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Mike Hightower

Sandia National Laboratories

Albuquerque, NM 87185-0755

Phone: (505) 844-5499 Fax: (505) 844-0116

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**DOE's Innovative Treatment Remediation Demonstration Program  
Accelerating the Implementation of Innovative Technologies**

**Introduction**

A program to help accelerate the adoption and implementation of new and innovative remediation technologies has been initiated by the Department of Energy's (DOE) Environmental Restoration Program Office (EM40). Developed as a Public-Private Partnership program in cooperation with the U. S. Environmental Protection Agency's (EPA) Technology Innovation Office (TIO) and coordinated by Sandia National Laboratories, the Innovative Treatment Remediation Demonstration (ITRD) Program attempts to reduce many of the classic barriers to the use of new technologies by involving government, industry, and regulatory agencies in the assessment, implementation, and validation of innovative technologies. In this program, DOE facilities work cooperatively with EPA, industry, national laboratories, and state and federal regulatory agencies to establish remediation demonstrations using applicable innovative technologies at their sites. Selected innovative technologies are used to remediate small, one to two acre, sites to generate the full-scale and real-world operating, treatment performance, and cost data needed to validate these technologies and gain acceptance by industry and regulatory agencies, thus accelerating their use nationwide.

Each ITRD project developed at a DOE site is designed to address a typical soil or groundwater contamination issue facing both DOE and industry. This includes sites with volatile organic compound (VOC), semi-VOC, heavy metal, explosive residue, and complex or multiple constituent contamination. Projects are presently underway at three DOE facilities, while additional projects are under consideration for initiation in FY96 at several additional DOE sites. A brief overview of the ITRD Program, program plans, and the status and progress of existing ITRD projects are reviewed in this paper.

**The Innovative Treatment Remediation Demonstration Program**

Common barriers to the use of innovative remediation technologies have been identified in several studies. These barriers include the lack of validated full-scale cost and performance data for these technologies, a lack of industry and regulatory involvement in technology evaluations, and the fear of penalties or fines for delays or failure of a new technology to meet required clean-up levels. The ITRD Program was initiated in 1993 in cooperation with the EPA's Technology Innovation Office in an attempt to reduce these barriers and accelerate the implementation of innovative remediation technologies.

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To try and accomplish this, the ITRD program was organized based on a public-private technology demonstration concept shown in Figure 1. To improve communications and teamwork, government, industry, and regulatory agencies are directly involved in assessing, implementing, and evaluating innovative technologies. Sandia National Laboratories, as technical coordinator for the ITRD Program, is responsible for forming advisory groups for each project. These groups are composed of technical representatives from the DOE and the national laboratories, the EPA and its laboratories, user industries with similar problems, and state and federal regulatory agencies. This composition of participants enhances communication and provides the teamwork necessary to effectively identify and review the variety of innovative technologies potentially applicable at a site.

The technologies considered for evaluation in each ITRD project are those innovative technologies whose lack of adequate cost and performance information generally prevent their full consideration as remedial alternatives. These type of technologies often have shown promise in pilot-scale applications, but have limited full-scale cost and performance data. Typical technologies that fall into this category include; bioremediation, insitu dynamic stripping, soil washing and soil flushing, solvent and surfactant extraction and chemical treatment, insitu passive treatment, and advanced physical separation techniques. After careful review of applicable innovative technologies for the site, conducting treatment studies, and conducting engineering evaluations of technology cost and performance estimates, the advisory group recommends the best technology options, considering cost, performance, and regulatory issues, that would enhance or improve remediation of the site.

The technologies selected for implementation are used to remediate small, one-two acre, sites. During the remediation of the site, the operating, treatment performance, and cost data are closely monitored by the advisory group, providing accurate full-scale operating and performance data on the innovative technologies. This provides the participating government, industry, and regulatory entities with the necessary operational test and evaluation data to validate the performance of these new technologies. The validation of these technologies is the mechanism that ultimately accelerates their use and implementation at other sites within the DOE and across the nation.

#### Current Innovative Treatment Remediation Demonstration Projects

Currently there are three ITRD projects underway. The sites selected for the ITRD program are generally small sites scheduled for remediation where most of the site characterization has been completed. This allows each project to be initiated quickly, minimizes additional program costs, and accelerates overall site remediation. The major emphasis for ITRD projects are sites with typical soil and ground water contamination problems. These include sites with contaminants such as: chlorinated solvents and petroleum products; pesticides, PCB's, and dioxins; heavy metals; explosives; and complex or multiconstituent contamination.

