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Office of Solid Waste and
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Progress in Reducing Impediments to the Use of Innovative Remediation Technology

BACKGROUND

The Office of Solid Waste and Emergency Response created the Technology Innovation Office (TIO) in April 1990 to act as an advocate for new technologies. TIO's mission is to increase the applications of innovative treatment technologies to contaminated waste sites, soils, and groundwater. Because of its small size, TIO has encouraged and relied on cooperative ventures with other partners to accomplish most of its early goals. This effort to leverage resources has led to numerous joint efforts that have enhanced the state of remediation. Over the past five years, TIO has worked with many partners inside EPA, in other federal agencies, and in the private sector to improve the Nation's understanding of remediation treatment technologies and reduce the impediments to their widespread use.

Within the agency, TIO works with other offices to: affect policy changes; assist technology demonstrations; analyze trends in technology development and use; identify the supply of technologies and vendors to the marketplace; chart the future demand for remediation technologies and services; document cost and performance parameters for technologies; improve the diffusion of technology-related information; and provide continuing education for federal and state remediation project managers.

Outside the Agency, TIO works in concert with states, other federal agencies, professional associations, and private companies to create a marketplace with a rich diversity of cost effective solutions for the Nation's and world's remediation needs. The goal of these partnerships is to create an information-rich and practical network for all public and private decision-makers who affect the applications of clean-up technologies to contaminated soil and groundwater.

This document highlights the accomplishments made to date by TIO and its partners to advance innovative treatment technologies. Through continued cooperative ventures, TIO will strive to enhance the supply of technologies and information to the market to speed the cleanup of our Nation's waste sites.

POLICY AND REGULATORY IMPROVEMENTS

The following policy and regulatory changes have been made by EPA to reduce impediments to technology use:

- Revised the Treatability Study Sample Exclusion Rule (59 FR 8362) on February 18, 1994, to increase the quantity limits up to 10,000 kilograms of contaminated media for treatability studies that may be conditionally exempt from RCRA permitting and manifest requirements. This provision will be available in states that have made appropriate revisions to their own regulations. These larger quantities will assist both hazardous waste technology development and remedial decision-making.

- Promulgated the Corrective Action Management Unit and Temporary Unit Rule (58 FR 8658) on February 16, 1993, as an optional provision under Subpart S of 40 CFR 264. This rule is expected to result in more on-site waste treatment, less reliance on incineration, and greater reliance on innovative treatment technologies.

- Delegated authority to issue Site Specific Treatability Variances for contaminated soils and debris to the Regions (OSWER Delegation 8-40).

- Authorized more states for the Treatability Exclusion Rule, Research, Development, and Demonstration Permit Authority, and Subpart X Permit Authority. These authorizations will simplify approvals and allow more flexibility for testing and demonstrating innovative treatment technologies (9380.3-09FS).

- Promulgated a rule on August 18, 1992, for Land Disposal Restriction of Contaminated Debris, which allows more flexible treatment standards than under the original Land Disposal Regulations (40 CFR 268).

- Developed and began implementation of *Strategy to Increase the Use of Innovative In Situ Treatment*

Technologies for Contaminated Ground Water (EPA/542/F-92/025, December 1992).

- Issued the Superfund Response Action Contractor Indemnification Rule (58 FR 5972) on January 25, 1993, which included provisions that allow lower deductibles for contractors using innovative treatment technologies.

- Issued a directive on furthering the use of innovative treatment technologies in Superfund and other EPA waste-related programs [OSWER Directive 9380.0-17FS (August 1991)], which:

  - ☑ encourages reasonable risk-taking in selecting innovative treatment technologies
  - ☑ requires innovative technologies to be routinely considered as an option in engineering studies
  - ☑ establishes initiatives and new procedures that will provide incentives for broader use of innovative technologies

RESEARCH, DEVELOPMENT, AND DEMONSTRATION IMPROVEMENTS

- Worked with Clean Sites, Inc., through a cooperative agreement, to establish public-private partnerships among Fortune 500 technology users, other federal agencies, and regulators to demonstrate and evaluate available innovative technologies on problems of mutual concern at federal facility sites. The first demonstrations were implemented at McClellan Air Force Base (CA) in 1994, and work is underway for field demonstrations at six additional facilities: Department of Energy (DOE) Pinellas Plant (FL), DOE Paducah Gaseous Diffusion Plant (KY), Joliet Army Ammunition Plant (IL), Otis Air National Guard Base (MA), Naval Air Station North Island (CA), and DOE Mound Plant (OH).

