

OPPORTUNITIES TO WORK WITH DOE'S NEW TECHNOLOGY INTEGRATION PROGRAM IN ENVIRONMENTAL MANAGEMENT

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ABSTRACT

The mission of the United States Department of Energy's Environmental Restoration and Waste Management's Office of Technology Development (OTD) requires that innovative technological systems be identified that may be applicable for environmental restoration to reduce development costs and save time. Public benefits also can be obtained by transferring these technological systems to the private sector to address analogous remediation problems within industry and other federal agencies. Leveraging government resources can be accomplished by coordinating technology development and applications among agencies and private sector participants. This paper describes how the OTD Technology Integration Program (TIP) is pursuing collaborative partnerships with industry and provides guidance on how industry can participate.

BACKGROUND

Since the U. S. government began developing nuclear weapons a half-century ago, public recognition of the importance of environmental protection has grown immensely. Waste treatment and disposal methods used for radioactive and mixed chemical wastes are now realized to have been seriously deficient. As knowledge of these deficiencies has grown, it has become apparent that the U. S. Department of Energy (DOE), as the landlord of this weapons production complex, is faced with an unprecedented contamination problem. Problems exist at both abandoned sites requiring environmental restoration and at facilities still engaged in national missions where wastes must be better managed than in the past.

If current technology is considered the only available source of solutions for these environmental waste management problems, then solutions are usually costly and time-consuming, where feasible solutions exist at all. DOE cost estimates for necessary environmental remediation and waste management are on the order of \$100 billion (1) and are rising steadily with time. DOE expects clean-up to require thirty years.

DOE has centralized responsibility for clean-up within its new Office of Environmental Restoration and Waste Management (EM). EM, in turn, established an Office of Technology Development (OTD) to carry out a process of research, development, demonstration, testing, and evaluation (RDDT&E) on innovative technological systems to reduce the cost of remediating the weapons complex sites. OTD activities are totally driven by the needs of those EM sites to achieve and maintain regulatory compliance. OTD's mission is to provide these sites with better clean-up alternatives, with "better" defined as quicker results, decreased exposure to workers, reduced public risk, and improved technical performance, as well as decreased costs. OTD's measure of technical success is ultimately the implementa-

tion of the innovative technological systems it has developed and tested.

The Technology Integration Program (TIP) within OTD has been organized primarily to seek out innovative technological systems or their components as "raw materials" for the RDDT&E process. The TIP and its relationship to industry is the focus of this paper.

MISSION OF THE TECHNOLOGY INTEGRATION PROGRAM

Industry, universities, and other government agencies have similar environmental problems to those of DOE. Movement of technology among these institutions can lower costs, save time, and avoid duplication of effort for all participants. In order to move technology within the complex and among these institutions, some type of "switching yard" is necessary to make connections between EM and all other institutional stakeholders who can use these advanced technological systems.

The Technology Integration Program is this "switching yard." The TIP is establishing collaborative partnerships with U. S. industry, the National laboratories, other federal agencies, universities, and appropriate international participants in order to facilitate timely and effective applications of generic technologies to meet DOE's environmental restoration needs. The TIP locates and acquires technology options from industrial and academic sources for use within the DOE complex. The term "technology infusion" describes this aspect of technology integration. The TIP facilitates delivery of DOE/EM-developed technological systems, or their components, to the private sector. The term "technology diffusion" adequately describes this aspect of the TIP function. The TIP helps move technology among EM units, other DOE research programs, or other federal agencies. "Technology adoption" reflects this portion of technology integration. Fig. 1 illustrates these concepts.