The first ITRD project was initiated at the DOE's Pinellas Facility in Largo, Florida. Agreement to proceed with this project was finalized in September 1993. The Pinellas Northeast Site Project addresses an approximately three to four acre site characterized by chlorinated solvent contamination of ground water in a shallow, sandy, surficial aquifer. A Corrective Measures Study proposed a standard thirty year pump-and-treat system as the baseline ground water remediation technology for the site. Because the facility is scheduled to be converted to private commercial uses, ways to accelerate the remediation of the site and reduce overall remediation costs were important considerations. This project has progressed to a stage where innovative technology assessment and site specific treatability studies have been completed by the technical advisory group and innovative technology alternatives have been selected for implementation. This project is discussed in detail later as a case study, demonstrating the operation of the public-private demonstration concept and its overall effectiveness.

A second project is underway at DOE's Mound Facility in Miamisburg, Ohio. This project addresses Mound's Operable Unit-1, a two acre site characterized by low level, generally less than 1 ppm, chlorinated solvent contamination of soil and ground water. The contaminated ground water is in a shallow, high permeability, sandy-gravel, sole source, aquifer that provides drinking water for many cities along the Miami River and for the plant itself. The contaminated vadose zone soil above the aquifer consists of lenses of glacial till, fill, and sand and gravel. The proposed baseline remediation technology for this site is a standard thirty year pump-and-treat system. Because the facility is scheduled to be converted to private commercial uses, ways to accelerate the remediation of the site and reduce overall costs are an important consideration for this project. The project was initiated in March 1995 and is at the stage where technology assessments and site-specific treatability studies are being conducted through the technical advisory group. Innovative technology recommendations for the site are scheduled to be completed by October 1995.

The third project that is presently underway is being done jointly with DOE's Fernald and Mound Facilities. Approximately forty miles apart with similar fine grained clayey soils, this project addresses heavy metals contamination of soil at both facilities. The concern at the Mound facility is predominately plutonium contaminated soil, while the concern at the Fernald facility is predominately uranium contaminated soil. The removal of heavy metals from fine grained soils to the levels required for regulatory compliance can be extremely difficult. Therefore, the baseline remediation alternative proposed for the Mound facility is soil excavation, compaction, and off-site shipment for disposal. The proposed baseline remediation alternative for the Fernald facility is disposal of most of the contaminated soil in a constructed on-site landfill with off-site shipment and disposal of small volumes of more highly contaminated soil. Approximately two million cubic yards of soil are contaminated with heavy metals at these two sites. Several areas containing five thousand to twenty thousand cubic yards of contaminated soil exist at these facilities, which can be used to effectively evaluate applicable innovative soil treatment technologies. Agreement to proceed on this project was finalized in May 1995. At the present time, innovative technology

evaluations are presently underway. Technology recommendations by the technical advisory group established for this project are scheduled for November 1995.

Three additional ITRD projects are presently under consideration and are expected to start early in fiscal year 1996. These projects include sites at DOE's Los Alamos National Laboratory, Central Nevada Test Area, and Paducah Facility. The Los Alamos project would address sandy soil sites contaminated with heavy metals, predominately lead and cadmium. The Central Nevada Test Area project would address a two acre sludge pond contaminated with heavy metals and VOCs, predominantly chromium and diesel fuel. The Paducah project will probably address PCB contamination of soil and ground water. The addition of each of these projects will expand the suite of contaminants and the geologic and hydrologic conditions being addressed by the ITRD Program. Additional ITRD project sites will be evaluated in the coming year in DOE's Southwestern, Eastern, and Northwestern Area Programs. Overall, the ITRD Program is scheduled to initiate two to three new projects each year through 1999.

#### The Pinellas Northeast Site ITRD Project: A Case Study

In this case study of the Pinellas ITRD Project, a detailed example of how the ITRD Program public-private demonstration concept functions is presented. Not only does this case study show how the government, industry, and regulatory participants are selected for an advisory group and how that group works together and with the site to assess and evaluate innovative technologies, it also demonstrates the overall benefits participating sites and the DOE can realize through their efforts and in applying innovative technologies identified through this process. In this section we describe the Pinellas ITRD Project, its status, and the expected benefits from this effort.