- With the Office of Research and Development (ORD), organized the Remedial Technologies Development Forum (RTDF). RTDF encourages collaboration among companies, public interest groups, states, universities, DOE, and the Department of Defense (DOD) in defining, prioritizing, and funding new, untried concepts for cleanup technologies. By consulting on technologies at the earliest stages of their development, RTDF seeks to combine the financial and intellectual resources of consortium members to promote research coordination and eliminate duplicative research and development.

- With ORD, serves as project director for the North Atlantic Treaty Organization's Committee for the Challenges to Modern Society pilot study. This is an international information exchange to evaluate demonstrated and emerging remedial action technologies for the cleanup of contaminated land and groundwater.

- Continuously tracked the status of all Superfund innovative treatment projects in *Innovative Treatment Technologies: Annual Status Report (Sixth Edition)*, September 1994 (EPA/542/R-94/005). This report contains information on over 300 innovative technology projects at Superfund remedial and removal sites, and enhances communication among vendors, experienced technology users, and those who are considering using innovative treatment technologies.

- With DOD and ORD, updated the *Remediation Technologies Screening Matrix and Reference Guide: Version 2* (EPA-542-B-93-005), which was originally developed by TIO and members of the Federal Remediation Technology Roundtable. This document profiles 55 innovative and established technologies for the remediation of soil, sediment, sludge, groundwater, and air/off gas treatment processes. This new document also presents a detailed discussion of the properties and behavior of five common contaminant groups (VOCs, SVOCs, fuels, inorganics, and explosives).

- With ORD, organized the EPA-led Bioremediation Action Committee (BAC), which has improved bioremediation as an innovative technology for site remediation. Since 1991, the BAC, an affiliation of industry, academia, and government officials, has:

  - ☑ identified high-priority research needs through a workshop of government, university, and industry representatives in April 1991
  - ☑ produced interim guidance for preparing bioremediation spill response plans to help On-Scene Coordinators determine whether bioremediation agents or methods are safe and effective for oil spills
  - ☑ set protocols that can be used to collect data to identify safe and effective products for the bioremediation of oil spills in the *Oil Bioremediation Products Testing Protocol Methods Manual*. This is available from the National Environmental Technology Application Corporation (1-800-48NETAC)

  For more information on the BAC, refer to the *Bioremediation Action Committee* brochure (EPA/600/F-93/001).

- With ORD, established the Bioremediation Field Initiative, an initiative that provides EPA and state project managers, consulting engineers, and industry with timely information regarding new developments in the application of bioremediation at hazardous waste sites. The initiative evaluates the performance of selected full-scale field applications at nine selected hazardous waste sites. These performance evaluations generate data needed to define the capabilities of bioremediation technologies. For more information on this initiative, refer to the *Bioremediation Field Initiative* brochure (EPA/540/F-92/012).

- ☑ *Soil Washing* (EPA/542/F-92/003)
- ☑ *Solvent Extraction* (EPA/542/F-92/004)
- ☑ *Glycolate Dehalogenation* (EPA/542/F-92/005)
- ☑ *Thermal Desorption* (EPA/542/F-92/006)
- ☑ *In Situ Soil Flushing* (EPA/542/F-92/007)
- ☑ *Bioventing* (EPA/542/F-92/008)
- ☑ *Using Indigenous and Exogenous Microorganisms In Bioremediation* (EPA/542/F-92/009)
- ☑ *Air Sparging* (EPA/542/F-92/010)

(Spanish versions became available in 1993.)

❖ Published the *Literature Survey of Innovative Technologies for Hazardous Waste Site Remediation: 1987-1991* (EPA/542/B-92/004), a bibliography of information resources on innovative technologies which was developed to improve awareness of the technical literature concerning innovative technologies.

