United States
Environmental Protection
Agency

Office of Solid Waste
and Emergency Response
Washington, DC 20460

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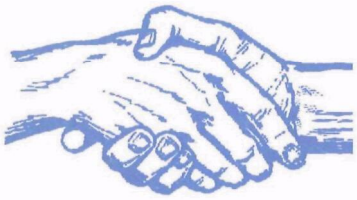
June 1991

EPA

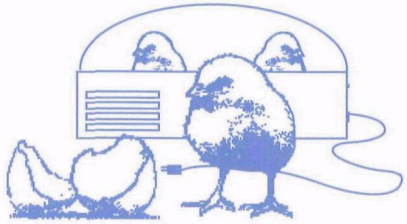
Innovative Hazardous Waste Treatment Technologies

A Developer's Guide To Support Services

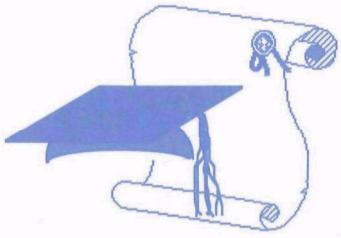
ASSISTANCE PROGRAMS



TECHNOLOGY INCUBATORS AND TEST AND EVALUATION FACILITIES



UNIVERSITY-AFFILIATED HAZARDOUS WASTE RESEARCH CENTERS



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INNOVATIVE HAZARDOUS WASTE TREATMENT TECHNOLOGIES

A DEVELOPER'S GUIDE TO SUPPORT SERVICES

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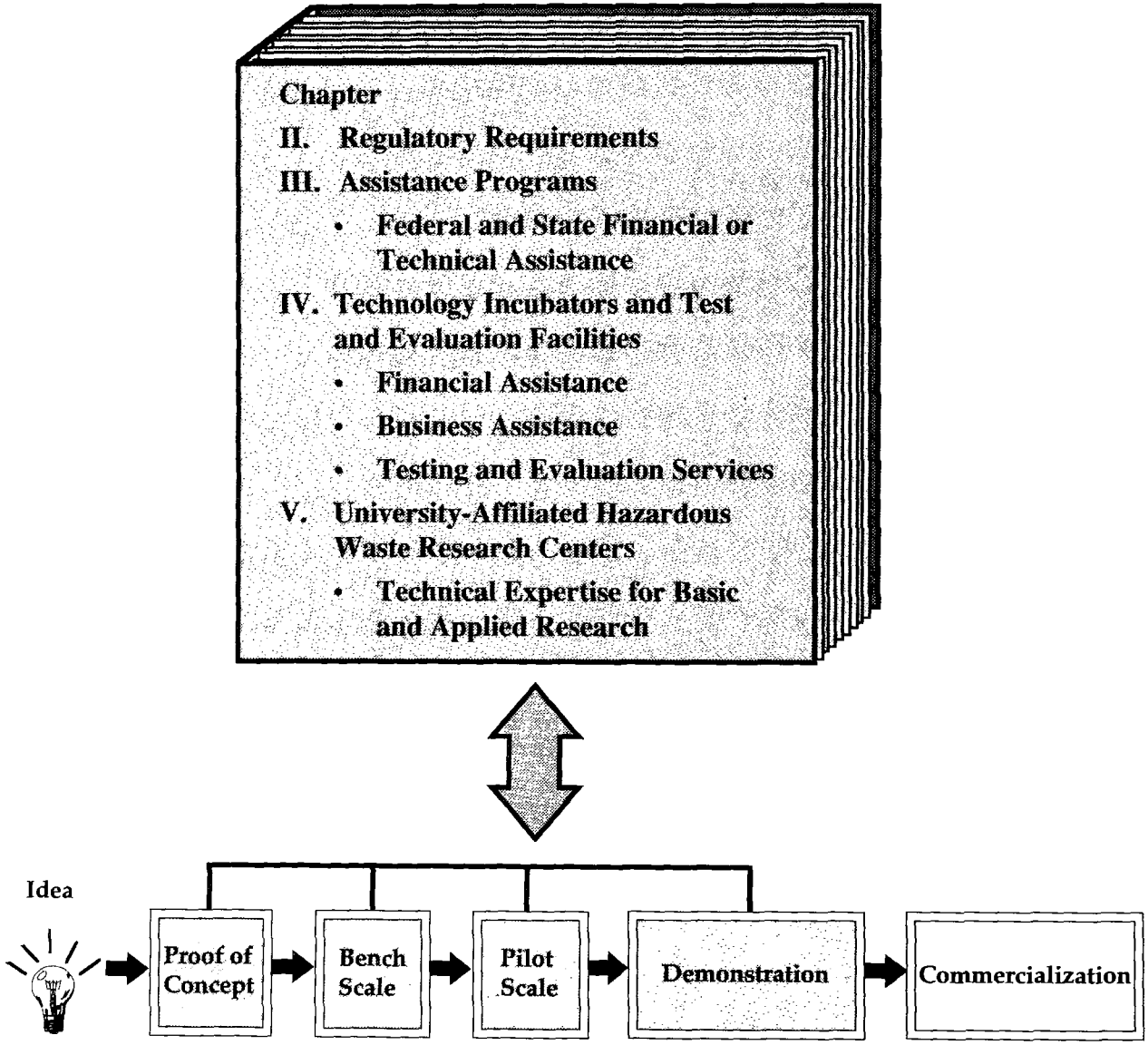
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Commercialization

FOREWORD

In the most recent amendments to the hazardous waste site remediation statute (the Superfund Amendments and Reauthorization Act - SARA), Congress expressed a preference for permanent remedies that reduce the toxicity, mobility, and/or volume of contaminants. Achievement of this goal requires the development and application of innovative approaches to hazardous waste treatment.

EPA recognizes the challenges faced by hazardous waste treatment technology developers and vendors. This booklet provides information on sources of assistance and support in bringing technologies from the proof of concept stage to the commercialization stage. It includes information on sources of grant funding and technical assistance, and identifies incubators, test and evaluation facilities, and university-affiliated research centers that can provide a range of technology development and evaluation services.

It is our hope that this information will be useful to both new and established developers of treatment technologies. Your comments and suggestions for future editions are welcome. The form on page 34 can be used to make such suggestions or to order additional copies of the booklet.

Walter W. Kovalick, Jr., Ph.D.
Director,
Technology Innovation Office
Office of Solid Waste and Emergency Response

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NOTE:

This booklet is intended to be used as a point of departure for technology developers seeking assistance. Inclusion in this booklet or the mention of trade names, commercial firms, or ventures does not constitute an endorsement by the U.S. EPA. In addition to the resources identified in this booklet, developers of innovative hazardous waste treatment technologies are encouraged to contact local programs, facilities, and universities not listed.

TABLE 1 -- SERVICES FOR DEVELOPERS

TYPES OF SERVICES	NATURE OF SERVICES
• **Financial Assistance**	Identification of alternative funding sources, including venture capital, government grant programs, and joint venture opportunities for technology developers.
• **Market Analyses**	Environmental market analyses for candidate technologies to define the size and nature of the applicable market. Analyses include recommendations on further developmental activities, as well as time and money likely to be required for commercialization.
• **Testing and Evaluation**	Demonstration and testing programs at various scales for promising technologies. Evaluation of technical feasibility or status, including projects such as prototype development and testing, and scale-up design. Facilities may provide test bays with secondary containment systems and/or analytical services.
• **Technical Assistance**	Technical expertise in a variety of science and engineering disciplines to assist in all stages of development through basic and applied research.
• **Permitting and Regulatory Assistance**	Assistance in addressing permitting and regulatory requirements by providing personnel with permitting expertise or, in some cases, providing permitted laboratory facilities.
• **Administrative Support**	Office space, office equipment, secretarial support, and other administrative assistance.
• **Training and Technology Transfer**	Assistance in working with universities and other public research institutions to strengthen technological skills and approaches.