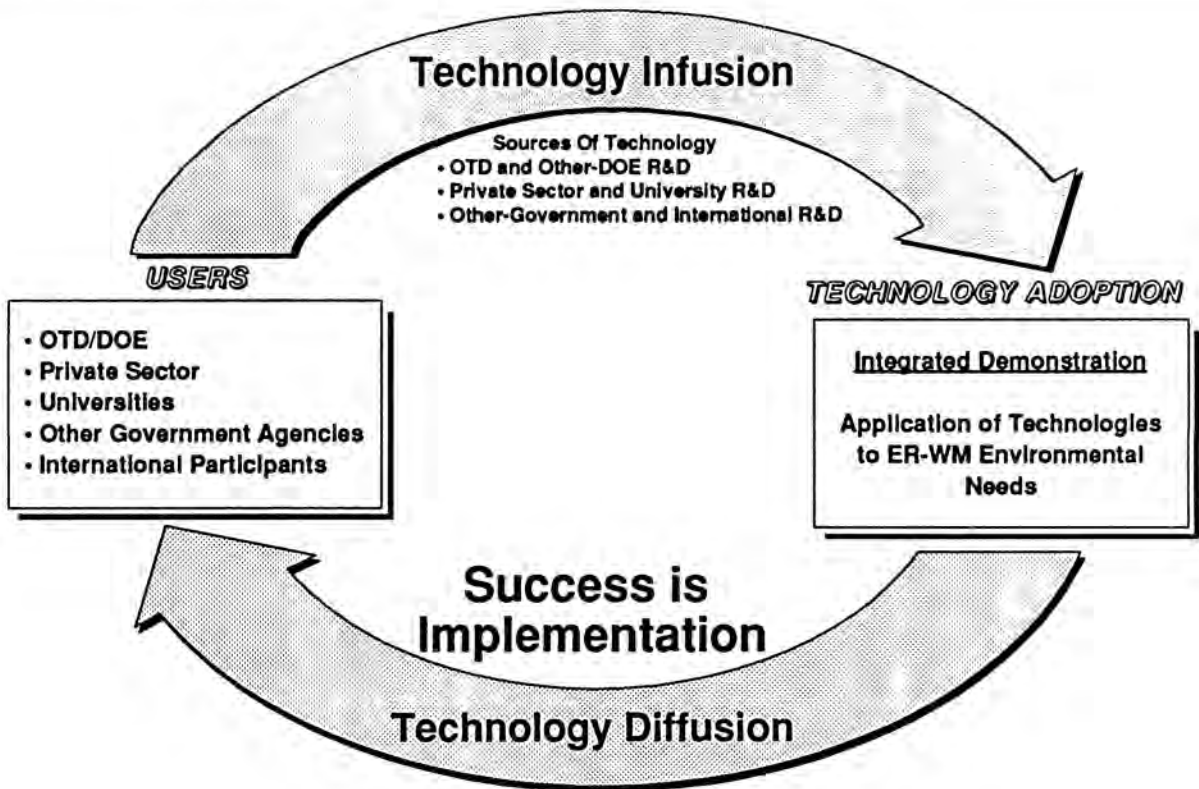


Fig. 1. The Technology Integration Process.

CENTRAL ROLE OF INTEGRATED DEMONSTRATIONS

The technology infusion, diffusion, and adoption activities of the Technology Integration Program come together in OTD's "integrated demonstrations." Indeed, the entire RDDT&E process is directed toward successful testing and evaluation of innovative technological systems in integrated demonstrations (ID's) for potential remediation of DOE weapons complex sites. An integrated demonstration assembles related and synergistic technologies at a single contaminated site to evaluate performance, either individually or as a system, for addressing EM needs. Each ID is centrally managed, action oriented, and needs driven. ID's can save repetitive permitting and National Environmental Policy Act (NEPA) compliance costs and provide an obvious focus for the collaborative goals of technology integration.

Reasonable chances of success for an integrated demonstration are expected because the ID systems concept is based on applied R&D results and sound engineering principles. "Successful" demonstration must include demonstrating full regulatory compliance and should address the "cheaper, faster..." characteristics already described. Demonstrated technologies are considered ready for DOE application at at least one site, though not necessarily in the

best form for use at other DOE sites or for other, industrial applications.

During 1991, several integrated demonstrations are planned. Volatile organics are being removed from saturated soil at the Savannah River Site in Aiken, South Carolina. This demonstration, now in its second year of operation, has already produced major successes with horizontal drilling technologies. Such systems have great importance for a wide variety of applications where existing construction denies direct access to contaminated areas or desired resources. The National Aeronautics and Space Administration (NASA) is assessing the technology to remediate similar soils and groundwater problems at NASA-owned facilities. This demonstration is being used to design a pilot technology integration strategy for adaptation to future ID's across the weapons complex.

Another integrated demonstration will feature the clean-up of groundwater and uranium-contaminated soil at Fernald, Ohio. The water solubility of uranium complicates the use of many remediation technologies. The use of automated analytical laboratories will be a technology focus at Fernald.

Waste retrieval and processing will be demonstrated for buried waste at Idaho National Engineering Laboratory and for underground storage tanks at a location yet to be determined. Waste minimization and avoidance are to be

demonstrated under the authority of an EM and Defense Programs Memorandum of Understanding to address solvents substitution for electronics, microelectronics, machining operations, and metals production. These results should be applicable to numerous DOE and Department of Defense facilities.

The clean-up of organics at arid sites will be demonstrated at Richland, Washington. Optimal techniques (e. g., soil washing) for remediation of large surface areas contaminated with plutonium is the subject of an ID at the Nevada Test Site. A further demonstration, to be conducted at Rocky Flats in Colorado, will address a combination of all of the preceding contamination problems.