TRAINING IMPROVEMENTS

❖ Developed and continued to operate the CERCLA Education Center (CEC), a unique training forum that aims at providing On-Scene Coordinators, Remedial Project Managers, Site Assessment Managers, and other Superfund staff with basic and advanced training on the laws, regulations, and processes that make up the Superfund program. TIO publishes a *Course Overview and Schedule* that describes CEC courses and provides a schedule of course offerings (EPA/542/F-95/004). CEC course curriculum includes:

- ☑ *Fundamentals of Superfund*
- ☑ *The Enforcement Process*
- ☑ *The Removal Process*
- ☑ *The Remedial Process*
- ☑ *Community Relations in Superfund*
- ☑ *Federal Facility Enforcement*
- ☑ *Innovative Treatment Technologies*

Orientation and training manuals include:

- ☑ *The CERCLA/Superfund Orientation Manual* (EPA/542/R-92/005)
- ☑ *The OSWER Source Book: Training and Technology Transfer Resources 1994-1995* (EPA/542/B-94/011a&b)
- ☑ *OSWER Quarterly Training Calendar*

❖ In cooperation with the U.S. Agency for International Development, the Office of Emergency and Remedial Response, and the Office of International Activities, developed the *Principles of Hazardous Waste Site Ranking* train-the-trainer course to provide basic environmental management information to the emerging democracies of Central and Eastern Europe. In 1993, the course was presented in Hungary and, in 1994, in Poland. In mid-1995, TIO plans to bring it to Bulgaria and, in 1996, again to Hungary. The primary objective of this course is to assist the host government in developing programs to establish hazardous site remediation priorities.

❖ Developed a teaching outline and support materials for a one-semester hazardous waste course on innovative technologies for use by graduate Environmental Engineering Departments. The course, developed by the University of Connecticut with the Association of Environmental Engineering Professors, is now available from Lewis Publishers, Inc., Boca Raton, Florida, 1-800-272-7737. Catalog # L1056.

❖ In conjunction with ASTSWMO, developed a five-day State Site Managers' CERCLA Training course. TIO delivered this course twice in 1994 to 144 participants, which fulfilled its original commitment for providing training sessions for state Superfund staff, and then handed over the training responsibilities to ASTSWMO. The course is a compilation of selected modules from three existing CEC courses: *Fundamentals of Superfund*, *Enforcement Process*, and *Remedial Process*.

❖ Continued sponsoring EPA's Training Forum, a group of Regional Training Coordinators organized to improve coordination of training-related activities and enhance communication among OSWER's Program and Regional Offices. They meet bimonthly via teleconference and hold semiannual meetings.

❖ Continued sponsoring the annual Regional and National Notable Achievement Awards. These awards are presented at the Regional and National level in seven categories: OSC of the Year, OSC Peer of the Year, RPM of the Year, RPM Peer of the Year, SAM of the Year, SAM Peer of the Year, and Superfund Team of the Year. Recipients of the Regional awards are honored in a special ceremony within the Region. They then go through a review process by a National Awards Panel, which is in charge of selecting the national award recipients. The National Award recipients are honored by EPA's Administrator in a special ceremony at EPA Headquarters in Washington, DC.

MAILING LIST/ORDER INFORMATION

To order copies of the EPA documents listed in this document, send a fax request to the U.S. EPA National Center for Environmental Publications and Information (NCEPI) at 513-489-8695, or send a mail request to NCEPI, P.O. Box 42419, Cincinnati, OH 45242-2419.

- Through the Bioremediation Field Initiative, developed Version 1.0 of the *Bioremediation in the Field Search System* (BFSS), an information resource about practical bioremediation projects nationwide for federal and state regulators, consulting engineers, industry personnel, and researchers interested in the field application of bioremediation. BFSS is available on EPA's Alternative Treatment Technology Information Clearinghouse (ATTIC) (703-908-2138), Cleanup Information (CLU-IN) (301-589-8366), and ORD (513-569-7610) electronic bulletin board systems.

- Supported a proposal to create a National Bioremediation Field Research Center at Wurtsmith Air Force Base in Michigan for applied public and private research and development on the use of bioremediation. Additional support and funding is being provided by a consortium of states and federal agencies, EPA Hazardous Substance Research Centers, and corporations.

