# THE EM TECHNOLOGY DEVELOPMENT STRATEGY

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## ABSTRACT

The Office of Technology Development (TD) supports research and development of technologies that will lower cost, reduce risk, improve safety, and accelerate cleanup of the Nuclear Weapons Complex and provide solutions to currently untractable environmental problems. The TD strategic plan outlines Applied Research, Development, Demonstration, Testing, and Evaluation (RDDT&E) that will provide needed technology products to be used by Environmental Restoration and Waste Management operations (i.e., our customers). The TD strategic plan is derived from EM Goals, Objectives, and Strategy and is incorporated into DOE's Five-Year Plan for Environmental Restoration and Waste Management. The TD strategic plan is developed based on integrating customer requirements, and is complemented by a top-down, bottom-up analysis of Site Specific Technology Needs and environmental problems.

The execution of TD's strategic plan is implemented largely through Integrated Programs (IP) and Integrated Demonstrations (ID). IDs have proven to be a cost-effective method of managing technology development, testing and evaluation, and implementation of successful technology systems into the DOE Environmental Restoration and Waste Management Programs. The Savannah River ID for Volatile Organic Compounds (VOCs) in Saturated Soils resulted in a 51 percent cost savings over stand-alone demonstrations, saving over $8 million.

The IPs and IDs are selected based on customer needs, technical complexity, and complex-wide regulatory and compliance agreements. New technology systems are selected for incorporation into an IP or ID from offerings of the DOE laboratories, industry, and the universities. A major TD initiative was announced in August 1991, with the release of a Program Research and Development Announcement (PRDA) requesting industry and universities to propose innovative new technologies to clean up the Weapons Complex.

## INTRODUCTION

The Office of Technology Development (TD) is one of the three major organizations in Environmental Restoration and Waste Management (EM). TD's mission is to develop the technology and supporting infrastructure to achieve the EM goals of cleaning up the Department of Energy's (DOE) Nuclear Weapons Complex by the year 2019, and to achieve competent and credible environmental stewardship. We face major challenges. A number of environmental problems cannot be solved with existing technology; existing technologies must be improved; and the capacity of our infrastructure must be more robust. TD must develop new technologies and foster the needed infrastructure if we are to solve DOE's environmental problems "faster, better, safer, and cheaper."

The EM strategy to cleanup the Complex and achieve environmental stewardship is described in the EM Five-Year Plan, published annually. The EM strategy incorporates input from DOE sites and external sources, e.g., other Federal Agencies, the State and Tribal Working Group, The Congress, the Office of Management and Budget, and the public. Figure 1 shows the EM strategic planning process.

The TD strategy, derived from the EM Strategic Plan, is driven by EM goals and mission needs, is a team effort, and incorporates comments received on the previous year's EM Five-Year Plan. The strategy is articulated in the planning and execution of our technical programs, described below. TD relies on customer-defined needs to formulate our technical programs. TD's principal customers are the DOE Environmental Restoration, Waste Operations, and Defense Programs. Our ultimate customers are our nation's citizens and taxpayers.

TD's strategic plan highlights the following investment areas where new technology products are needed:

Groundwater and Soils Cleanup. Technologies and processes must be developed to remove or reduce hazardous and/or radioactive materials from contaminated soils and groundwater. Activities include providing interim or temporary containment of hazardous or radioactive materials in groundwater and soils until a suitable future technology can be implemented.

Waste Retrieval and Waste Processing. Technologies are required to excavate or remove hazardous and/or radioactively-contaminated material more effectively from the site and/or facilities to treat contaminated material for transportation, storage, and/or disposal. For example, we do not have the waste treatment technologies to needed meet RCRA requirements for the major portion of DOE's mixed waste

designated for land disposal. These technologies will reduce operational and public exposure risk.

Waste Minimization and Waste Avoidance. Technologies and processes are needed to reduce, at the source, the toxicity or amount of hazardous materials resulting from the production and dismantlement of nuclear weapons and the management of existing waste. The Office of Defense Programs is primarily responsible for waste minimization within DOE. TD supports this waste minimization effort under the provisions of the DP-EM Memorandum of Understanding.

