

THE DOE EM SCIENCE AND TECHNOLOGY PROGRAM VISION – AN OVERVIEW

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ABSTRACT

The Department of Energy (DOE) Office of Environmental Management (EM) is in an era of shrinking budgets and increasing scrutiny of the budget that is provided. This is occurring at a time when EM has established a new, aggressive approach to environmental restoration and disposition of legacy waste inventory. This approach, as outlined in the guidance for the *Accelerating Cleanup: Paths to Closure* document, calls for completion of cleanup for most of the DOE sites by 2006. The need for expedited demonstration and deployment of treatment technologies has never been more critical. Consequently, DOE EM is working to improve its success rate for demonstrating and deploying technologies, such that the goals of the *Accelerating Cleanup: Paths to Closure* can be met.

DOE EM recognizes that several key features are necessary for any technology development program to achieve successful demonstrations and deployments. First, the technology development program must have frequent and effective communication with the operations end-users to understand their needs. Second, the program must have an accountability system that ensures funded projects support site needs and are validated by the end-users. Third, the program must provide a technology life-cycle continuum that effectively spans from basic research to technology development, through demonstration, and finally to deployment. Historically, the DOE EM Office of Science and Technology (OST) has focused more on technology development and demonstration, not fully recognizing the resources and effort required to actually deploy a “demonstrated” technology. For the program to be successful, OST must establish and maintain a balanced portfolio of activities, through its various program elements, in which each phase of the technology life-cycle continuum is appropriately represented. Examination of the Mixed Waste Program, as an example, illustrates the actions OST has taken to establish and maintain a program that has these keys to success.

The Mixed Waste Program is comprised of several components, including: the Mixed Waste Focus Area (MWFA), Environmental Management Science Program (EMSP), Accelerated Site Technology Deployment Program (ASTD), Industry and University Programs, and various crosscutting programs. While each of these program elements has its own work scope, collectively they provide a technology life-cycle continuum that offers a balanced portfolio, with projects that address problems ranging from basic science and research to technology deployment. This paper describes the various components of the Mixed Waste Program, how they communicate with the end-users, how they interface with each other, and the role of each in establishing the technology life-cycle continuum.

Over the past few years, the Mixed Waste Program has greatly improved the overall effectiveness of the program, through continuous interaction with operations end-users at the sites, communication among program elements, and implementation of a project accountability system. Consequently, a technology continuum has been established that is beginning to produce results.

INTRODUCTION

The DOE Assistant Secretary for Environmental Management implemented policies and systems in September 1997 that were designed to establish a defensible Ten Year Plan for accomplishing cleanup of the DOE weapons complex. A guidance document (1) was issued for development of site-specific plans that describe the activities, schedule, and budget associated with cleanup of the site. Collectively, these plans constitute a document entitled *Accelerating Cleanup: Paths to Closure*. These actions were taken in direct response to the criticisms received from Congress on the Discussion Draft of DOE's first attempt at a Ten Year Plan. As discussed in the cover letter for the revised draft "Paths to Closure guidance document" from Alvin L. Alm to all DOE Operations Office Managers (October 20, 1997) (2), the House Appropriations Bill stated:

"The Committee is extremely discouraged by the Department's failure to issue a supportable Ten Year Plan for completing cleanup of the Environmental Management sites. The Committee views the repeated delays by the Department to provide a Ten Year Plan, as symptomatic of broad, cultural problems that require aggressive, institutional changes."

Development of the Paths to Closure document pointed out an inherent deficiency in the OST system. While the right "pieces" were in place, the OST Mixed Waste Program was compartmentalized and fragmented. This "broad, cultural problem" resulted in a program that was not effectively addressing the sites' technology needs, and, consequently, was not able to support the goals of *the Accelerated Cleanup: Paths to Closure*.

An important performance metric for determining the effectiveness of a technology development program is the number of deployments. While OST has accomplished many deployments, the program recognizes a need to improve its performance in this area. The results of self-assessments, General Accounting Office reports (3), and congressional inquiries all indicated the need to increase the rate of technology deployments within OST. A few key features have been identified that are necessary to make a successful technology development program, as measured by the number of deployments. First, the technology development program must have frequent and effective communication with the operations end-users to understand their needs. Second, the program must have an accountability system that ensures funded projects support site needs and are validated by the end-users. Third, the program must provide a technology life-cycle continuum that effectively spans from basic research to technology development, through demonstration, and finally to deployment. This paper discusses the steps that OST has taken to incorporate these features in its overall technology development program. The Mixed Waste Program will be used as an example.

BACKGROUND

In 1989, the Congress directed DOE to establish a research program to develop technologies to cleanup the sites in the DOE weapons complex, and restore the environment. The Office of Technology Development (OTD) was established in November 1989 to develop innovative environmental restoration and waste management technologies to reduce risks to workers, the public, and the environment; reduce cleanup costs; and provide solutions for waste management issues that could not be addressed using existing capabilities. In 1996, OTD added two new responsibilities—management of a Congressionally mandated environmental science program

and development of risk policy, requirements, and guidance. OTD was renamed the Office of Science and Technology.

In August 1993, the DOE Assistant Secretary for Environmental Management initiated a new approach for environmental research, technology development, and deployment (4). A key feature of the new approach was to identify five major problem areas for technology development associated with the cleanup of the DOE complex. The EM OST then established five “focus areas” to identify deficiencies, develop solution strategies, and implement those strategies to address the five identified problem areas. The focus areas that OST eventually settled on included: the Mixed Waste Characterization, Treatment, and Disposal, High Level Waste Tank Remediation, Decontamination and Decommissioning, Subsurface Contamination, and Nuclear Materials focus areas.