- Established a Groundwater Remediation Technologies Analyses Center. A cooperative agreement will be awarded in the summer of 1995. The center will:

  - ☑ track ongoing groundwater research and development on a continuing basis
  - ☑ promote coordination between public and private research groups
  - ☑ encourage the demonstration of promising remediation research

- Inventoried the status of *in situ* groundwater remediation technologies in *In Situ Treatment of Contaminated Ground Water: An Inventory of Research and Demonstration* (EPA/500/K-93/001).

- Expanded the status reports on six abiotic technologies:

Surfactant Enhancements	(EPA 542-K-94-003)
Treatment Walls	(EPA 542-K-94-004)
Hydrofracturing/Pneumatic Fracturing	(EPA 542-K-94-005)
Cosolvents	(EPA 542-K-94-006)
Electrokinetics	(EPA 542-K-94-007)
Thermal Enhancements	(EPA 542-K-94-009)

INFORMATION SHARING IMPROVEMENTS

TIO and its partners have sponsored activities to enhance the remediation technology marketplace, including:

- Sponsored three marketplace conferences to highlight business opportunities and markets for developers and vendors of innovative treatment technologies (1993-1994). Invitees included senior state, EPA, DOD, DOE, and Commerce officials with business executives from technology firms. Summary proceedings of these conferences are available: *West Coast Remediation Marketplace: Business Opportunities for Innovative Technologies* (EPA/542/R-94/008); *Rocky Mountain Remediation Marketplace: Business Opportunities for Innovative Technologies* (EPA/542/R-94/006); and *Northeast Remediation Marketplace: Business Opportunities for Innovative Technologies* (EPA/542/R-94/001). Two additional marketplace conferences will be held in 1995: one in the Southeast and the other in the Mid-Atlantic.

- Through a cooperative agreement with the American Academy of Environmental Engineers and its associated professional organizations, developed monographs to outline state-of-the-practice information on the operating parameters of eight treatment technologies. The Departments of Defense and Energy provided joint funding for the project, entitled WASTECH. All monographs will be completed by the WASTECH workgroups by late spring, 1995. The volumes will be expanded over the next two years to add information on actual operating experience. In addition, WASTECH offered five Regional training seminars on the technologies included in the series.

- Chaired the Federal Remediation Technologies Roundtable, a working group of senior officials from federal agencies involved in the development and use of innovative site cleanup technologies. The Roundtable provides the opportunity for free exchange of information among these organizations through its semiannual meetings, its series of publications highlighting federal sources of information and demonstrations, and its subgroups. The Cost and Performance Subgroup recently completed an effort to achieve greater standardization in the reporting of information on the cost and performance of innovative technologies at completed site cleanups with the publication of a *Guide to Documenting Cost and Performance for Remediation Projects* (EPA/542/B-95/002).

- Published and revised three Federal Remediation Technologies Roundtable publications describing federal agency activities related to innovative treatment technologies: *Accessing Federal Data Bases for Contaminated Site Clean-up Technologies: Third Edition* (EPA/542/B-93/008); *Federal Publications on Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation: Third Edition* (EPA/542/B-93/007); *Synopses of Federal Demonstrations of Innovative Site Remediation Technologies: Third Edition* (EPA/542/B-93/009).

- Published 37 clean-up case study reports prepared by the Federal Remediation Technologies Roundtable. These studies are available in four separate volumes: *Remediation Case Studies: Bioremediation*; *Remediation Case Studies: Groundwater Treatment*; *Remediation Case Studies: Soil Vapor Extraction*; *Remediation Case Studies: Thermal Desorption, Soil Washing, and In Situ Vitrification*. Published *Abstracts of Remedia-*

tion Case Studies (EPA/542/R-95/001) containing two-page summaries of each case study.

- Signed a Memorandum of Understanding between EPA and the Small Business Administration to "ensure that the U.S. Government effectively encourages, supports, and enables U.S. small businesses to develop, market, and/or adopt cost-effective environmental technologies to achieve economic growth and environmental compliance."

- Co-authored with SBA *Bridging the Valley of Death*, a finance study that addresses management, regulatory, exporting, and financing issues faced by environmental technology developers and users. The study was released at the White House Conference on Technology for a Sustainable Future.