I. INTRODUCTION

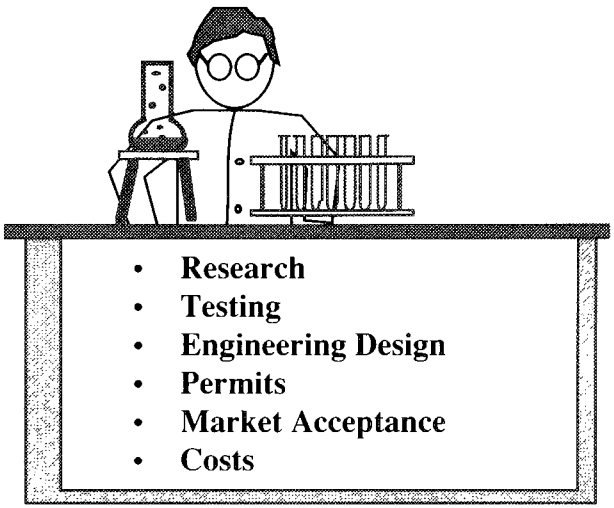
As required by the Superfund Amendments and Reauthorization Act (SARA), EPA's Office of Solid Waste and Emergency Response (OSWER) is placing greater emphasis on permanent remedies at hazardous waste sites, where such action is appropriate. OSWER's Technology Innovation Office (TIO) has a broader mandate to also increase the application of innovative technologies at Resource Conservation and Recovery Act (RCRA) corrective action sites and in the remediation of underground storage tanks. An important component of such efforts is the development of less costly and more effective innovative treatment technologies.

In investigating the needs of technology developers in the development, demonstration, and commercialization of their technologies, TIO found that much of the available information was not assembled in a single conveniently available format. TIO also found that there is potential demand for a variety of programs, facilities, and services. Table 1 on the previous page lists the types of services available to developers.

For the purposes of this booklet, available programs, facilities, and services have been divided into three categories:

- Assistance programs
- Technology incubators and test and evaluation (T&E) facilities
- University-affiliated hazardous waste research centers.

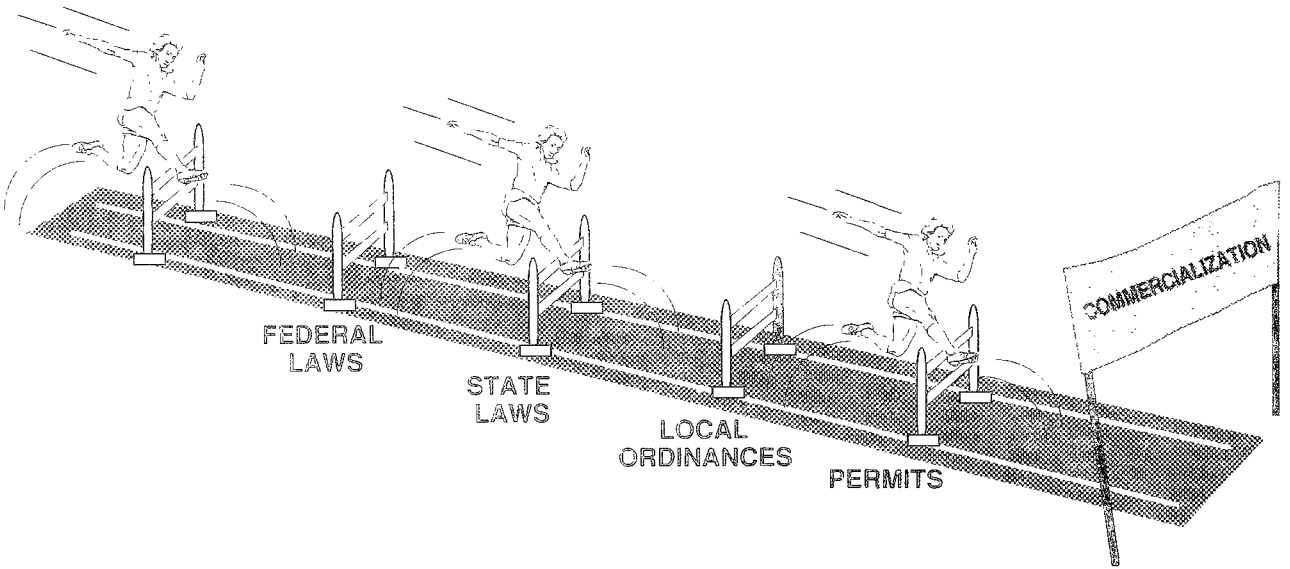
Developers are Confronted With an Array of Challenges



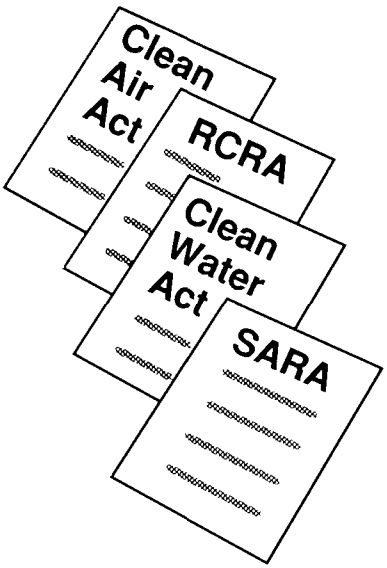
This booklet begins with a brief overview of the regulatory requirements. The remainder of the document summarizes assistance programs, facilities, and research center services available to developers of innovative hazardous waste treatment technologies.

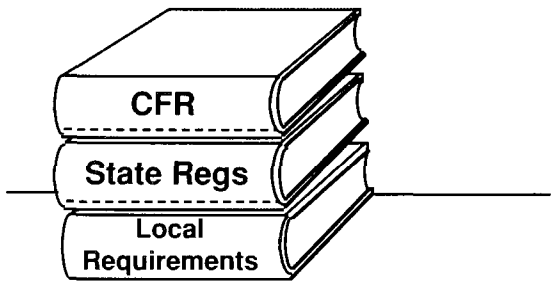
Information contained in this booklet was gathered primarily from facility personnel. The descriptions provide a snapshot of the equipment and expertise available. The list of assistance programs and test and evaluation facilities is comprehensive. The university-affiliated research centers are meant only to be illustrative of potential sources of assistance. Developers should use this booklet as a point of departure for contacting programs, facilities, and services.

Developers Face Regulatory Hurdles



II. REGULATORY REQUIREMENTS





The field of hazardous waste remediation is relatively unique in the extent to which research and development, as well as full-scale technology application, may be subject to regulation. Acquiring permits not only necessitates gathering substantial amounts of information, but also may require a significant lead time before they are actually issued. These factors must be considered in developers' planning processes.

An awareness of regulatory requirements can assist technology developers in avoiding regulatory problems, determining market "niches," and accelerating market acceptance.

Since Federal and State regulatory programs are dynamic, and because requirements differ among States, it is not possible to provide definitive guidance in this booklet. Interested parties should contact appropriate Regional or State regulatory personnel for up-to-date information on regulatory requirements. The following sections on technology development and technology application provide some general regulatory information useful to developers, particularly those just entering the environmental field who may not be fully aware of regulatory requirements.

TECHNOLOGY DEVELOPMENT

Permitting

EPA has issued a number of regulatory provisions intended to provide relief in permitting and testing requirements for technology developers. Since States vary in the extent to which they have adopted these provisions, developers should contact their EPA Region or State to verify their applicability in a particular jurisdiction.

Research, Development, and Demonstration (RD&D) permits (40 CFR 264, 270) are available to technology developers who wish to conduct limited duration and limited quantity testing on actual hazardous waste. The intent of this provision is to set up a permitting process for RD&D activities that is less expensive and time-consuming than full-fledged Resource Conservation and Recovery Act (RCRA) permitting.

EPA has also issued the 1000kg Treatability Exclusion (40 CFR 261), which may exempt small-scale testing activities from permitting requirements. Developers wishing to use the 1000kg treatability exclusion should obtain a copy of the regulation to ensure compliance with its provisions and verify that it is applicable in their State.

Table 2 contains a list of EPA Regional contacts to consult in determining the applicability of RD&D permitting and the 1000kg treatability exclusion. In addition to the Regional contacts, personnel at a number of the facilities described in this booklet may be able to provide assistance in understanding regulatory requirements.

