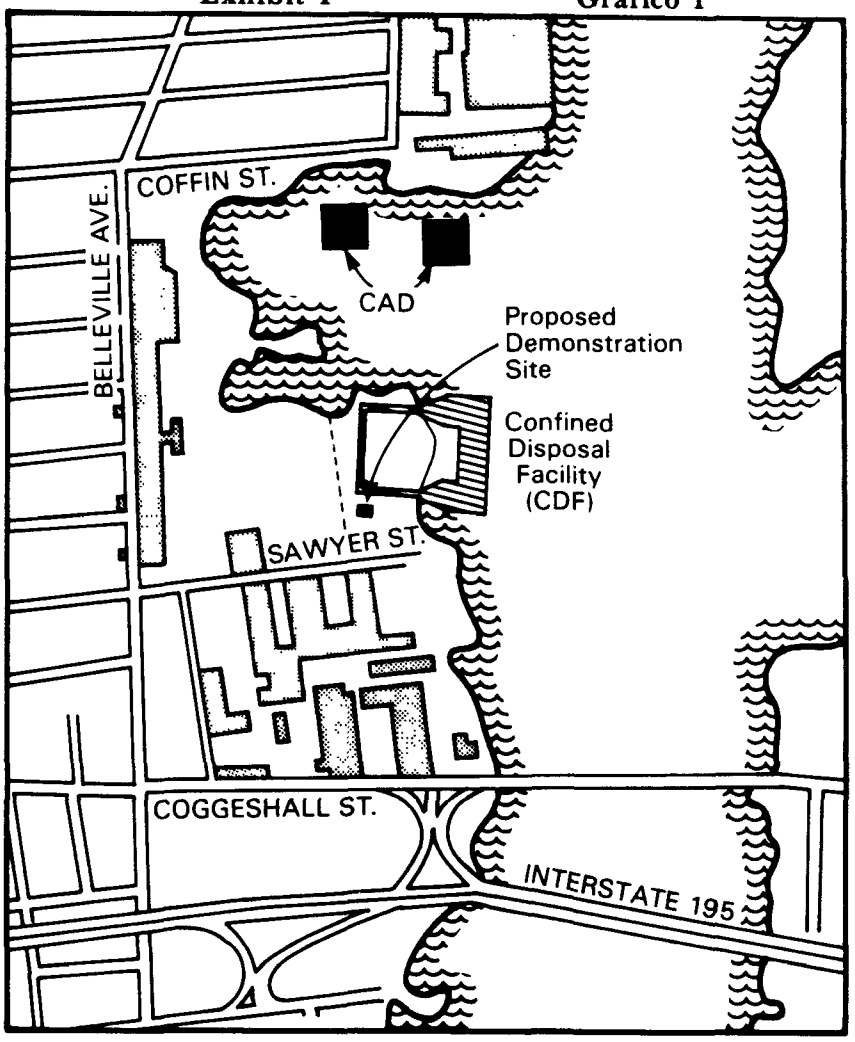
Exhibit 1 is a map of the harbor area, indicating the location of the CDF, an underwater disposal area (Confined Aquatic Disposal Area, CAD), the new soccer field, and the proposed technology demonstration site, between the CDF and the security fence.

Onde

O local das obras do Superfundo na Enseada de New Bedford é uma área vasta que abrange mais de 728 hectares. Materiais contaminados por PCB e soluções contendo metais como chumbo, cádmio, cobre e cromo foram depositados na enseada durante vários decênios até o fim da década de 70. O Corpo de Engenheiros do Exército está atualmente fazendo um estudo piloto na enseada para avaliar três métodos de dragagem e duas técnicas de remoção dos sedimentos poluídos. As atividades de dragagem deverão começar no fim de agosto ou no início de setembro. Já está em construção um Local de Descarga Confinado (CDF), que será usado para receber os sedimentos poluídos retirados da enseada. A demonstração do tratamento proposto é basicamente uma nova fase do estudo de viabilidade que está sendo preparado para o local e será coordenada com as atividades do Corpo de Engenheiros.

O Gráfico 1 apresenta um mapa da enseada, indicando o CDF, a área de descarga submarina (Área de Descarga Aquática Confinada—CAD), o novo campo de futebol e o local de demonstração da tecnologia proposta, entre o CDF e a cerca de segurança.