The Technology Integration Program has important responsibilities in connection with the ID's. Indeed, just as operational requirements (i. e., programmatic steps to solution) constitute one key dimension of an ID, and technology filtering through the RDDT&E process constitutes another, the significance of technology integration is great enough to constitute a third key dimension, as Fig. 2 illustrates.

As a coordinator with other government agencies, the Technology Integration Program has responsibilities for regulatory aspects of the integrated demonstrations. Under law, the ID's are regulated activities that require permits.

These are expanded responsibilities for the TIP, with activities to be carried out under this mandate now being defined. Several Environmental Protection Agency (EPA) offices and programs need to be linked closely to the demonstrations. Linkages with EPA headquarters and appropriate regional offices will be supplemented by liaison with pertinent state, local, and other federal regulatory bodies.

Public participation issues are another important ID responsibility for the TIP. The Department encourages public involvement in and awareness of all of its activities. Secretary Watkins has said, "The new culture will emphasize an open door philosophy...wherein constructive criticism from any source, external as well as internal, is encouraged and rewarded" (2).

Public participation activities promote input from both public interest groups and the general public surrounding ID sites. With the strong support of the Governor of Colorado, the Colorado Center for Environmental Management is beginning an effort to develop a prototype for comprehensive methods to effectively include both public participation and regulatory issues within the framework of integrated demonstrations. This effort is expected to provide the first success in encouraging industry, university, regulatory, and public participants to work jointly with EM

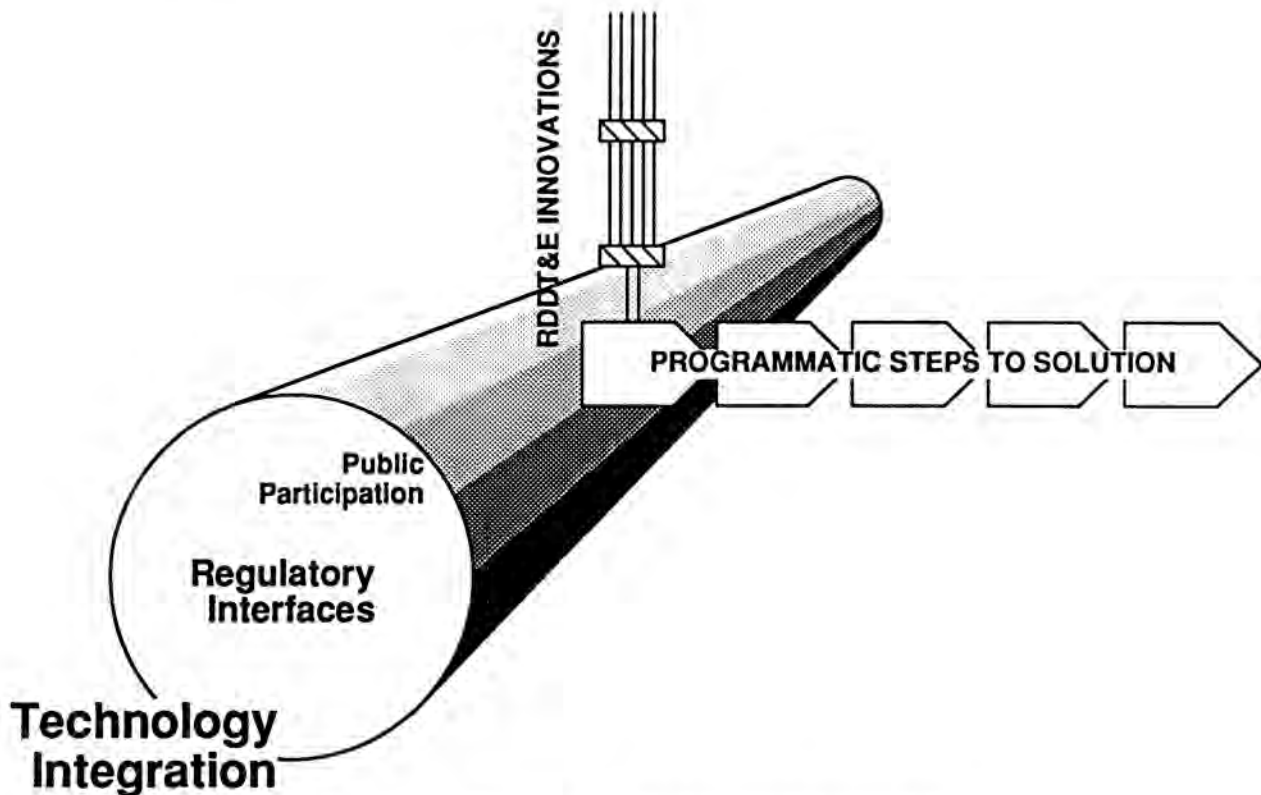


Fig. 2. The Three Dimensions of the Integrated Demonstration.

in developing and demonstrating innovative technological systems.