TABLE 2
EPA REGIONAL CONTACTS
(See Figure 1 for map of Regional offices)

Region I	John Podgurski (617) 573-9673
Region II	Andrew Bellina (212) 264-0504
Region III	John Humphries (MD, VA, WV, DE) (215) 597-1812 Paul Gotthold (PA, D.C.) (215) 597-7370
Region IV	Douglas McCurry (404) 347-3433
Region V	Karl Bremmer (312) 353-4783
Region VI	James Sales (214) 655-6785
Region VII	Lydell Harrington (913) 551-7657
Region VIII	Tom Burns (303) 293-1798
Region IX	James Breitlow (415) 744-2064
Region X	Mike Gearheard (206) 553-2782

Performance Standards

Developers need to know the performance standards potentially applicable to their technology. Performance requirements for hazardous waste cleanup may involve cleanup goals based on site-specific factors or the application of pre-established technology-based standards. Standards to which a technology *may* be subject can be found in EPA's Land Disposal Restriction guidelines (40 CFR 268) for contaminated waste streams and in the Maximum Contamination Limit (40 CFR 141) regulations for contaminated groundwater. Information on *actual* cleanup levels at individual hazardous waste sites may be available at EPA Headquarters and Regional libraries and from State agencies.

Developers should note that in addition to meeting specific cleanup goals for the contaminated media in question, there also may be limits on permissible air emissions and/or wastewater discharges.

TECHNOLOGY APPLICATION

By the time a developer achieves full-scale commercialization, it is likely that regulatory requirements are reasonably well-understood; however, attention to this complex area can prevent unpleasant surprises.

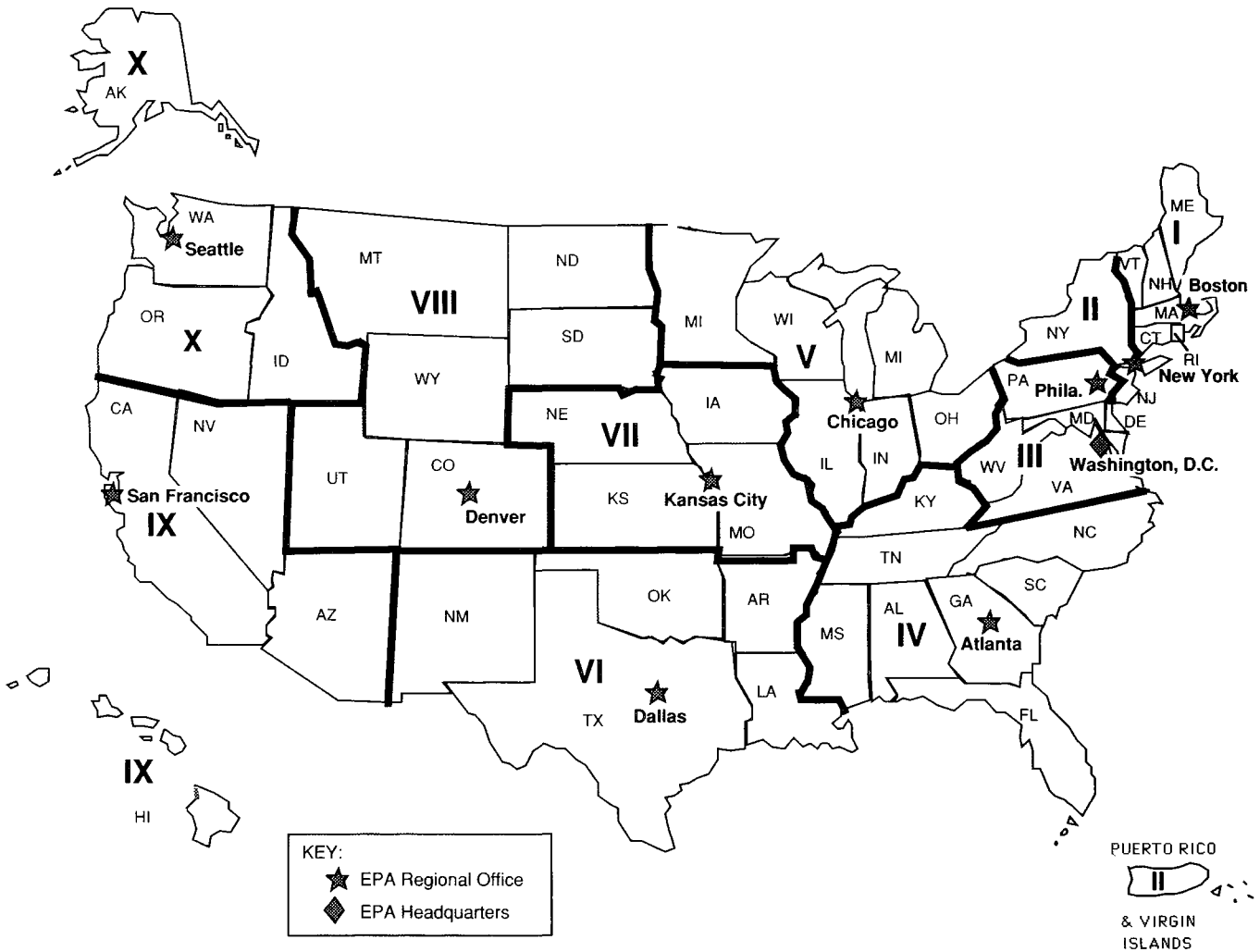
There are provisions for relief from *administrative* requirements (i.e., permits) for activities at some sites being cleaned up under the "Superfund" statute (CERCLA/SARA); however, substantive cleanup standards must still be met. Depending on the nature of the activity and its location, technology applications at other sites may be subject to permit requirements under the Federal RCRA, Clean Air Act, Clean Water Act, or underground injection control provisions of the Safe Drinking Water Act. States generally have equivalent provisions that also must be satisfied.

For General Regulatory Information Call the RCRA/CERCLA Industry Assistance Hotline
1-800-424-9346

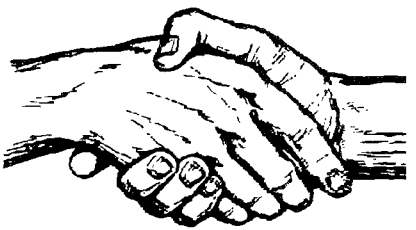
Developers of technologies for treating polychlorinated biphenyls (PCBs) should be aware that these technologies are subject to separate regulation by EPA's Office of Toxic Substances (40 CFR 761).

Toxic Substances Control Act Assistance Information Service
202-554-1404

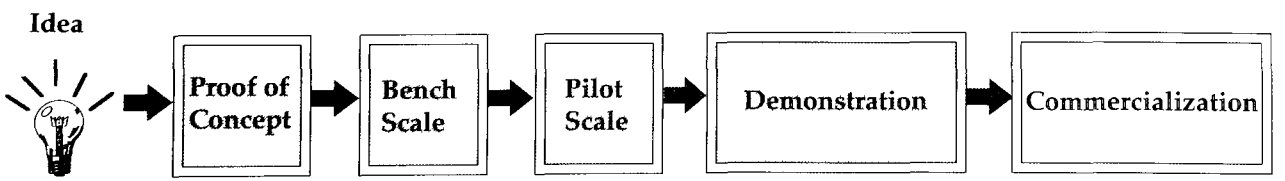
FIGURE 1
EPA REGIONS



III. ASSISTANCE PROGRAMS



- **Federal, State, and private programs exist to assist developers of innovative hazardous waste treatment technologies.**
- **Programs may provide financial and/or technical assistance, occasionally at no cost, to developers.**
- **The assistance programs identified in this section are particularly helpful in the development and demonstration stages of innovative hazardous waste treatment technology development.**
- **Assistance programs may provide developers with a mechanism for independently validating their results and communicating their successes.**
- **Conditions for assistance vary widely among programs.**



A number of Federal and State programs have been established to provide financial and/or technical assistance to technology developers. These programs range from those where grants are awarded for technology development to those where developers are given the opportunity to demonstrate the performance of their technologies at actual hazardous waste sites. This section highlights Federal and State assistance programs that may aid individuals in the development and demonstration stages of innovative hazardous waste treatment technology development. Interested developers should contact the appropriate programs for additional information.