Exhibit 1 **Gráfico 1**



What

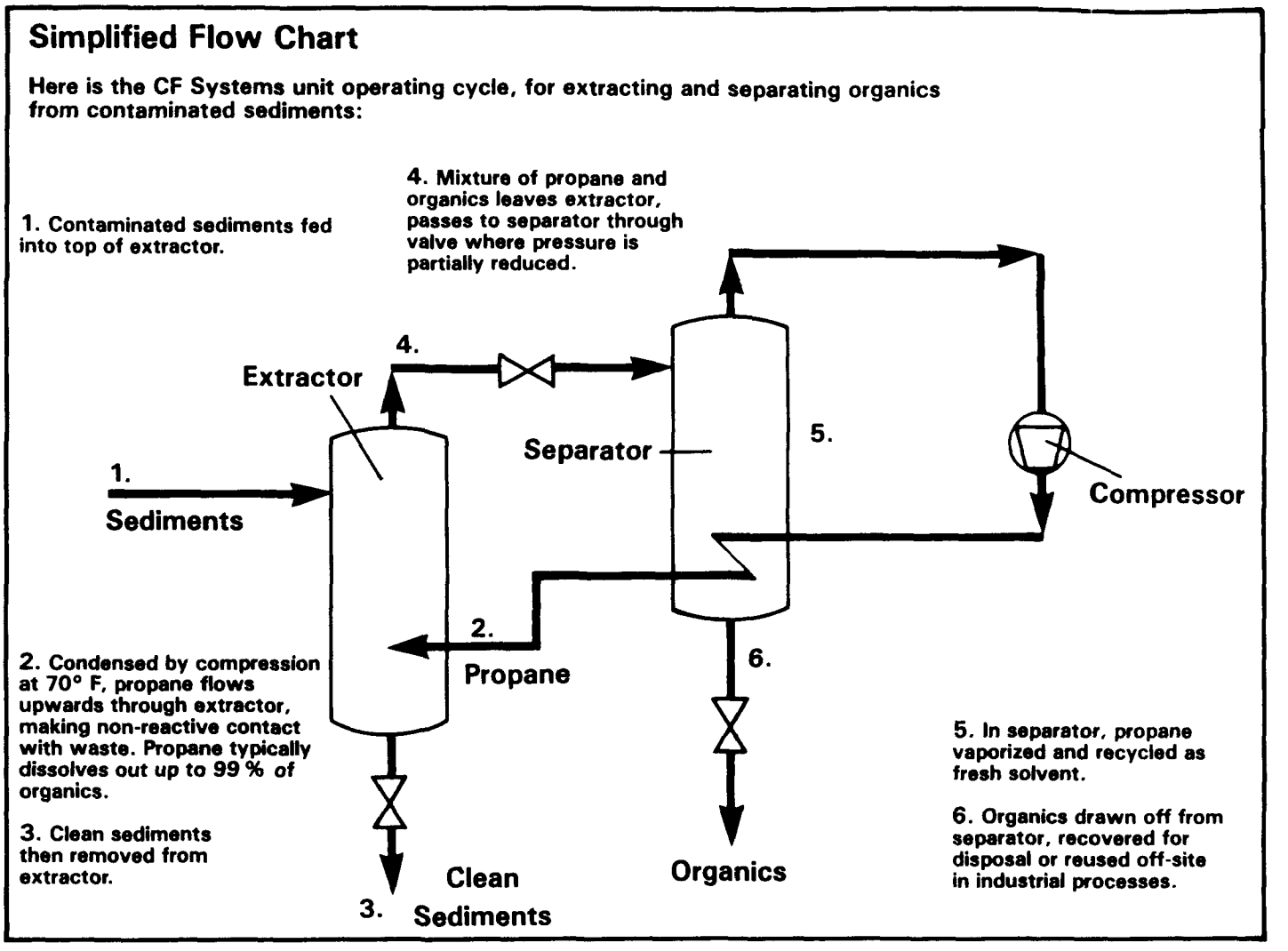
The innovative technology proposed to be demonstrated was developed by CF Systems Corporation of Waltham, Massachusetts. The entire extraction unit is mounted on a tractor-trailer truck so that it can be moved to the most favorable location at Superfund sites. The unit uses propane gas, liquefied under pressure, to selectively extract PCBs and other complex organics from contaminated sludge and sediments. The propane gas is collected after treating sediments so that it can be reused in the process. At other pilot study demonstrations, this extractor unit has been shown to remove over 99% of the organics from sludges.