- Published *Innovative Hazardous Waste Treatment Technologies. A Developers Guide to Support Services, Third Edition* (EPA/542/B-94/012), a booklet that provides information on sources of technical, financial, and regulatory assistance and support in bringing technologies from the proof-of-concept stage to commercialization.

- Published the benchmark study *Cleaning Up the Nation's Waste Sites: Technology and Market Trends* (EPA/542/R-92/012, PB93-140762) to provide innovative technology developers and investors with information on future demand for remediation services. With over 4,000 copies in circulation, this study includes information on site characteristics, market size, and other demand factors of the major waste site cleanup programs in the United States. Initiated report update, which is scheduled for late 1995.

- Developed Quick Reference Fact Sheets on Regional experiences with procurement of innovative technologies at Superfund remedial sites (EPA/542/F-92/012) and removal sites (EPA/542/F-92/013).

- Continued to sponsor the Superfund Technical Support Project, which is comprised of the Groundwater, Engineering, and Federal Facility Forums and the Technical Support Centers. These groups address groundwater and engineering concerns related to site remediation, develop issues papers on these topics, and conduct technical reviews for four guidance documents each year. They conduct monthly teleconferences and sponsor a semiannual meeting, where speakers are invited to present information on a diverse set of topics related to groundwater, engineering, and federal facility site remediation issues.

- Continued to support seven Superfund Technical Support Centers, which provide Regional staff with site-specific assistance in the areas of groundwater remediation, risk assessment, engineering, site characterization, radiological evaluation, and modeling. This assistance often is provided through telephone communications, site visits, document review, technology evaluation, information clearinghouses, demonstration projects, publication of reports and journal articles, and technical workshops.

- With ORD, co-sponsored the five Forums on *Innovative Hazardous Waste Treatment Technologies: Domestic and International*. These three-day conferences introduced and highlighted innovative treatment technologies having actual performance results. They showcased results of selected international technologies, Superfund Innovative Technology Evaluation (SITE) program technologies, and case studies from those using innovative technologies. Since the Forums were introduced in 1991, over 2,000 people from government, industry, and international organizations have had a unique opportunity to exchange information on remediation technologies and practices.

- Published a brochure entitled *Accessing EPA's Environmental Technology Programs* (EPA/542/F-94/005). This brochure was developed to help environmental technology developers and users access the full range of assistance and cooperative partnerships offered by EPA. It briefly describes the role of each major EPA office in encouraging the development and use of innovative technologies for pollution prevention, pollution control, and remediation.

- Published *Profile of Innovative Technologies and Vendors for Waste Site Remediation* (EPA/542/R-94/002), which documents the characteristics of vendors that supply innovative technologies. The study included an analysis of the number of employees and sales.

- Completed an analysis of Feasibility Studies from 1991 and 1992 Superfund ROD sites to determine why innovative technologies were or were not being selected, and to identify barriers and data gaps about specific technologies. The information from this analysis will be distributed to the Regions and EPA's laboratories and will be used to support development of policies to encourage more widespread, constructive consideration and use of innovative technologies.

- Produced five Technology Resource Guides on Innovative Treatment Technologies, which contain user-friendly information on documents, databases, hotlines, and dockets pertaining to these technologies:

  - ☑ *Bioremediation Resource Guide* (EPA/542/B-93/004)
  - ☑ *Groundwater Treatment Technology Resource Guide* (EPA/542/B-94/009)
  - ☑ *Soil Vapor Extraction Treatment Technology Resource Guide* (EPA/542/B-94/007)
  - ☑ *Physical/Chemical Treatment Technology Resource Guide* (EPA/542/B-94/008)
  - ☑ *Enhancements to Soil Vapor Extraction Technology* (EPA/542/B-95/003)

- Published three regular newsletters devoted to current application of innovative technology:
  - ☑ *Tech Trends* provides descriptions and performance data for innovative source control technologies that have been applied in the field. (EPA/542/N-93/001, EPA/542/N-93/007, EPA/542/N-93/010, EPA/542/N-94/001, EPA/542/N-94/004, EPA/542/N-94/006, EPA/542/N-94/008, EPA/542/N-95/001)
  - ☑ *Bioremediation in the Field* offers information on applying bioremediation to site cleanup. Describes treatability studies and bioremediation projects planned, operating, or completed at CERCLA, RCRA, UST, and TSCA sites. (EPA/540/N-94/500, EPA/540/N-94/500, EPA/540/N-94/501)
  - ☑ *Ground Water Currents* provides information on innovative groundwater treatment technologies including development and demonstrations, new regulations, and conferences and publications. (EPA/542/N-93/003, EPA/542/N-93/006, EPA/542/N-93/008, EPA/542/N-93/011, EPA/542/N-94/002, EPA/542/N-94/005, EPA/542/N-94/007, EPA/542/N-94/009, EPA/542/N-95/002)