FEDERAL ASSISTANCE PROGRAMS

Name: **Superfund Innovative Technology Evaluation (SITE) Program**

Address: U.S. Environmental Protection Agency
Risk Reduction Engineering Laboratory
Office of Research and Development
26 W. Martin Luther King Drive
Cincinnati, OH 45268
Contact: Stephen James
Phone: (513) 569-7696

The SITE Program was established in 1986 by EPA's Office of Research and Development and the Office of Solid Waste and Emergency Response. Its purpose is to promote the development and use of innovative technologies to clean up Superfund sites across the country. The SITE Program has three major components:

- The Demonstration Program - Generates engineering and cost data on selected pilot and full-scale innovative technology demonstrations. EPA publishes an annual solicitation for proposals from developers to demonstrate their technologies, ideally at actual Superfund sites. Under this program, the vendor typically pays for the operation of the demonstration. EPA pays for the sampling and analysis and generates a report to communicate the results of the demonstration.

- The Emerging Technologies Program - Supports bench-scale and pilot testing of innovative treatment technologies. EPA publishes an annual solicitation for participants who may receive up to $150,000 per year for two years.

- The Monitoring and Measurement Technologies Program - Supports the development and demonstration of innovative field-ready technologies that detect, monitor, or measure hazardous substances in the air, surface water, soil, subsurface, wastes, and biological tissues. (For more information contact Eric Koglin (702)798-2432.)

Name: **Small Business Innovative Research Program**

	Environmental Protection Agency	Department of Energy	Department of Defense
Address:	401 M St., SW Washington, D.C. 20460	19901 Germantown Road Germantown, MD 20874	Office of the Secretary of Defense Small Business Affairs Washington, D.C. 20301
Contact:	Donald Carey	Gerry Washington	Robert Wrenn
Phone:	(202) 382-7445	(301) 353-5867	(703) 697-9383

The Small Business Innovative Research (SBIR) Program is a multi-media assistance program. The program focuses primarily on U.S.-owned, high-technology companies with 500 or fewer employees. SBIR activities are overseen by the Small Business Administration. Funding is provided to companies through grants or contracts awarded individually by SBIR program offices in 11 Federal agencies. Each agency offers at least one SBIR program solicitation per year specifying the types of research to be funded. Responses to agency solicitations are reviewed and award decisions made by the distributing agency.

SBIR is a three-phased contract and grant program. In Phase I, contracts and grants are awarded in average amounts of $50,000 each for technology feasibility studies of six months or less. In Phase II, SBIR awards contracts and grants for one to two years of principal research and/or development. Contract and grant amounts in Phase II range from a minimum of $150,000 to a maximum of $500,000 depending on the awarding agency. Only Phase I recipients are eligible for Phase II awards. Phase III funding assistance is provided in one of two ways: commercial application with funding or sales from the private sector; or non-SBIR funding by the agency for further R&D of interest to the agency. Interested developers of hazardous waste treatment and remediation technologies should contact the individuals listed above for agency-specific solicitation schedules.

FEDERAL ASSISTANCE PROGRAMS (Cont'd)

Name: **The Federal Technology Transfer Act**

Address: Environmental Protection Agency
OTTRS/ORD
26 W. Martin Luther King Drive
Cincinnati, OH 45268
Contact: Larry Fradkin
Phone: (513) 569-7960

In the past, legal and institutional barriers have prevented government and industry from collaborating in developing and marketing effective technologies to prevent and control pollution. The Federal Technology Transfer Act of 1986 (FTTA) removes some barriers to the joint development of commercial treatment technologies. The FTTA allows flexible cooperative research and development agreements (CRDAs) among Federal laboratories, industry, and academic institutions.

Under CRDAs, companies may be given exclusive rights to market and commercialize new technologies that result from the collaboration. For industry, the key advantage of CRDAs is the speed and ease with which the agreements can be negotiated and signed. CRDAs are not subject to Federal contracting or grant requirements.

Environmental research, such as development of innovative technologies for treating hazardous wastes, require the collaboration of experts in many different fields. EPA's 12 interdisciplinary research laboratories that employ over 600 scientists and engineers can provide the needed expertise. Many of these laboratories combine world-class expertise with state-of-the-art equipment and fully permitted testing facilities.

STATE ASSISTANCE PROGRAMS

Name: **Illinois Industry and Technology Assistance Program**

Address: Illinois Hazardous Waste Research
and Information Center
1 East Hazelwood Drive
Champaign, IL 61820
Contact: Daniel Kraybill
Phone: (217) 333-8947

The Illinois Industry and Technical Assistance (ITA) Program is administered through the Illinois Hazardous Waste Research and Information Center (HWRIC). HWRIC operates a T&E facility discussed in Section IV of this booklet. The ITA program acts as an intermediary among local Illinois businesses, technology developers, and regulatory agencies to promote the use of innovative technologies for addressing hazardous waste. The ITA program offers advice to technology developers and access to networks within the State's business community. Information is offered on the availability of innovative hazardous waste treatment technologies. Participation in this program may offer developers of innovative hazardous waste technologies the opportunity to apply their technology to actual hazardous waste sites in the State of Illinois.

Name: **California Remedial Technology Assessment Program**

Address: Alternative Technology Division
Toxic Substances Control Program
Department of Health Services
P.O. Box 942732
Sacramento, CA 94234-7320
Contact: John Wesnousky
Phone: (916) 322-2543

The Remedial Technology Assessment Program (RTAP) was established to identify innovative treatment technologies and to match these technologies with appropriate Superfund sites in California. RTAP's annual solicitation of interest lists candidate sites around the State and requests developers to submit information on their technology. The annual summary of responses to the solicitation of interest provides an alphabetical listing of technology developers and a technology summary.

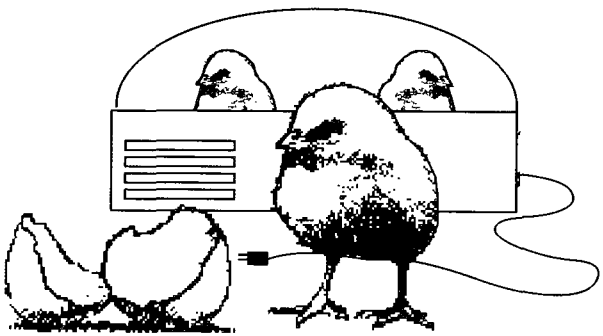
RTAP assists in locating sources of funding for site-specific demonstration projects at State Superfund sites. Funding may be provided through State Superfund program monies, responsible parties, a competitive waste reduction grant program, or funds of other government agencies. The program may issue variances instead of permits to developers as a means of expediting the application of their technology to specific sites.

Name: **MERRA**

Address: 2200 Commonwealth Blvd.
Suite 230
Ann Arbor, MI 45105
Contact: Mark H. Clevey
Phone: (313) 930-0033

MERRA is a non-profit, public/private venture of government, industry, research institutions, and academia. Waste treatment technology developers can benefit from MERRA's Specialty Business Development Center (SBDC), an industry-sponsored effort to provide business development assistance to Michigan proprietary technology-based small firms. MERRA-SBDC provides a variety of services to technology developers, including: Federal procurement assistance (e.g., providing information on R&D funding or grant applications), commercialization assistance (e.g., developing business plans or raising investment capital), and technology transfer (through collaborations with Michigan University and Federal laboratories).