O Quê?

A nova tecnologia a ser demonstrada foi desenvolvida pela CF Systems Corporation de Waltham, Massachusetts. Toda a unidade de extração é montada num caminhão reboque de trator para poder ser transportada ao melhor local das operações do Superfundo. A unidade usa gás propano, liquefeito sob pressão alta, para extrair seletivamente os PCB e outras substâncias orgânicas dos sedimentos e detritos sólidos poluídos. O gás propano é recolhido depois do tratamento dos sedimentos para ser reciclado novamente no processo. Em outras demonstrações do estudo piloto, essa unidade de extração mostrou ter capacidade de extrair 99% das substâncias orgânicas dos detritos sólidos.

Exhibit 2 provides a simplified flow chart of the process.

Exhibit 2



How

If the New Bedford site is approved, the demonstration will be run for a two-week period in early fall of this year. The demonstration is designed to meet the following objectives.

1. Determine the ability of the extraction process to reduce PCBs and other complex organics in harbor sediments;
2. Determine the effectiveness of the technology to achieve decontamination over a range of different concentrations;
3. Develop costs for applications of the technology; and
4. Evaluate the process performance and reliability.

The demonstration equipment will be operated only on weekdays during normal business hours. The unit is constructed such that there are no possible odor or noise problems. Air monitoring will be conducted regularly to assure that there are no emissions. A locked trailer will be used for storage of cleaning chemicals and the sediments before and after treatment. The trailer and the treatment unit will be located within a temporarily-fenced area inside the security fence erected by the Corps. Security personnel will be on-site during non-operational hours (nights and weekends) unless the Corps of Engineers will also be on-site conducting dredging operations during those hours. A strict health and safety plan will be prepared for the project and will be followed during set-up, demonstration, and removal of all equipment and materials used for the demonstration.

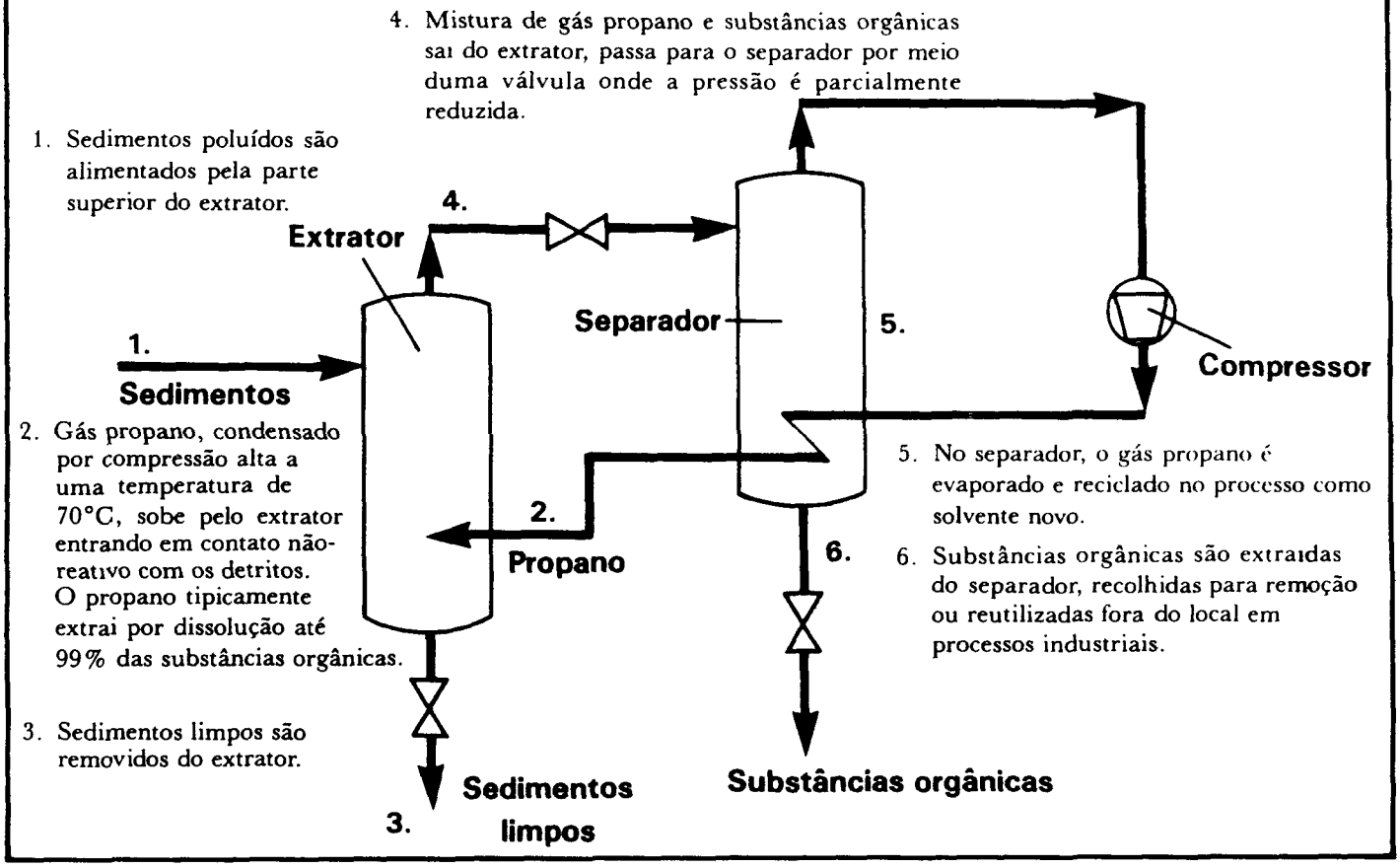
During their dredging activities, the Corps will provide approximately 15 55-gallon drums of contaminated sediment to the developer of the technology. One drum of sediments will be run through the extractor unit per day. The "cleaned" sediments will be evaluated after the test. If their PCB levels do not exceed those of the sediments in the CDF, the decontaminated sediments will be handled in the CDF. Otherwise they will be shipped off-site. The small quantity (less than half a drum) of concentrated organics stripped from the sediments will be incinerated off-site in a licensed hazardous waste incinerator. The solvents (less than five drums) used for cleaning out the unit after the demonstration project is completed will either be incinerated or recycled off-site.