- Participated as a major exhibitor at over 100 national and international conferences, workshops, symposiums, and trade shows focusing on the development and use of innovative treatment technologies for site remediation. Distributed over 100,000 copies of technical literature on innovative technologies, such as fact sheets, bulletins, reports, and bibliographies on the application of innovative technologies.

- In coordination with the National Exposure Research Laboratory in Las Vegas, Nevada, developed the Vendor Field Analytical and Characterization Technologies System (Vendor FACTS) database, which will be released in the first quarter of FY96. This database will contain information on innovative techniques for site and waste characterization and promote the use of more cost-effective methods for on-site monitoring.

- Developed and maintained the Vendor Information System for Innovative Treatment Technologies (VISITT), which provides current information on innovative technology vendors, their products, and capabilities. As of FY94, the VISITT 3.0 database included information on 277 innovative treatment technologies offered by 171 developers and vendors. The system is being used by more than 10,000 users from 60 countries. For more information, refer to the VISITT brochure (EPA/542/N-94/003).

- Developed and enhanced EPA's Clean-Up Information (CLU-IN) electronic bulletin board to provide hazardous waste professionals information on innovative treatment technologies. This computerized bulletin board offers a number of information sources that may be read on-line in bulletin format or as files that can be downloaded. As of April 1995, CLU-IN averaged 3,600 calls per month from its 6,800 active registered users. In 1994, availability of and connectivity to CLU-IN were enhanced. Dial-in users can now access the system at (301) 589-8366 using up to a 28,000-baud modem. INTERNET users may access CLU-IN using TELNET. The TELNET address is *134.67.99.13* or *clu-in.epa.gov*. Contents include *Federal Register* notices on hazardous wastes, listings of EPA publications, a calendar of EPA training programs, and listings of National Priority List sites. Voice assistance is available at (301) 589-8368.

- In cooperation with the Association of State and Territorial Solid Waste Management Officials (ASTSWMO), TIO opened an ASTSWMO Special Interest Group (SIG) on CLU-IN. The SIG facilitates information exchange among state waste management officials across the nation.

- In cooperation with EPA's Office of Underground Storage Tanks, TIO opened an Underground Storage Tank (UST) SIG on CLU-IN to facilitate information exchange among state officials responsible for managing tank clean-up programs.

- Regularly updated a bibliography of the best EPA documents related to innovative technologies, entitled *Selected Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation: A Bibliography of EPA Information Resources* (EPA/542/B-95/001).

- Developed a series of satellite videoconferences sponsored by the Air and Waste Management Association and the Hazardous Waste Action Coalition in cooperation with the U. S. Air Force, DOE, the Water Environment Federation, EPA, the American Institute of Chemical Engineers, the National Solid Waste Management Association, the Association of State and Territorial Solid Waste Management Officials, and the Technology Innovation and Economics Committee of EPA's National Advisory Council on Environmental Policy and Technology. These seminars included: *Bioremediation: The State of Practice in Hazardous Waste Remediation Operations* (January 9, 1992), *Bioventing and Vacuum Extraction: Uses and Applications in Remedial Operations* (April 15, 1992), *Thermal Treatment: Thermally Enhanced Volatilization* (February 18, 1993), and *Changing Molecular and Physical States* (March 18, 1993).

- Produced ten *Citizens' Guide* fact sheets on innovative technologies, which provide easy-to-understand technology descriptions for the general public:
  - ☑ *Innovative Treatment Technologies For Contaminated Soils, Sludges, Sediments, and Debris* (EPA/542/F-92/001)
  - ☑ *How Innovative Treatment Technologies Are Being Successfully Applied At Superfund Sites* (EPA/542/F-92/002)