IV. TECHNOLOGY INCUBATORS AND TEST AND EVALUATION FACILITIES

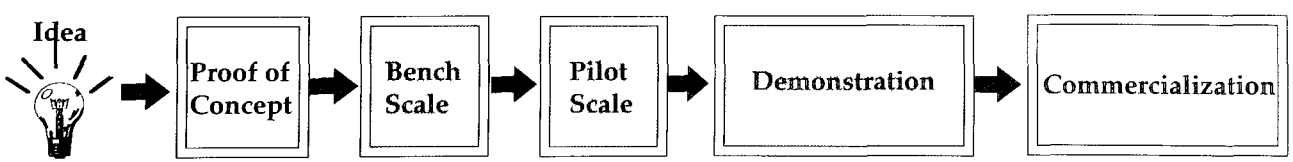


INCUBATORS

- **Business incubators provide:**
  - **Office space and equipment**
  - **Market services**
  - **Secretarial support**
  - **Business planning.**
- **Technology incubators may also provide:**
  - **Lab space and equipment**
  - **Analytical services**
  - **Permitting and regulatory assistance.**

TEST & EVALUATION FACILITIES

- **Permitted facilities and equipment for conducting technology tests or demonstrations at the lab, bench, or pilot scales.**
- **Personnel for independent technology testing and evaluation.**



BUSINESS INCUBATORS

Business incubators are playing a greater role in helping infant businesses survive and grow. Business incubators are facilities that specialize in providing small businesses with office space and shared administrative support services, identifying sources of capital, performing market analyses, and assisting in business development. The National Business Incubator Association estimates that there are over 400 incubators across the country. For more information on business incubators, contact:

Dinah Adkins
National Business Incubator Association (NBIA)
One President Street
Athens, OH 45701
(614) 593-4331

TECHNOLOGY INCUBATORS

Some business incubators specialize in encouraging the development and commercialization of innovative technologies. These technology incubators provide a wide variety of services to developers of innovative hazardous waste treatment technologies at all stages of development. Some of these facilities, such as the National Environmental Technology Applications Corporation, also serve as test and evaluation facilities. In addition to general business support services offered by most incubators, technology incubators may offer:

- Permitting and regulatory assistance
- Laboratory space
- Analytical services
- Testing and evaluation facilities and expertise
- Technical expertise in many disciplines and experience in the hazardous waste industry, especially when affiliated with university research centers.

TEST AND EVALUATION FACILITIES

Test and evaluation (T&E) facilities offer services to technology vendors at the developmental and equipment demonstration stages. Federal, State, and private facilities generally have the necessary permits to allow testing on actual hazardous wastes at lab, bench, or pilot scales. T&E facilities may have "secondary containment," controls on emissions and effluents independent of those associated with the technology being evaluated, that offer a safe environment to test the limits of the technology. In addition, facilities may have the personnel and expertise to ensure that tests are conducted in accordance with appropriate analytical protocols. The opportunity to perform tests at one of these facilities can offer a developer independent validation of the technical performance of an innovative technology. This can facilitate marketability and commercial acceptance. The profiles of the test and evaluation facilities developed for this booklet were prepared from information provided by the facilities.

TECHNOLOGY EVALUATION PROGRAMS

In addition to facilities and services, developers would benefit from information on testing procedures applicable to their technologies. EPA's Office of Research and Development has developed generic treatability study guidance and is in the process of developing treatability study protocols for individual technologies. For information on the availability of these protocols, contact Dave Smith ORD/RREL at (513) 569-7957.

FEDERAL TEST AND EVALUATION FACILITIES

Name: **U.S. EPA Incineration Research Facility**

Address: U.S. Environmental Protection Agency
26 W. Martin Luther King Drive
Cincinnati, OH 45268
Contact: Robert Thurnau
Phone: (513) 569-7692

The EPA Incineration Research Facility (IRF) is located on the grounds of the National Center for Toxicological Research in Jefferson, Arkansas. The IRF consists of a 12,000 square foot building that houses two pilot-scale incineration systems along with adjacent labs, offices, trailers, and outdoor support equipment. The pilot-scale research incinerators include a Rotary Kiln System and a Liquid Injection System. The IRF has a full RCRA Part B permit for incineration research and is authorized by the State of Arkansas to perform research with alternate air pollution control technologies.

Non-incineration technology developers may also be able to use the facilities. In addition to its testing and research services, technology developers can benefit from the IRF's extensive analytical chemistry capabilities directed toward incineration and air pollution control technology. IRF also provides administrative assistance to vendors through support of the development of test plans, drafting quality assurance plans, and preparing final reports.

FEDERAL TEST AND EVALUATION FACILITIES (Cont'd)

Name: **U.S. EPA Solid and Hazardous Waste Research Facility**

Address: 5995 Center Hill Road
Cincinnati, OH 45224
Contact: Robert Landreth
Phone: (513) 569-7871

The U.S. EPA Solid and Hazardous Waste Research Facility is designed to evaluate solid waste management technologies and hazardous waste remediation technologies at the bench and pilot-scales. The facility is operated by University of Cincinnati staff and is equipped to perform geo-technical, geo-chemical, biological, and geo-hydrological tests. The facility can accommodate technologies including but not limited to: delivery and recovery systems for in-situ site remediation, chemical stabilization and solidification, and computer-aided site characterization modeling. Hazardous waste treatment technology developers can obtain services from the Facility including: testing and evaluation for validation of developer claims, short-term and long-term leach analyses, field evaluation, and program design and implementation for field testing. The facility currently operates under a 1000kg treatability exclusion from the State of Ohio.

Name: **U.S. EPA Test and Evaluation Facility**

Address: U.S. Environmental Protection Agency
T & E Facility
Cincinnati, OH 45268
Contacts: EPA - Francis L. Evans, III
ITEP - Radha Krishnan
Phone: (513) 684-2621

The facility was constructed in 1979 to accommodate a broad spectrum of approaches for treating wastewater. However, the RCRA-permitted facility can perform research and testing for hazardous waste treatment. The facility is managed under contract by the operational support contractor - IT Environmental Programs, Inc. The facility contains a 24,000 square foot high-bay experimental area, on-site analytical chemistry laboratories, chemical storage areas, hazardous waste storage facilities, liquid pumping systems, and two 5-ton bridge cranes. The facility's research capabilities are accessible to other government agencies, as well as to private industry and developers.

Name: **Hazardous Waste Research and Development Center**

Address: U.S. Army Corps of Engineers,
Waterways Experiment Station
3909 Hall Ferry Road
Vicksburg, MS 39180
Contact: Norman Francingues
Phone: (601) 569-7692

The Hazardous Waste Research and Development Center (HWRDC) is part of the larger Waterways Experiment Station (WES). WES offers a full service testing and evaluation facility with safety equipment, a high-bay testing area, and a fully equipped analytical lab including GC/MS. In addition to extensive analytical equipment and facilities, HWRDC has technical personnel with research experience in a variety of hazardous waste treatment technology types. WES has been involved in best demonstrated available technology development work for EPA and has conducted treatability testing at Federal facility sites. In addition, WES is capable of conducting/assisting in treatability testing for other Federal agencies on a cost reimbursement basis and is currently investigating the possibility of government/industry cost sharing for testing and evaluation of hazardous waste treatment technologies. WES has a RCRA Part B permit for testing hazardous waste treatment technologies.

STATE TECHNOLOGY INCUBATOR AND TEST AND EVALUATION FACILITIES

Name: **The Illinois Institute of Technology Research Institute (IITRI)**

Address: Center for Environmental Research
Illinois Institute of Technology
Chicago, IL 60616-3799
Contact: Demetrios Moschandreas
Phone: (312) 567-4310

The Center for Environmental Research is designed to encourage cooperation among its 300 member research scientists at the main campus of the Illinois Institute of Technology and the 400 additional scientists at satellite campuses. IITRI obtained a Research, Development, and Demonstration permit from EPA Region V that is expansive in scope and allows the Institute to perform a variety of services. Specific IITRI services available to developers of hazardous waste treatment technology include professional testing and evaluation, technology development planning assistance, and services for matching innovative technologies with actual site needs. IITRI evaluates innovative technology independently under confidential conditions, and conducts professional testing to verify developer claims.

STATE TECHNOLOGY INCUBATOR AND TEST AND EVALUATION FACILITIES (Cont'd)

Name: Illinois Hazardous Waste Research and Information Center

Address: Illinois Department of Energy and Natural Resources
1 East Hazelwood Drive
Champaign, IL 61820
Contact: David Thomas
Phone: (217) 333-8940

The Hazardous Waste and Research Information Center (HWRIC) located on the University of Illinois, Urbana-Champaign campus, was created by State legislation to support research and development on hazardous waste prevention, treatment, and remediation technologies. The facility accommodates researcher and vendor work at the large bench and small pilot-scales.