O Gráfico 2 apresenta um organograma simplificado do processo.

Gráfico 2

Organograma Simplificado

Encontra-se aqui o ciclo de operação da unidade dos CF Systems para extrair e separar substâncias químicas orgânicas dos sedimentos poluídos.



Como

Se for aprovado o projeto da Enseada de New Bedford, a demonstração será feita num período de duas semanas no início do outono deste ano. A demonstração destina-se a alcançar os seguintes objetivos:

1. Determinação da capacidade do processo de extração de reduzir a concentração de PCB e outras substâncias orgânicas complexas nos sedimentos da enseada;
2. Determinação da eficiência da tecnologia em conseguir descontaminar uma ampla série de sedimentos de diferentes concentrações;
3. Estimativa do custo de utilização da tecnologia;
4. Avaliação do desempenho e confiabilidade do processo.

O equipamento de demonstração só funcionará nos dias de semana durante o horário comercial. A unidade é construida de tal maneira que não haverá problemas de odor ou barulho. A qualidade do ar no ambiente será vigiada frequentemente para assegurar que não haverá emissões. Um carro-reboque trancado será utilizado como depósito para os produtos químicos de limpeza e os sedimentos antes e depois do tratamento. O carro-reboque e a unidade de tratamento estarão localizadas, dentro de uma cerca de segurança construida pelo Corp, Guardas de segurança estarão no local fora dos horários normais dos dias úteis (noites e fins de semana) a não ser que o Corpo de Engenheiros estará também no local para realizar dragagem durante tais horários. Um plano rigoso de saúde e segurança será preparado para o projeto o qual será seguido durante a iniciaçao, demonstração e remoção de tôdo o equipamento e materiais usados para a demonstração.