TD's strategy for accomplishing these objectives is based on fulfilling customer needs, prioritizing the most urgent complex needs, capitalizing on the synergy of related technologies, embracing a systems approach, eliminating duplication in the federal government and with industry, and leveraging our scarce resources by joining in partnerships. Our strategy requires continuous integration at all levels. TD has established focused programs and demonstrations aimed at solving the major generic problems at DOE sites that will yield technology products to solve specific site problems. We are implementing this strategy using IPs and IDs to rapidly bring new technology products to the field, and to improve the EM infrastructure. Figure 2 illustrates the interrelated concept of IPs and IDs.

An IP is a set of RDDT&E activities dedicated to providing technology solutions for a single problem category (e.g.,

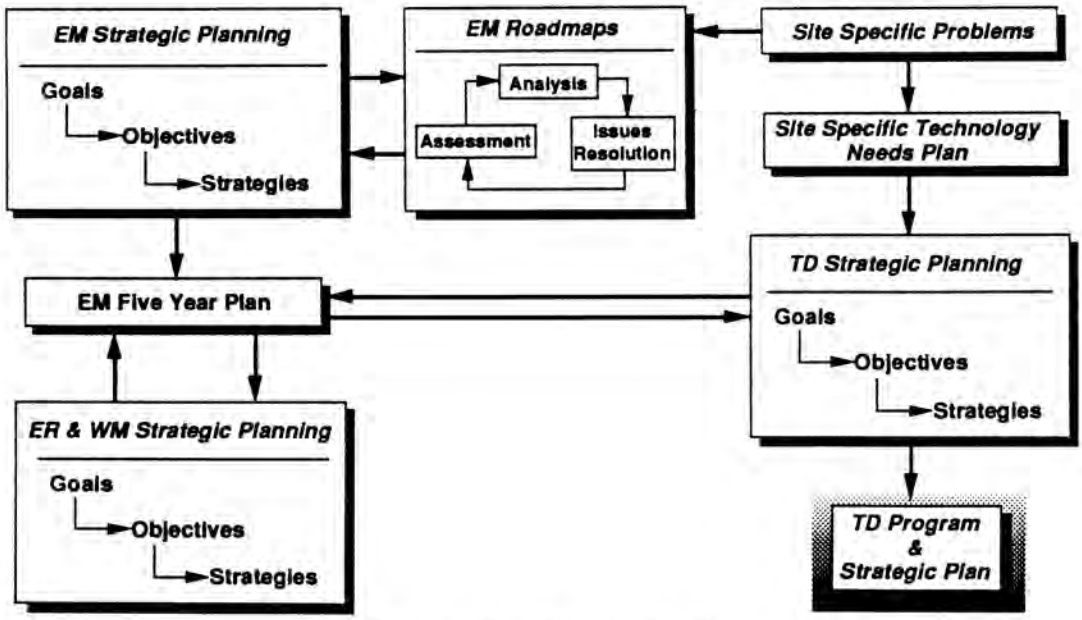



Fig. 1. EM goals direct RDDT&E initiatives.