Research The center awards approximately one million dollars annually to sponsor five categories of research. These categories include waste characterization and assessment; waste reduction and pollution prevention; waste treatment, disposal, and remediation; environmental processes and effects; and risk assessment and policy analysis. Proposals are solicited on an annual cycle and are due at the end of December of each year. Funding for research projects that are selected averages approximately $75,000 per year.

Industry and Technical Assistance Program - (Discussed in Section III of this booklet.)

Lab Services Program - The 22,000 square feet HWRIC contains high-hazard laboratories, two treatability laboratories, and a pilot-scale laboratory for working with industry and technology developers. It can accommodate technologies up to approximately tractor trailer size. Developers are currently authorized to conduct up to 1000kg treatability studies. The program uses $100,000 of the Center's research funds to provide testing assistance to developers and industry.

NON-PROFIT AND PRIVATE TECHNOLOGY INCUBATOR AND TEST AND EVALUATION FACILTIES

Name: **National Environmental Technology Applications Corporation**

Address: University of Pittsburgh Applied Research Center
615 William Pitt Way
Pittsburgh, PA 15238
Contact: Jack Adams
Phone: (412) 826-5511

The National Environmental Technology Applications Corporation (NETAC) was created in 1988 through a Cooperative Agreement with EPA as a subsidiary of the University of Pittsburgh Trust. It utilizes the resources and experience of industry, government, and academia to assist clients in the development and commercialization of innovative technologies. NETAC staff are engineers, scientists, and businessmen trained to assist in the development of more affordable and effective environmental technologies. NETAC services include: financial assessments; technology assessments; market analyses; testing and evaluation; permitting, regulatory, and legal assistance; and commercialization assistance.

Name: **Western New York Technology Development Center**

Address: Baird Research Park
1576 Sweet Home Road
Amherst, NY 14228
Contacts: Robert J. Martin; Kenyon A. Riches
Phone: (716) 636-3626

The mission of the Western New York Technology Development Center (TDC) is to promote business development, primarily for the five western counties of New York. The TDC, located adjacent to the State University of New York at Buffalo (SUNY), has established a working relationship, especially for technical assistance, with the New York Center for Hazardous Waste Management. Two TDC-managed business incubators provide both physical space and essential start-up services for new technical business ventures. The center has 24,000 and 40,000 square foot facilities, both of which can accommodate activities requiring up to 2,500 square feet of space. Both facilities are outfitted with wet laboratories and central services including: compressed air, vacuum natural gas, and distilled water. In addition, the center provides a full range of services, including capital resources. Environmental health and safety services are also provided through SUNY. Prospective developers may be required to submit a business plan and a research plan.

NON-PROFIT AND PRIVATE TECHNOLOGY INCUBATOR AND TEST AND EVALUATION FACILTIES (Cont'd)

Name: OHM Remediation Services Corp.

Address: 2950 Bushkirk Avenue
Suite 315
Walnut Creek, CA 94596
Contact: Ann Kuffner
Phone: (415) 256-7187

OHM Remediation Services Corporation offers testing and evaluation and research services to developers of innovative treatment technology. Possible arrangements with OHM include: professional tests and evaluations, collaborative research efforts by OHM and developers, and joint agreements whereby OHM and developers can team to license a technology and promote its commercialization. OHM emphasizes biological and thermal treatment processes. In addition, OHM is currently experimenting with soil washing and other treatment technologies. OHM also performs treatability studies and analytical research at its laboratory facilities in Findley, Ohio where it has a full RCRA Part B permit. OHM is staffed with technology research experts and performs on-site remediation testing.

Name: The Tennessee Innovation Center

Address: 701 Scarboro Road
Oak Ridge, TN 37830
Contact: Tom Valunas
Phone: (615) 482-2440

The Tennessee Innovation Center (TIC) is a wholly-owned subsidiary of Martin Marietta Corporation. It was established to encourage industrial development in the Oak Ridge, Tennessee area through equity investment in start-up companies. In addition to providing equity capital, TIC maintains a staff of professionals who are available to assist their client companies' management.

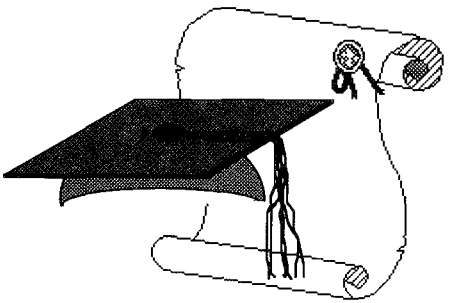
Name: **International Technology Corporation**

Address: Technology Development Lab
304 Directors Drive
Knoxville, TN 37923
Contacts: Bob Fox; Ed Alperin
Phone: (615) 690-3211

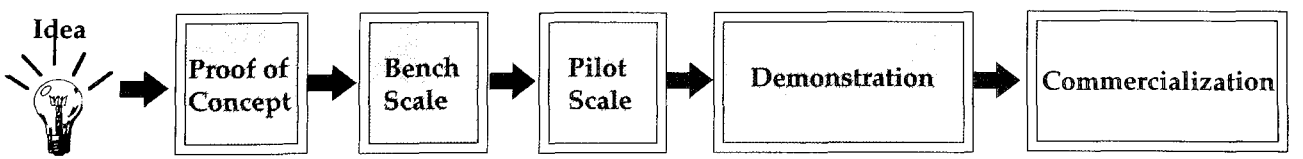
International Technology (IT) Corporation offers services to treatment technology developers to assist them in promoting the development and commercialization of their products.

IT's facilities include two 16,000 square foot laboratories. IT's lab in Knoxville, Tennessee is designed primarily for bench scale testing and IT has facilities to perform high-hazard testing involving dioxins and other hazardous substances. Special analytical capabilities are available to support treatability testing activities. Pilot-scale testing is performed by IT at its laboratory in Oak Ridge, Tennessee. The Oak Ridge lab handles a variety of technology tests and evaluations including soil washing and extraction, low temperature thermal stripping, and air and steam stripping. After evaluations are performed, IT has the technical and professional capabilities to improve technology processes based on analytical findings. IT also offers office space to developers for administrative tasks associated with technology development.

V. UNIVERSITY-AFFILIATED HAZARDOUS WASTE RESEARCH CENTERS



- **Enable developers to obtain multi-disciplinary technical expertise on an as-needed basis**
  - **Consulting support**
  - **Basic and applied research.**
- **Frequently less expensive than maintaining in-house expertise or procuring commercial services.**
- **University-based research has been a source of many innovative technologies.**



University-affiliated research centers are an important source of both basic and applied research. The multi-disciplinary faculty and graduate students accessible through these research centers can provide scientific and engineering assistance to developers. These centers can also provide support for addressing associated technology requirements such as materials handling and emission controls.

EPA established the Hazardous Substance Research Center (HSRC) program to study all aspects of the manufacture, use, transportation, disposal, and management of hazardous substances, as well as the publication and dissemination of the results of such research. Five HSRCs have been funded, composed of geographically proximate universities that service pairs of EPA Regions. EPA has also provided funding for the Gulf Coast Hazardous Substance Research, Development, and Demonstration Center.

In addition, EPA provides funding under the Environmental Research Centers (ERC) program. Under this ERC program several universities are conducting hazardous waste remediation research. EPA's Office of Exploratory Research is in the process of selecting additional universities to participate as ERCs.

In addition to EPA-funded research centers, many universities across the country have hazardous waste treatment expertise. This Section provides a partial list of universities that have identified themselves as having hazardous waste treatment expertise. The list of universities was extracted from the "Directory of Cooperative University/Industry Environmental Research and Development Centers," published by EPA's Office of Cooperative Environmental Management.

Hazardous waste treatment is a rapidly growing and evolving field. There are many universities that may be able to provide assistance in hazardous waste treatment research. Developers are encouraged to contact other universities, in addition to those listed in this booklet.