Durante as atividades de dragagem, o Corpo de Engenheiros fornecerá ao fabricante da tecnologia aproximadamente 15 barris de 208 litros de sedimentos poluídos. A unidade de extração processará um barril de sedimentos por dia. Os sedimentos "limpos" serão avaliados depois do teste. Se seus níveis de PCB não ultrapassarem os dos sedimentos no CDF, os sedimentos descontaminados serão tratados no CDF. Caso contrário, serão removidos do local. A pequena quantidade (menos da metade de um barril) de substâncias orgânicas concentradas, extraídas dos sedimentos, será removida da enseada para ser destruída num incinerador de detritos perigosos, devidamente autorizado Terminada a demonstração, os solventes (menos de cinco barris) usados na limpeza da unidade serão incinerados ou removidos para serem reciclados.

Mailing List Additions

If you know of someone who is not receiving information and would like to be placed on the New Bedford Harbor Superfund site mailing list, please fill out and mail this form to:

Paul Knittel
U.S. Environmental Protection Agency
Office of Public Affairs, RPA-2203
J.F. Kennedy Federal Building
Boston, Massachusetts

Name: _____

Address: _____

Affiliation: _____ Telephone: _____

Acréscimos à Lista de Endereços

Se souber de alguém que queria receber informação sobre a área do Superfundo na Enseada de New Bedford, por favor, preencha o formulário abaixo e remeta-o a:

Paul Knittel
U.S. Environmental Protection Agency
Office of Public Affairs, RPA-2203
J.F. Kennedy Federal Building
Boston, Massachusetts 02203

Nome: _____

Endereço: _____

Afiliação: _____ Tel. _____

APPENDIX 2. LIST OF ACRONYMS, ABBREVIATIONS, AND TRADE NAMES

ACRONYMS

AOAC	Association of Official Analytical Chemists
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
ATS	Aqueous Treatment System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERI	Center for Environmental Research Information
CRF	Combustion Research Facility
CROW	Contained Recovery of Oily Waste
DRE	Destruction and Removal Efficiency
EDDM	Experimental Debris Decontamination Module
EMSL-LV	Environmental Monitoring Systems Laboratory - Las Vegas
EPA	Environmental Protection Agency
EP Toxicity	Elutriate Procedure Toxicity
ESD	Electroacoustic Soil Decontamination
GAC	Granular Activated Carbon
HSWA	Hazardous and Solid Waste Amendments
ISV	In-Situ Vitrification
KPEG	Potassium Polyethylene Glycolate
LSCD	Liquid-Solid Contact Digestion
LT3	Low-Temperature Thermal Treatment
MIS	Mobile Incineration System
NGA	National Governors Association
NPL	National Priorities List
NTIS	National Technical Information Service
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
OTA	Office of Technology Assessment
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCDDs	Polychlorinated Dibenzodioxins

PCDFs	Polychlorinated Dibenzofurans
PCPs	Pentachlorophenols
QA/QC	Quality Assurance/Quality Control
RCRA	Resources Conservation and Recovery Act
R&D	Research and Development
RD&D	Research, Development, and Demonstration
RFP	Request for Proposal
RREL	Risk Reduction Engineering Laboratory
SARA	Superfund Amendments and Reauthorization Act
SDEB	SITE Demonstration and Evaluation Branch
SITE	Superfund Innovative Technology Evaluation
STDD	Superfund Technology Demonstration Division
TCDF	Tetrachlorodibenzofuran
TCE	Trichloroethylene
TEA	Triethylamine
TSCA	Toxic Substances Control Act
USATHAMA	United States Army Toxic and Hazardous Materials Agency
UST	Underground Storage Tank
UCS	Unconfined Compressive Strengths
UV	Ultraviolet
VOCs	Volatile Organic Compounds
WBAS	Westinghouse Bio-Analytical Systems

ABBREVIATIONS

cm	Centimeter
CO	Carbon Monoxide
dscm	Dry Standard Cubic Meter
GC/MS	Gas Chromatograph/Mass Spectrophotometer
JP-4	Jet Propulsion Fuel
kg	Kilogram
lbs	Pounds
mg	Milligram
NOx	Nitrous Oxides
O2	Oxygen
ppb	Parts Per Billion
ppm	Parts Per Million
psi	Pounds Per Square Inch
sec	Second
2,4,5-T	2,4,5-Trichlorophenol

TRADE NAMES

AlgaSORB	
B.E.S.T.	Basic Extraction Sludge Treatment
CHEMFIX	
Chloranan	
Oberlin	
PACT	Powdered Activated Carbon Treatment
Pyretron	
Silvex	
Tyvek	
URRICHEM	
X*TRAX	