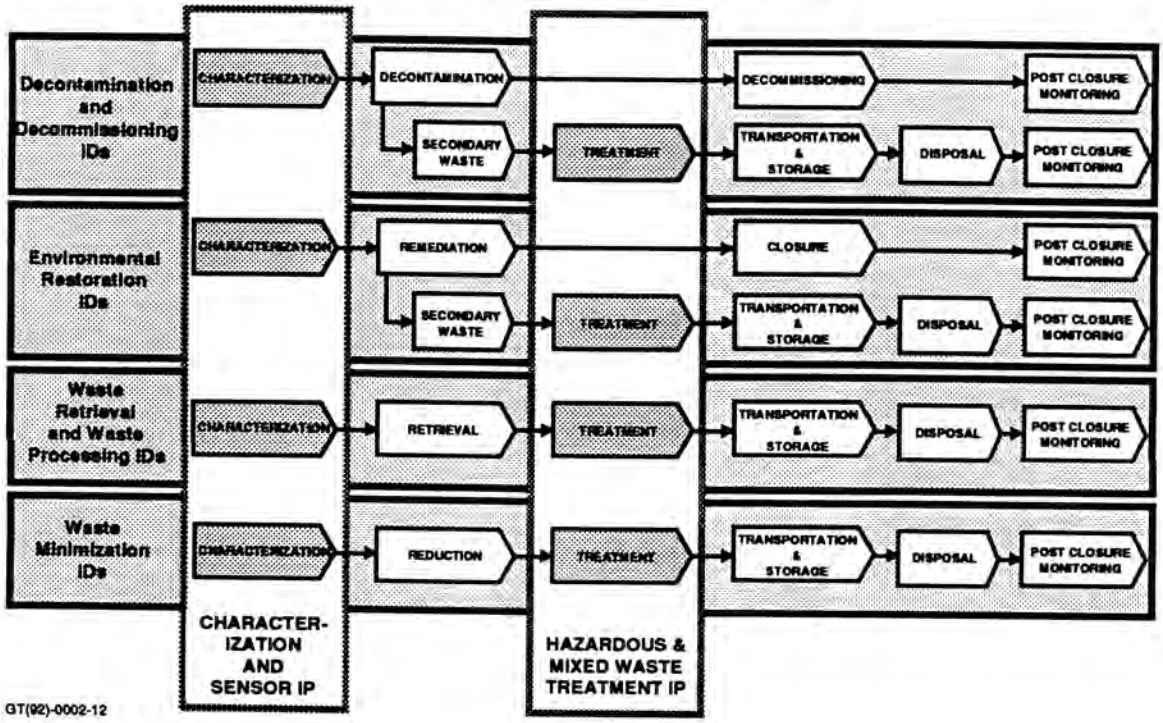



Fig. 2. Integrated programs provide a coordinated technology base: integrated demonstration provide end-to-end solutions.

minimization, characterization, treatment, storage, or disposal) common to EM activities across the DOE complex. IPs provide feed stock to IDs and focus the development of the technical base for environmental technologies. They are centrally managed, although not necessarily centrally executed. Currently planned and on-going IPs are shown in Fig. 3.

An ID is a set of RDDT&E activities that solve a complex-wide environmental problem. An ID incorporates new technologies and compares them at various stages of development. The ID concept is shown in Fig. 4. New technologies are driven by customer need, and are judged based on regulatory and public acceptability and technical feasibility. Ultimately, technologies are selected based on whether they are faster, better, safer, cheaper, or solve an intractable problem.

## THE SAVANNAH RIVER INTEGRATED DEMONSTRATION

TD implemented the first ID at Savannah River to assess its potential, and to develop a workable protocol for demonstrating technology products. Dr. John Steele, the Integrated Demonstration Coordinator (IDC) showed the ID concept could work. He established the right management and technical methodologies to integrate the separate technology products. In the process, he created a solution that complies with regulations, is technically feasible, cost effective, and ultimately successful. He achieved a satisfactory end-to-end solution to remediate VOCs in non-arid soils with a documented cost savings of $8 million, a 51 percent reduction in anticipated costs over traditional methods. The Savannah


**Currently Planned Integrated Programs**

| TECHNICAL AREA | INTEGRATED PROGRAM | COORDINATOR | START DATE |
|---|---|---|---|
| Treatment | Mixed and Hazardous Waste Treatment | Paul Lurk, HQ | Pre-1989 |
| | Efficient Separations | Stan Wolf, HQ | 1990 |
| Soils and Groundwater | Dynamic Stripping | J. Yow, LLNL | 1990 |
| | Characterization and Sensors | W. Haas, Ames Lab | 1991 |
| | In-Situ Remediation | M. Peterson, PNL | 1991 |
| Cross-Cutting | Robotics | L. Yarbrough, HQ | 1990 |
| | Decision Support | M. Barainca, HQ | 1991 |
| | Analytical Laboratory | D. Lillian, HQ | 1991 |

Fig. 3. Ongoing and presently planned integrated programs.