EPA-FUNDED HAZARDOUS WASTE RESEARCH CENTERS

Name: **Northeast Hazardous Substance Research Center**

Address: Northeast Hazardous Substance Research Center
New Jersey Institute of Technology
Newark, NJ 07103
Director: Richard S. Magee
Phone: (201) 596-3006

The Northeast Hazardous Substance Research Center (NHSRC) supports EPA Regions I and II. The Center's programs focus on the development and demonstration of remediation and treatment technologies. In particular, the Center concentrates on in-situ remediation techniques and incineration.

Participating Institutions: New Jersey Institute of Technology (NJIT), Massachussetts Institute of Technology, Princeton University, Rutgers University, Stevens Institute of Technology, Tufts University, University of Medicine and Dentistry of New Jersey.

NJIT also serves as the lead institution for the Hazardous Substance Management Research Center (HSMRC), funded by the National Science Foundation and composed of many of the same institutions. The HSMRC performs research in hazardous waste treatment and administers New Jersey's Innovation Partnership (IP) Grant Program. IP provides funding to private developers for research at the HSMRC. Developers must match the funds provided through IP.

Name: **Great Lakes and Mid-Atlantic Hazardous Substances Research Center**

Address: Department of Civil Engineering
181 Engineering Building 1-A
College of Engineering
The University of Michigan
Ann Arbor, MI 48109-2125
Director: Walter J. Weber, Jr.
Phone: (313) 763-1464

The Great Lakes and Mid-Atlantic Hazardous Substance Research Center serves EPA Regions III and V. The Center's research program focuses on remediating organic pollutants through integrating bioremediation with complementary chemical and physiochemical technologies. The Center groups these projects into three general categories: microbial degradation, pollutant properties affecting degradation, and engineered systems.

Participating Institutions: The University of Michigan, Michigan State University, Howard University.

EPA-FUNDED HAZARDOUS WASTE RESEARCH CENTERS (Cont'd)

Name: Waste Minimization and Management Center

Address: Department of Chemical Engineering
Box 7905
North Carolina State University
Raleigh, NC 27695-7905
Director: Michael Overcash
Phone: (919) 737-2325

The Waste Minimization and Management Center services EPA Regions IV and VI. The Center's projects fall into the following categories: waste minimization, transportation, treatment and management, and containment and clean-up.

Participating Institutions: North Carolina State University, The University of North Carolina, Chapel Hill, Texas A&M University, Galveston and College Station.

Name: Hazardous Substance Research Center for Regions VII and VIII

Address: Department of Chemical Engineering
Durland Hall
Kansas State University
Manhattan, KS 66506-5102
Director: Larry E. Erickson
Phone: (913) 532-5584

The Hazardous Substance Research Center for EPA Regions VII and VIII was established to conduct research pertaining to the identification, remediation, treatment, and reduction of hazardous substances resulting from agriculture, forestry, mining, mineral processing, and other activities of local relevance.

Participating Institutions: Kansas State University, Montana State University, University of Iowa, University of Missouri, University of Montana, University of Nebraska, University of Utah.

Name: Western Region Hazardous Substance Research Center

Address: Department of Civil Engineering
Stanford University
Stanford, CA 94305-4020
Director: Perry McCarty
Phone: (415) 723-4131

The Western Region Hazardous Substance Research Center services EPA Regions IX and X. The primary research focus for the Center is to support the development of alternative and advanced physical, chemical, and biological processes for treating hazardous substances in the surface and subsurface environments. A major focus of the Center's research program is in groundwater treatment and remediation of subsurface contamination.

Participating Institutions: Stanford University, Oregon State University.

Name: Gulf Coast Hazardous Substances Research, Development, and Demonstration Center

Address: Lamar University
P.O. Box 10613
Beaumont, TX 77710
Director: William Crawley
Phone: (409) 880-8707

The Gulf Coast Hazardous Substance Research, Development, and Demonstration Center funded by EPA, was established under the Superfund Amendments and Reauthorization Act of 1986. The purpose of the Center is to conduct research to aid in more effective hazardous substance response and waste management throughout the Gulf Coast through waste minimization and alternative technology development.

Participating Institutions: Lamar University-Beaumont, Louisiana State University, Mississippi State University, Texas Engineering Experiment Station/TAMU, University of Alabama, University of Central Florida, University of Houston-University Park, University of Texas-Austin

EPA-FUNDED HAZARDOUS WASTE RESEARCH CENTERS (Cont'd)

Name: **National Center for Ground Water Research**

Address: Department of Environmental Science and Engineering
Rice University
P.O. Box 1892
Houston, TX 77251
Director: C.H. Ward
Phone: (713) 527-4086

The Center for Ground Water Environmental Research receives funding from government and private sectors. The Center focuses on factors affecting the fate and transport of subsurface pollutants and methods to assess and protect ground water. On-going work in in-situ bioremediation includes research on tolerance to high concentrations of hydrogen peroxide and factors influencing microbe mobility. The Center also conducts assessments and field demonstrations of various remedial technologies.

Participating Institutions: Rice University, University of Oklahoma, and Oklahoma State University.

Name: **Hazardous Waste Research Center**

Address: 3418 CEBA Building
Louisiana State University
Baton Rouge, LA 70803
Contact: Louis Thibodeaux
Phone: (504) 388-6770

The HWRC, also an Environmental Research Center, conducts research on hazardous waste treatment and disposal. Research priorities include incineration, alternative methods of treatment, and interaction between waste constituents and natural media. In addition to fundamental research, the Center conducts applied research and technology transfer. The applied research program fosters university-industry research and has included studies of nitric oxide, single cell cascade cross-flow air stripping of volatile organics from ground water, and dry sorbent injection to remove hydrogen chloride from air emissions.

UNIVERSITY-AFFILIATED HAZARDOUS WASTE RESEARCH CENTERS

Name: **University of California, Los Angeles**

Address: Center for Clean Technology
School of Engineering and Applied Science
7420 Boelter Hall
405 Hilgard Avenue
Los Angeles, CA 90024-1600
Contact: Robert J. LaPointe
Phone: (213) 206-0678

UCLA's Center for Clean Technology has established an Industrial Affiliates Program (IAP) to support its three government-funded environmental research centers:

- Engineering Research Center for Hazardous Substance Control
- National Center for Intermedia Transport Research
- Center for Risk and Systems Analysis for the Control of Toxics.

Participation in IAP enables firms to access and collaborate in university research projects. In addition, developers outside the IAP can access the UCLA faculty, specialized research capabilities, library and computing resources, students, and educational opportunities.

Name: **Carnegie Mellon University**

Address: Carnegie Mellon Research Institute
4400 5th Avenue
Pittsburgh, PA 15213
Contact: William Kaufman
Phone: (412) 268-3190

Carnegie Mellon Research Institute is an applied research organization that develops practical applications of technologies for industry and government. The Center's staff specializes in conducting research on biodegradation of waste materials. It also conducts research in the areas of gas sensors and artificial intelligence concepts to be used as a tool in evaluating permit requests. The Center is primarily funded (85%) through industry sponsorships. The remaining funding is through government grants. In addition to providing research for a diverse group of sponsors, the Center also provides specialized capabilities to smaller companies that do not have access to such capabilities in-house.

Name: **University of Cincinnati**

Address: Center for Hazardous Waste Research and Education
Department of Civil and Environmental Engineering
Cincinnati, OH 45221
Contact: Paul Bishop
Phone: (513) 556-3648

In addition to the services provided through EPA's Solid and Hazardous Waste Research Facility in Center Hill, Ohio (see Section IV), the University of Cincinnati conducts research on hazardous waste treatment technologies. Specific research projects have included: biological treatment using thin film bioreactors, solidification and stabilization of soils, reverse osmosis, hazardous waste composting, and wastewater treatment. The University is testing aerobic and anaerobic treatment methods in fluidized bed reactors using activated carbons as a support medium.