Such responsibilities are of vital importance to the success of the integrated demonstrations. Of even greater importance to the private sector, the TIP also functions to maximize industrial participation in the ID's. The Program searches out the best available industrial technologies for evaluating to apply in DOE's restoration efforts. It helps industry identify the demonstrations for which particular technologies may have application. It assists with the transfer of industry technology among integrated demonstration sites. Finally, the TIP provides procurement and contractual advice to overcome institutional barriers to working with DOE. At all times, it strives to maintain a proactive, "can-do" attitude.

RELATED PROGRAM ACTIVITIES IN TECHNOLOGY DIFFUSION

Technology diffusion is the most advanced element within the Technology Integration Program because diffusion-related activities have built on existing DOE research programs. Although the large majority of innovative technological systems that the TIP will eventually deliver to the private sector still await demonstration (or even development), much is already being done to adapt existing DOE infrastructure to the particular circumstances of environmental technologies and to build the collaborative relationships that are the key to long term success.

All of the DOE National laboratories have Offices of Research and Technology Applications (ORTA's) as centralized points of contact to assist industry in accessing and licensing laboratory-developed technology. The ORTA's, laboratory-based adjunct organizations, and spin-off companies are among the mechanisms DOE already uses to accomplish technology transfer. The Technology Integration Program intends to fully utilize the ORTA technology integration network and all other in-place contractor capabilities at the National laboratories and production plants to accelerate and streamline the process of technology diffusion. The Program is moving to address a variety of long-standing barriers to the diffusion of DOE environmental technologies.

DOE recognizes that the opportunity to establish a market niche before technology is duplicated is important to industry and works to protect intellectual property accordingly. A customized intellectual property package is being developed for application to EM-industry partnerships to facilitate cost-shared collaboration. The package will take advantage of existing five-year limited data withholding provisions available through use of Cooperative Research and Development Agreements (CRADA's). It is seeking to extend three-year limited data withholding to other significant cost-shared participation mechanisms.

Special issues of liability related to clean-up technologies are being examined because of perceptions of extreme risk by some industrial concerns. Liability issues are not, of course, exclusive to work involving DOE sites, but are instead general to hazardous waste management problems. In the context of EM remediation and waste management issues, liability is primarily a legal and procurement policy issue. The TIP is working closely with DOE procurement personnel; a new DOE rule on liability is expected early in 1991.

Other barriers are recognized as important to industry involvement and are being addressed within the overall context of EM remediation needs and the TIP's specific mission. These barriers include: the lack of co-planning of research programs with industry so output is of greater use to industry; the need for market determination studies and technology evaluation; and, the need to insure a "business-like" atmosphere within DOE through streamlining of operations and to insure a consistent operating philosophy across the complex.

The TIP is determining the feasibility of a Business and Technology Integration Office at a National laboratory. This new Office would manage technology maturation for DOE uses (i. e., adaptation, modification, and enhancement), business development assistance, and licensing. In this regard, many technologies that DOE develops for its own use, but discontinues prior to ID testing because better alternatives emerge, may nevertheless have potential for other applications outside of DOE if they are transferred to industry for maturation. DOE and the Department of Commerce have a partnership to adapt the Ames Center for Advanced Technology Development to accommodate the DOE multiprogram laboratory style of operation and to establish an equivalent EM capability. The Ames Center has three years of successful technology "de-risking" experience for technology-based business ventures.

Several efforts are underway to improve communications regarding capabilities of DOE technology to enlist additional private sector interest. Media being explored for such purposes currently include publications, a television documentary series, and an online user tool to access information about OTD programs.

Industry-TIP cooperation depends on facilitating commercialization opportunities having a "win-win" nature. DOE recognizes that industrial participation occurs only if industry sees business potential commensurate with risks. DOE does expect industrial participants to share costs and/or pay license fees for government technology. Both industry and the individual taxpayer can then share the benefits of government technology, and society as a whole will benefit.