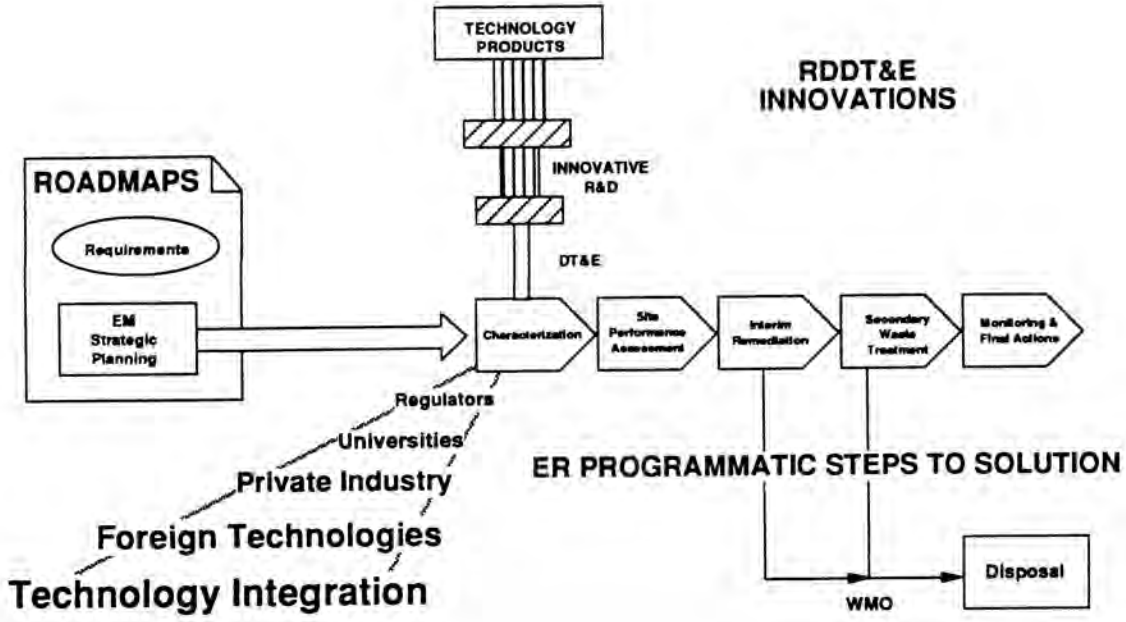



Fig. 4. Integrated demonstration concept.

River ID successfully demonstrated advanced characterization and drilling techniques to facilitate in situ remediation. The lessons learned have been passed on to new IDs, including methods for technology transfer.

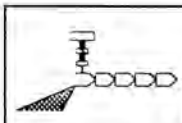
Based on the success at Savannah River, TD initiated eight additional IDs (Fig. 5). The TD strategy for IDs is based on solving complex-wide problems from simple to complex, providing the user with a proven cleanup system, and then transferring technology products across the Complex (see Fig. 6, ID Network). This integrated systems approach ensures mutual support and maximizes the probability of success.

The management of an IP and ID are similar -- both are centrally managed. IPs are currently managed at TD Headquarters, usually by a Government Program Manager called an Integrated Program Coordinator (IPC). IDs are managed in the field through the Field Office Technical Program Officer (TPO) by the Integrated Demonstration Coordinator (IDC), a Management and Operating (M&O) contract person selected based on experience and proven capability. The designated IPCs and IDCs for on-going IPs and IDs, listed in Figs. 3 and 5, are responsible for the integration of commercially-based technology initiatives.

## IDS AND IPS ENCOURAGE PARTICIPATION

Technical committees and working groups, with representation from the TD staff and across the Complex, support the IPCs and IDCs to develop and implement a complex-wide program. External coordination with industry, universities, regulators, and the public is provided by close working relationships among TD, committees, and groups established to facilitate outside communications. For example, TD coordinates and works closely with the Superfund Innovative Technology Evaluation Program, the Interagency Working Group for Hazardous Waste Technologies, the State and Tribal Government Working Group, and other similar organizations.

Technical review committees sponsored by prestigious external organizations, such as the National Academy of Sciences, provide impartial and highly-qualified scientists and



**Integrated Demonstrations Must**

**Solve a Real Problem End-To-End, Address a Broad Application of Technology, Demonstrate a System, Compete Technologies Side-by-Side, Integrate Regulatory Requirements, Incorporate Stakeholder Concerns**