The technical advisory group established to identify, implement, and validate applicable innovative remediation technologies at the Pinellas Northeast Site consisted of technical representatives from government, industry, and regulatory agencies with backgrounds in environmental remediation and technology research in soil and ground water remediation. Industry participants included representatives from Phillips Petroleum, General Electric, Exxon, Clean Sites, and Lockheed Martin Specialty Components, the Pinellas Facility operator. EPA participants included representatives from the Technology Innovation Office's groundwater remediation staff, the Superfund Innovative Technology Evaluation (SITE) Program, the Federal Facility Restoration and Reuse Office (FFRRO), and the R. S. Kerr Environmental Research Laboratory, EPA's groundwater research laboratory. DOE participants included representatives from environmental restoration and technology development (EM40 and 50), the Albuquerque Operations and Pinellas Area Offices, and researchers from Lawrence Livermore and Sandia National Laboratories. Regulatory participants included representatives from EPA Region IV and the Florida Department of Environmental Protection.

This advisory group identified approximately twenty innovative enabling, active, and passive technologies for investigation and review, each with the potential to enhance the proposed pump-and-treat process. Technologies identified for review included: barriers; insitu treatment walls such as iron filings, microbubbles, and zeolites; horizontal wells; hot air and steam injection for insitu dynamic stripping; insitu heating; air sparging and vapor extraction; insitu aerobic and anaerobic bioremediation; electrokinetics; and insitu soil flushing with surfactants or cosolvents.

The major contaminants of concern at the Northeast Site are tetrachloroethene, trichloroethene, dichloroethene, vinyl chloride, and dichloromethane. In two areas of the site the contaminant concentrations exceed 1000 ppm. Controlling factors at the site are a high water table, high iron content in the ground water, a low ground water flow gradient, and anaerobic aquifer conditions. With this information in mind, all the technologies identified were reviewed and many were eliminated from further consideration by the technical group due to immaturity or inapplicability at the site. Several innovative technologies with potential application were selected for further investigation and site specific treatment studies. Treatability studies were conducted for iron dechlorination, insitu stripping, and insitu anaerobic bioremediation. Though these types of studies can be costly and can take three to nine months to complete, the data generated was necessary to enable the project participants to determine whether these technologies were viable alternatives at the site. Based on the treatment studies and engineering evaluations of innovative technology cost and performance estimates, three technologies were recommended and selected to enhance the effectiveness of the proposed baseline pump-and-treat system at the Northeast Site.

The technologies selected include a membrane separation system to treat pumped groundwater, a mobile rotary steam stripping system to treat the areas of high contaminant concentration, and nutrient injection for enhanced insitu anaerobic bioremediation of the areas of low contaminant concentration. Using a conventional pump-and-treat system for thirty years would reduce the VOC levels in the areas at the site of highest concentration to 250 to 300 ppb, which still is significantly above drinking water standards. As shown in Figure 2, implementation of the three innovative technologies would eliminate air emissions and reduce the ground water contaminant levels at the site to drinking water standards in three to five years at a cost savings of \$5 million to \$10 million, when compared to the proposed baseline design.

A pervaporation system will replace air stripping for treating pumped ground water. The system uses a membrane permeable to organics but impermeable to water that with vacuum assistance can remove 99 percent of the organic contaminants from the water. The removed solvents can be recycled, and the treated water should meet federal discharge standards. The system minimizes water pretreatment and overall air emissions. A pilot pervaporation system is presently in operation at the site undergoing operational evaluation.

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Albuquerque, NM 87185-0755

Phone: (505) 844-5499 Fax: (505) 844-0116

The mobile rotary drill steam stripping system will be used to reduce VOC contamination levels in the areas of high concentration, greater than 1000 ppm, to concentrations more in line with the rest of the site, around 50 ppm to 100 ppm. In this process, hot air or steam is injected through a modified rotary drill while the drill is agitating the soil, volatilizing organic contaminants trapped in the soil. The volatilized contaminants are captured by a hood attached to the drill rig and placed over the soil being treated. Implementation of a pilot rotary drill system to study site specific operational issues prior to full-scale implementation is being coordinated with the Pinellas Environmental Restoration Program.