RELATED PROGRAM ACTIVITIES IN TECHNOLOGY ADOPTION

Several TIP technology adoption activities may be invisible to industry, and so technology adoption will be discussed only briefly. The most visible TIP activities are those directly associated with integrated demonstrations. Particularly important are facilitating movement of successful technological systems across integrated demonstrations throughout the DOE complex. The TIP facilitates introduction of industrial technologies first demonstrated successfully at DOE sites to other government applications, such as in the Department of Defense, and facilitates regulator acceptance of such technological systems by providing information about the successful DOE demonstrations. Thus, the private sector can still have interest in technology adoption elements of technology integration. Collaborations with other DOE research programs and linkages with other federal agencies having technology development missions of potential relevance to EM are being established, such as initiatives in waste minimization and advanced manufacturing techniques.

RELATED PROGRAM ACTIVITIES IN TECHNOLOGY INFUSION

Although DOE has in-depth technological capabilities, the TIP is explicitly looking to industry for technology with the "cheaper,

faster..." solutions to address DOE environmental clean-up needs. Infusing innovative technological systems developed outside of the DOE complex into the clean-up process provides one of the best options for rapid remediation progress. The TIP collaborates with industry (as well as other non-government institutions) to prepare such systems for integrated demonstration, testing, and evaluation. This collaboration normally takes the form of cost-shared partnerships.

Significant planning and coordination are underway toward establishing these partnerships, the first of which is expected by the end of FY 1991. The on-going Savannah River ID is the learning model for this effort, with an immediate focus on bioremediation and air emissions aspects.

Oak Ridge National Laboratory is identifying the waste industry infrastructure, to include waste generators, waste management operators, and waste technology users and developers, to assist in establishment of TIP-industry dialogue and liaison. Industrial technology needs and sources are to be further explored through a series of targeted workshops to be held throughout the complex. Among the topics of these workshops will be soils and groundwater clean-up, waste retrieval and processing, and waste minimization and avoidance.

Once the TIP organization is institutionalized and the ID's are operating throughout DOE, the proportion of TIP efforts devoted to technology infusion should steadily increase for at least the next three to five years until infusion supplants diffusion as the best developed aspect of technology integration. This evolution is inevitable if the TIP is to remain driven by DOE's environmental restoration and waste management needs and meet regulatory requirements.

PROGRAM MANAGEMENT AND OVERSIGHT

In all of these efforts, the TIP will listen to industry, responding to criticisms that past DOE-industry collaboration has often been one-sided. Private sector input is essential for both the technical content and the management of the Technology Integration Program. Such an approach is consistent with the new culture of openness and its enhanced technology transfer program (3).

Similarly, Technology Integration Program management is as decentralized as possible to insure the broadest input to management, maximum responsiveness to site problems, and maximum participation by local and regional public interests. Definition of headquarters and field responsibilities is being finalized, with certain oversight structures identified in which industry is invited to play a key part.

One oversight body, the Program Steering Committee, meets on a quarterly basis to provide guidance on overall program direction. This committee is intentionally large and is made up of representatives of all program participants.

A second body, the Technology Integration Committee, will have a more operationally-oriented oversight role, focusing on specific Program activities and priorities. When fully organized, this committee will include industry representatives, as well as technology transfer, federal agency, and university representatives.

In keeping with the intent of a decentralized management structure, routine industry contacts regarding access to technology, licensing, CRADA's, etc., are being handled at the DOE field offices or individual facilities. TIP headquarters personnel are available to assist industry with special problems or to identify appropriate field office and local facility points of contact. Teamwork throughout DOE will be a key to TIP success.

ADDITIONAL PRIVATE SECTOR PARTICIPATION OPPORTUNITIES AND BENEFITS

The National laboratories have a variety of other mechanisms in place for collaboration with industry. They include technical personnel exchanges, performing work for the private sector, encouraging industry use of laboratory

scientific user facilities, consulting, scientist-to-scientist discussions, conferences, and technical documents and software. The TIP makes maximal use of such mechanisms and increasingly supplements them with other creative approaches.

The opportunities for mutual benefit have hardly begun to be explored. As that exploration continues, more and more common technical ground will be identified. For example, one recent state-wide meeting at which an outline of the TIP framework was presented led to a request by a national textile firm to review the patent portfolio of the closest laboratory for possible licensing applications.

Private sector participants in the Technology Integration Program can benefit in several ways directly related to their business goals. Their overall competitive position can be improved by being in the forefront of commercializing new environmental technologies. They can achieve production cost savings (for environmental clean-up) by learning ways to modernize their manufacturing to minimize waste generation. They can gain access to a more skilled environmental management labor force. Most importantly, the

technological systems being developed and tested can themselves be important sources of revenue.

The benefits to the individual companies can be mirrored within the larger society. America can achieve improved international economic competitiveness. There can be reduced environmental risks and reduced costs to mitigate those risks. New jobs will be generated. There should be an improved quality of life.

All of us, whether from industry, government, or the public at large, will share in those benefits to American society.

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