**Currently Planned Integrated Demonstrations**

| TECHNICAL AREA | INTEGRATED DEMONSTRATION | COORDINATOR | START DATE |
|---|---|---|---|
| Waste Retrieval and Processing | In-Situ Vitrification | J. Buelt, PNL | Pre-1989 |
| | Buried Waste Retrieval & Processing | S.K. Merrill, INEL (EG&G) | 1991 |
| | Underground Storage Tanks | R. Gilchrist, Westinghouse Hanford | 1991 |
| | D&D Concrete & Metal Structures | J. Hyde, HQ | 1991 |
| | Stored Waste | | 1997 |
| Waste Minimization | Weapons Complex Program | P. Saxman, DOE/ALO | 1990 |
| | Y-12 | J. Koger, MMES | 1990 |
| | Environmentally Conscious Manufactoring | B. Granoff, SNL | 1990 |
| | DOE/USAF MOU Program | K. Koller, INEL (EG&G) | 1990 |
| | Dismantlement | T. Wheelis, SNL | 1992 |
| | Pu Minimization | | 1996 |

**Currently Planned Integrated Demonstrations**

| TECHNICAL AREA | INTEGRATED DEMONSTRATION | COORDINATOR | START DATE |
|---|---|---|---|
| Soils and Groundwater | VOCs in Non-Arid Soils | J. Steele, Westinghouse SR | 1990 |
| | VOCs in Arid Soils | S. Stein, PNL | 1991 |
| | Pu in Soils | L. Rodgers, EG&G NV | 1991 |
| | U in Soils | K. Nuhfer, Westinghouse Fernald | 1991 |
| | Mixed Waste Landfill | L. Tyler, SNL | 1991 |
| | Mixed Waste in Non-Arid Soils | | 1995 |
| | General Waste Minimization | | 1996 |
| | Non-VOCs in Non-Arid Soils | | 1996 |
| | Heavy Metals in Soils | | 1996 |
| | Priority Metals in GW | | 1996 |
| | U in Groundwater | | 1996 |
| | Tritium in Soils & GW | | 1996 |
| | MFP in Soils & GW | | 1997 |
| | Non-VOCs in Arid Soils | | 1997 |
| | Organics in Surface Water | | 1998 |

Fig. 5. Ongoing and presently planned integrated demonstrations.

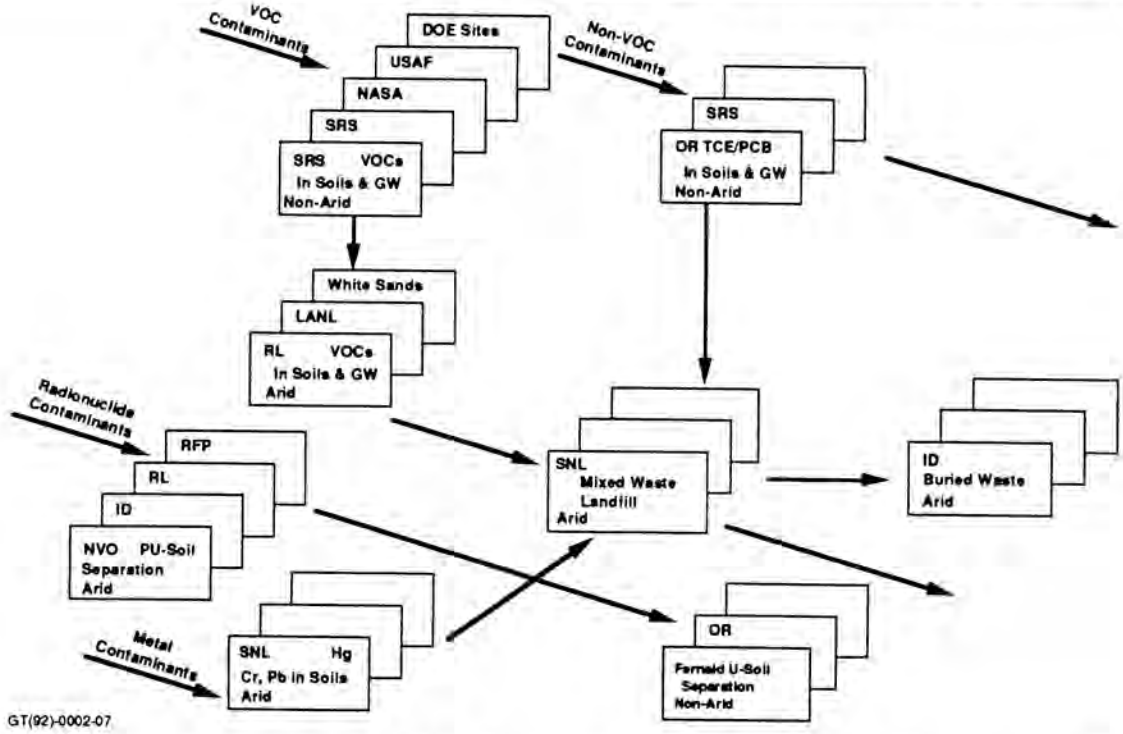



Fig. 6. The evolutionary ID strategy through time, place and complexity soils and groundwater remediation.