In situ bioremediation will be used to treat the areas of low VOC contamination, below 100 ppm. Baseline pump-and-treat activity will be used with injection wells to supply nutrients to the existing anaerobic microbial populations that naturally are capable of degrading the chlorinated solvent contaminants at this site. Several nutrient supplements were shown in laboratory testing to stimulate indigenous microbial populations in degrading these contaminants. Implementation of a pilot in situ anaerobic bioremediation system to identify optimum full-scale operating parameters is also being coordinated with the Pinellas Environmental Restoration Program.

### Conclusions

As demonstrated by the Pinellas ITRD Project case study discussed above, bringing together technical representatives from EPA, DOE, industry, and regulatory agencies with the appropriate knowledge and backgrounds can lead to a team approach to identifying and defining innovative and more cost effective solutions to site remediation problems. The public-private partnership approach improves the communication necessary to identify appropriate technologies, generate the necessary treatment study data, and address the regulatory and cost concerns required to minimize the risks and identify the advantages of applying innovative treatment technologies at any site.

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Co-authors

Tom Crandall

EM-451, Cloverleaf

U.S. Department of Energy

Germantown, MD 20874

Phone: (301) 903-7454, Fax: (301) 903-3877

Paul Beam

EM-451, Cloverleaf

U.S. Department of Energy

Germantown, MD 20874

Phone: (301) 903-8133, Fax: (301) 903-3877



# Cooperative Environmental Cleanup Technology Validation

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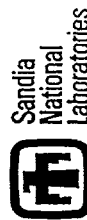
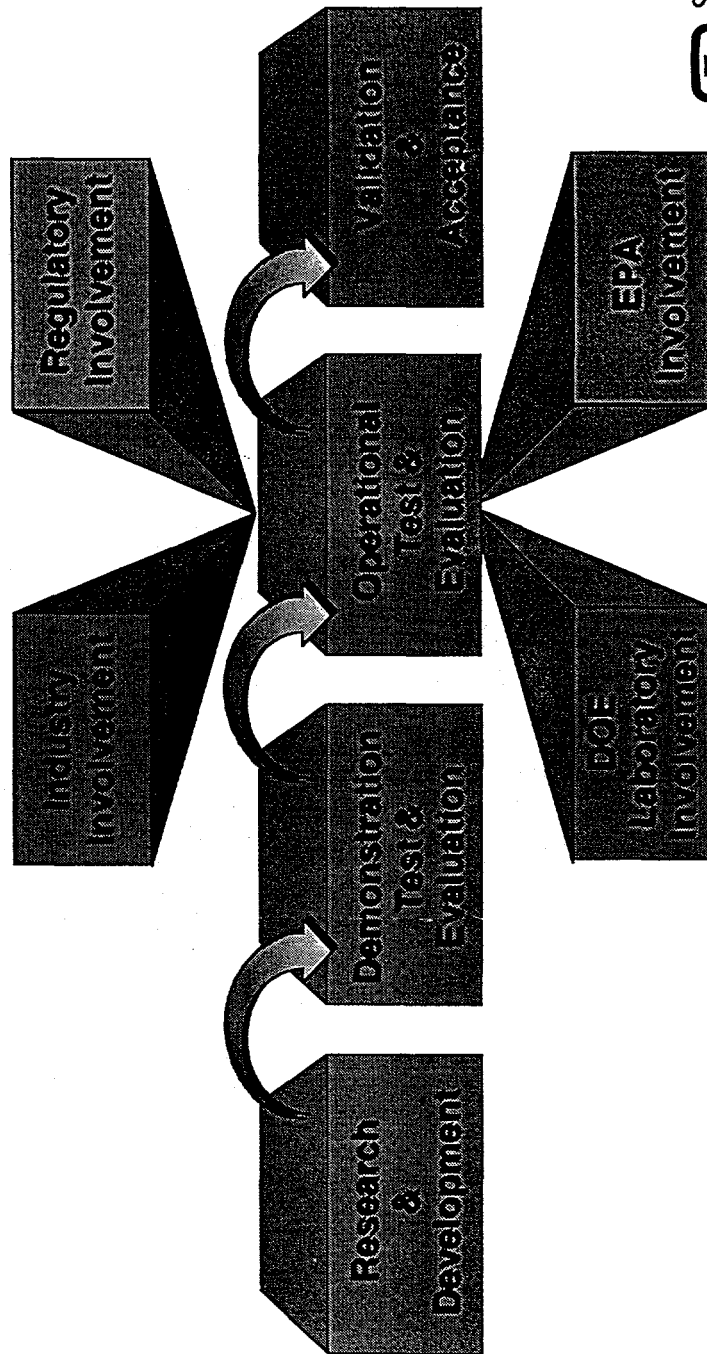


FIGURE 1. Organization of the Innovative Treatment Remediation Demonstration Program.