Name: **University of Florida**

Address: The Florida Center for Hazardous and Solid Waste Management
3900 SW 63rd Boulevard
Gainesville, FL 32608
Contact: James Bryant
Phone: (904) 392-6264

The University of Florida is the host institution for the Florida Center for Solid and Hazardous Waste Management. Participating universities include Florida State University, University of South Florida, University of Central Florida, Florida A&M University, Florida Atlantic University, Florida Institute of Technology, and the University of Miami. Established by Florida legislation in 1988, the Center conducts research and provides education on hazardous waste management. Specific areas include: methods and processes for recycling, treating, and disposing of solid and hazardous waste. The University annually issues requests for pre-proposals from which it selects new research projects and appropriates funding based on the researcher receiving matching amounts from outside sources.

Name: **University of Illinois**

Address: Advanced Environmental Control Technology Research Center
3230 A Newmark C.E. Lab
205 North Mathews Ave.
Urbana, IL 61801
Contact: R. S. Engelbrecht
Phone: (217) 333-3822

The University of Illinois Advanced Environmental Control Technology Research Center conducts research in hazardous waste treatment. Specifically, research focuses on physical, biological, and chemical treatment technologies for air and water pollution. Recent experimental research studies funded with EPA core support include: treatment applications of supercritical extraction; thermal regeneration of powdered activated carbon; development of the expanded-bed granular activated carbon anaerobic reactor for the treatment of hazardous wastes; and simultaneous collection of sulfur dioxide, nitrogen oxides, and hydrochloric acid.

Name: **New Mexico State University**

Address: Waste Management and Research Consortium
Chemical Engineering Department
New Mexico State University
Las Cruces, NM 88003
Contact: Ron Bhada
Phone: (505) 646-1214

New Mexico State University is a member of the Waste Management and Research Consortium composed of University of New Mexico, New Mexico Institute of Mining and Technology, and Los Alamos and Sandia national laboratories. The consortium conducts research in all areas of hazardous waste management. Currently, there are 34 projects in process including research on in-situ remediation and bioremediation of toxic wastes. The consortium is examining different technologies involving sensor instrumentation and robotics for cleaning up soils. University faculty and staff collaborate with industry and third parties in developing new technology. Requests for Proposals (RFPs) are sent out by the University that specify the research topic areas.

UNIVERSITY-AFFILIATED HAZARDOUS WASTE RESEARCH CENTERS (Cont'd.)

Name: **State University of New York at Buffalo**

Address: Center for Hazardous Waste Management
207 Jarvis Hall
Buffalo, NY 14260
Contact: Ralph Rumer
Phone: (716) 636-3446

The New York State Center for Hazardous Waste Management administers research projects directed at the development of strategies, technologies, and methods that will enable safe and permanent clean-up of inactive hazardous waste disposal sites in New York State. The Center reviews competitive proposals from university and private industry researchers aimed at the development of methods for permanent remediation of inactive waste disposal sites. Most of the research funds to date have been awarded to University investigators; however, the Center has provided co-funding to a private technology developer. In addition, the Center can locate principal investigators at the University to provide research and technical expertise to private technology developers. Current areas of site remediation research include: incineration/ash management, field studies, physical/chemical treatment, manufactured gas plant remediation, and biological treatment technologies.

Name: **University of Pittsburgh**

Address: Center for Hazardous Materials Research
University of Pittsburgh Applied Research Center
320 William Pitt Way
Pittsburgh, PA 15238
Contacts: Edgar Berkey
Timothy Foss Delgado
Phone: (412) 826-5320

The Center for Hazardous Materials Research (CHMR) conducts a wide range of environmental research, including the development and implementation of new technologies for hazardous waste management and remediation. CHMR's facility includes offices, laboratories, and pilot plants. CHMR's multi-disciplinary staff have industrial experience with large and small companies, as well as regulatory experience at both the Federal and State level. CHMR can also provide independent testing and evaluation of innovative remedial technologies, equipment, and procedures.

Name: **University of Tennessee**

Address: Center for Environmental Biotechnology
Energy, Environment and Resources Center
327 South Stadium Hall
Knoxville, TN 37996-0710
Contact: Gary Sayler
Phone: (615) 974-4251

The Center for Environmental Biotechnology (CEB) focuses on training and research leading to the development and effective use of microorganisms for environmental remediation. CEB has offices for over 70 environmental services companies, 30,000 square feet of fully equipped research space, with 15,000 square feet as a single laboratory facility exclusively for environmental research and biotechnology. CEB receives Federal, industrial, and University support to conduct research activities. Ongoing investigations include: molecular probe development for monitoring and optimizing TCE degradation; molecular methods for quantifying microbial PAH degradation in manufactured gas plant soil; and bioluminescent sensor technology for on line in-situ measurement of biodegradation.

Name: **University of Waterloo**

Address: Waterloo Center for Groundwater Research
Waterloo, ONT Canada N2L3G1
Contact: David Smyth
Phone: (519) 888-4516

The Waterloo Center is the largest groundwater research center in Canada. The Center is also affiliated with other university and non-university research groups in Canada. The Center performs field research, laboratory testing, and computer modeling research in organic and inorganic contaminant hydrogeology. Areas of research and testing expertise at the Center include processes of contaminant movement through subsurfaces, fate of contaminants, and remediation technology. Center facilities include experimental laboratories and analytical capabilities. Of particular interest to developers is the availability of field sites at which testing is conducted on the behavior, fate, and remediation of contaminants in the subsurface.

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James Cummings
U.S. Environmental Protection Agency
Technology Innovation Office
OS 110-W
401 M Street, S.W.
Washington, D.C. 20460

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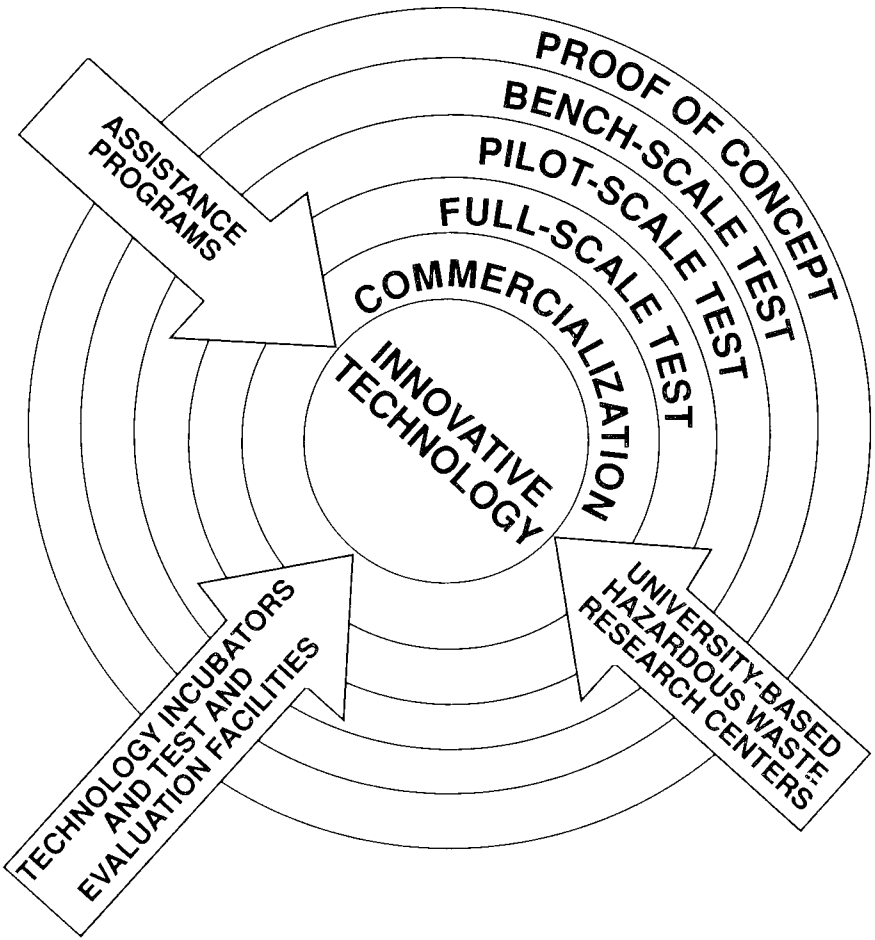
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