engineers to conduct independent technical reviews. These expert panels make recommendations to TD regarding a wide range of technical issues.

TD wants to increase commercial participation in our program, but the Federal procurement process is a very rigorous and time-consuming process, particularly in dealing with intellectual property rights. Current Federal public disclosure regulations of Government-held information (such as the Freedom of Information Act) are inhibiting. Companies are reluctant to enter into agreements with the Government if there is a risk that proprietary information will be disclosed. When we deal with foreign countries, intellectual properties are rarely an issue. Thus, the Federal Government unwittingly can favor foreign entities over U.S. industry regarding intellectual property rights. We are trying to resolve this problem.

## OPTIONS FOR PARTICIPATION

Contractors can be involved in the TD program in a variety of ways. These are described in detail in DOE/MA0274 - "Doing Business with the Department of Energy," which can be obtained through the Office of Procurement, Assistance, and Program Management. The procurement process is illustrated in Fig. 7. The highlighted areas are solicitations methods TD has used in the past and expects to continue to use in the future. Other options will be used as the program matures.

TD is committed to working with the public, industry, and academia as demonstrated by its participation in over 100 meetings since EM has been established. We want you to know about our program and what we are trying to do. We want to know more about your technologies and programs and how we can best work together. This is not a one-way street -- we have an obligation to help U.S. industry capitalize successful technologies that can ultimately improve U.S. competitiveness abroad. To facilitate this integration, TD is sponsoring two procurements to bring commercial innovations into DOE. TD plans to issue a series of Program Research and Development Announcements (PRDAs). The first of these announcements, valued at $8 million, was advertised in the Commerce Business Daily, August 20, 1991, and includes, among others: waste minimization, instrumentation, characterization, immobilization and treatment, decontamination, and robotics (see Fig. 8). The Morgantown Energy Technology Center is currently evaluating the many industry offerings.

Cooperative Research and Development Agreements (CRADAs) are another means to facilitate DOE and private industry working together (see Fig. 9). This instrument is an agreement between a DOE research and development laboratory and any non-Federal agent for cooperative R&D. The industrial or university partner may provide funds, facilities, people, or other resources. The DOE partner provides facilities and people, but no funds beyond what might be used by the participating laboratory. A CRADA provides unique protection of intellectual property to encourage commercial firms to participate. Only the data jointly produced is subject to ultimate disclosure (National Competitiveness Technology Transfer Act, PL 101-1889). The CRADA is a new contracting vehicle available to the M&O contractors and national laboratories to offer industry the opportunity to capitalize in a joint DOE-Industry technology development and transfer. Savannah River has the most aggressive CRADA effort within the Technology Cooperative Research and Development program, through the outstanding efforts of John Steele. TD plans other solicitations, to be announced in the future.

## CONCLUSION

For TD programs to be effective and publicly acceptable, we must develop and implement technical solutions to DOE's environmental problems using a systems approach. Our solutions must solve problems "end-to-end" without creating egregious secondary waste streams, or redistributing contaminates from one media to another, in response to prescriptive