# Comparison of Baseline vs. Innovative Technology Performance and Costs at the Pinellas NE Site

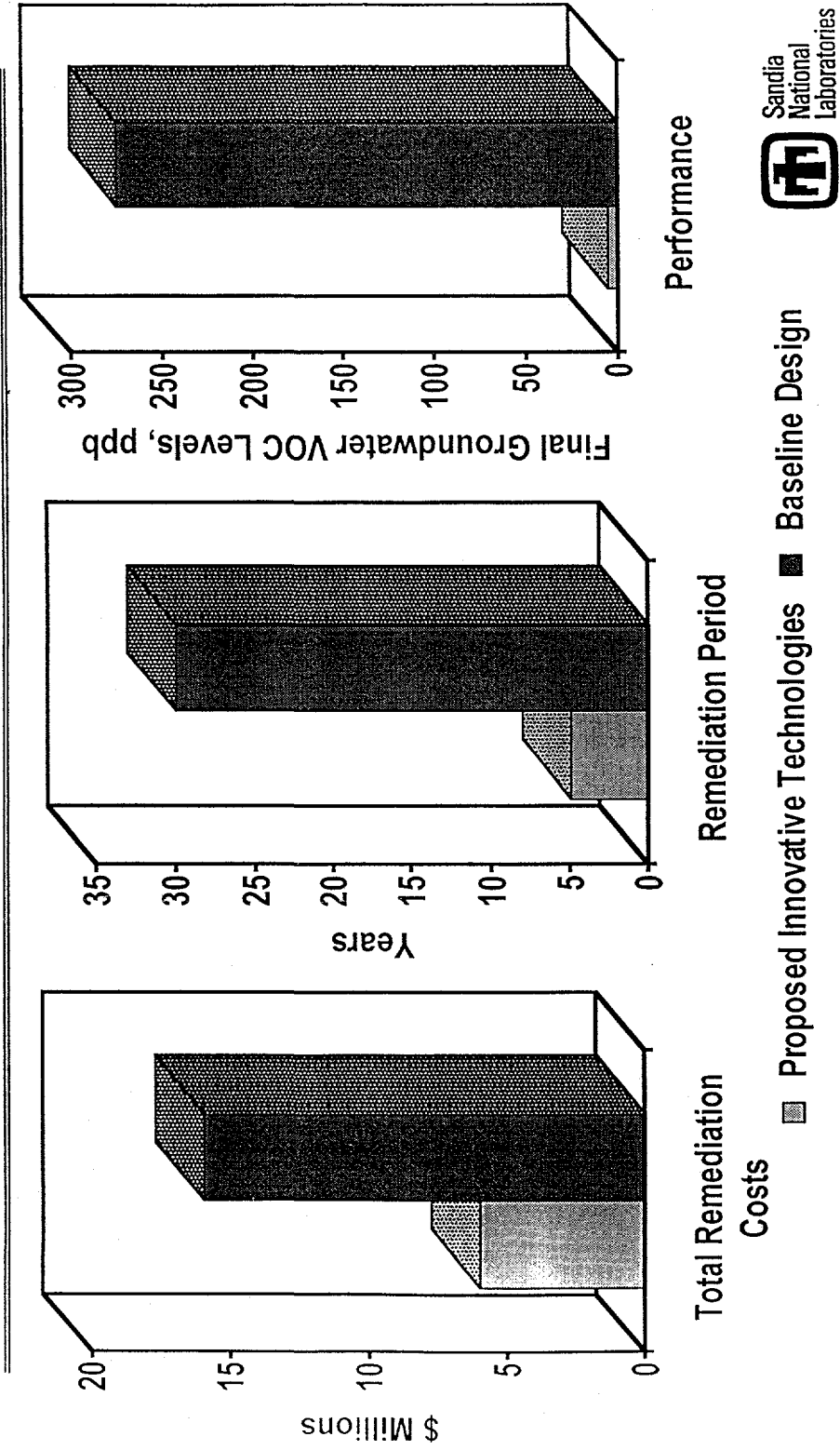


FIGURE 2. Comparison of Innovative and Baseline Technologies at Pinellas.