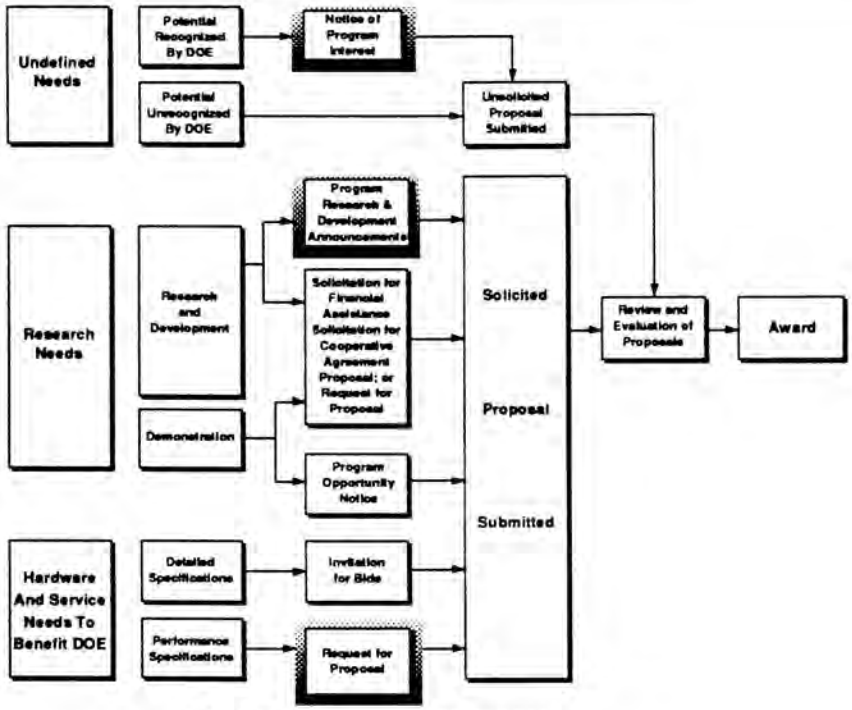



Fig. 7. The procurement process.

| | |
|---|---|
| **Procurement Office:** | **Morgantown Energy Center** |
| **Release Dates:** | **CBD Announcement, August 20, 1991,<br>Proposals In Evaluation<br>Others Will Follow** |
| **Scope:** | **Proposals Are Requested Along Broad Technical Areas That Relate To Complex Needs** |
| **Contract Value:** | **August 20, 1991 - $8 Million** |

Fig. 8. Program research and development announcements.

- **What It Is**
  - **A Flexible Agreement Between One or More DOE Labs and One or More Non-Federal Parties to Conduct Specified R&D**
  - **Not a Procurement Contract or Grant**
- **Characteristics**
  - **Allows Lab and Other Parties to Provide/Share Facilities, Personnel, Equipment, and Funds**
  - **No DOE Funds Can Leave Lab**
  - **Rights to Inventions, Intellectual Property are Negotiated**
  - **Certain Data Generated Can Be Protected Up to 5 Years**

Fig. 9. Cooperative research & development agreement (CRADA).

regulatory requirements. We must do what is right for the environment and human safety based on rationally-derived, risk-based criteria.

Technology development is a winnowing process that requires continuous customer participation in all phases so that industrial partners can complement our activities. Commercialization occurs with cooperative activities where industry begins to share in the cost risk, balanced with an expectation of profitable returns. We want to commercialize these technologies in the marketplace. Through the free market, we will realize the rewards of an optimized technology product.

To support the EM goals of achieving effective environmental stewardship and cleanup by the year 2019, TD must deploy the majority of new technologies and produce an upgraded infrastructure by the year 2005. This requires well-articulated strategic goals, aggressive execution of the TD Program, innovative management of a complex process, and sufficient resources to accelerate and maintain the TD program pace. Further, we must energize our national laboratories and vigorously integrated commercial innovative environmental technologies to bring our nation's best capabilities to solve this problem. Finally, TD must produce. We must demonstrate that we have produced cost savings and returned our taxpayers' investment to maintain national support of our development efforts. We are not a regulatorally-driven component of the Federal budget. We are an Investment -- a means to do vital work faster, better, cheaper, and safer; a vision, with the optimism to solve today's intractable environmental problems (see Fig. 10).

- **The Office Of Technology Development Is Developing User-Needed New Technology Products For:**
  - **Faster, Better, Safer And Cheaper Cleanup**
  - **Solutions To Currently Intractable Environmental Problems**
- **The TD's Strategy Plan Envisions Rapid Implementation By:**
  - **Utilizing Integrated Programs/Integrated Demonstrations**
  - **Encouraging Contractor Participation Through PRDAs And CRADAs**
  - **Leveraging DOE Resources Using Joint Interagency Programs**
- **Technology Implementation Is TD's Only Measure Of Success**

Fig. 10. DOE needs new technology products to cleanup the complex.