The EM OST also established three “cross-cutting” programs including Characterization, Monitoring, and Sensor Technology (CMST); Efficient Separations and Processing Technologies (ESP); and Robotic Technology Development Program (RTDP). These programs address technical issues that are common to more than one focus area. In addition, OST implemented the Industry and University Programs. The purpose of this organization is to involve the private sector, such as colleges, universities, not-for-profit institutions, and industry, in developing and implementing improved technologies that address the needs of the focus areas, through government contracting mechanisms and competitive procurement. Another key support program is the EM Science Program. The EMSP was started in response to the Galvin Report *Alternative Futures to the Department of Energy National Laboratories* (5), in which Congress requested that DOE initiate a longer-term basic science research program to seek innovative cleanup methods to replace current conventional approaches, which are often costly and ineffective. In fiscal year 1998 (FY1998), OST initiated the Accelerated Site Technology Deployment (ASTD) Program. The purpose of the ASTD Program was to help increase the deployments within OST by providing funding to sites for deployment projects with low risk and high probability of success.

The following sections briefly describe the program components that comprise the overall Mixed Waste Program, and the general roles and responsibilities of each. Information provided was generally obtained from the Introduction Section of the DOE EM Rainbow Books, and from the programs’ web sites.

Mixed Waste Focus Area

The MWFA was initiated to provide an integrated, multi-organizational, national team to develop, demonstrate, and deploy treatment systems capable of addressing all technology needs for disposition of the DOE mixed waste inventory, in accordance with applicable regulations. This generally includes characterization, treatment, packaging, transportation, and disposal activities. The MWFA provides the lead role for the DOE EM Mixed Waste Program.

The mission statement of the MWFA is as follows:

The Mixed Waste Focus Area delivers technical and engineering solutions necessary to ensure that program managers of mixed low-level and transuranic (TRU) waste can resolve

present and future needs identified in their accelerated path to closure planning. The Mixed Waste Focus Area invests in solutions that will be deployed and will have a significant national impact. This is accomplished by an end-user driven process that enables all steps from need identification through solution deployment, and is completed in partnership with EM Programs.

Environmental Management Science Program

As previously stated, EMSP was initiated in response to the Galvin Report, "Alternative Futures for the Department of Energy National Laboratories". Congress specifically requested that DOE establish a program that provides longer term basic science research to seek new and innovative cleanup methods to replace current conventional approaches, which are often costly and ineffective. Accordingly DOE, in partnership with the Office of Science (formerly Office of Energy Research), designed, developed, and implemented the EMSP as a directed basic research effort to establish the scientific and engineering understanding required to solve the most challenging technical problems facing the government's largest, most complex environmental cleanup program. The objectives of the EMSP are to:

1. Provide scientific knowledge that will revolutionize technologies and cleanup approaches to significantly reduce future costs, schedules and risks.
2. "Bridge the Gap" between broad fundamental research that has wide-ranging applications, such as that performed in the DOE Office of Science, and needs-driven technology development that is conducted by OST.
3. Focus the nation's science infrastructure on critical DOE environmental problems.

Crosscutting Programs

In addition to work directed to specific Focus Areas, EM is engaged in research and development programs that cut across these problem areas. Technologies from these Crosscutting Programs may be used within two or more of the Focus Areas to help meet program goals. These programs complement and facilitate technology development in the Focus Areas. The Crosscutting Programs are:

- Characterization, Monitoring, and Sensor Technologies
- Efficient Separations and Processing
- Robotics Technology Development Program

Characterization, Monitoring, and Sensor Technologies Crosscutting Program

DOE is required to characterize more than 3,700 contaminated sites, 1.5 million barrels of stored waste, 385,000 m³ of high-level waste in tanks, and from 1,700 to 7,000 facilities, before remediation, treatment, and facility transitioning can begin. Monitoring technologies are needed to ensure worker safety and effective cleanup during remediation, treatment, and site closure. CMST provides basic and applied research activities for mixed waste characterization and monitoring needs.

Efficient Separations and Processing Crosscutting Program

The scope of this crosscutting program is almost specifically devoted to high-level tank waste issues, and does not generally provide support to the MWFA.

Robotics Technology Development Crosscutting Program

Existing technologies are often inadequate to meet EM's mission needs, at a reasonable cost, and under conditions that promote adequate worker safety. Robotic systems reduce worker exposure to the absolute minimum, while providing proven, cost-effective, and, in some cases, the only acceptable approach to problems. Robotics remote-systems development work occurs in three areas:

1. Remote systems for decontamination and dismantlement of facilities will reduce or eliminate extensive worker radiation protection requirements and increase productivity.
2. Robotic systems for characterization and retrieval of stored tank waste will allow work to proceed within the radiation fields in the waste storage area.
3. Automated chemical/radiological analysis systems are estimated to provide a cost benefit of \$10.5 billion from FY1996 through FY2000.

Industry and University Programs

Industry and University Programs provide, to the Focus Areas and the Crosscutting Programs, the capability to involve private industry, universities, and other interested parties in their program through direct procurement with DOE. The public-private partnerships that are established encourage the enhancement and commercialization of technologies developed by the private sector through pilot- and field-scale demonstration at DOE sites. The integration of industry, academia, and the DOE laboratories allows all aspects of the technology to be evaluated, including worker safety and health, potential to commercialize, and technical merit.

Industry and University activities support more than 100 agreements with the private sector. These agreements include the Small Business Innovative Research (SBIR) program, international activities, stakeholder activities, worker safety and health activities, and commercialization initiatives, as well as direct support to the Focus Areas.

Accelerated Site Technology Deployment

Current and projected EM budget constraints do not support expedient qualification and **deployment** of alternative technologies or innovative processes. Nevertheless, the DOE stakeholders have repeatedly expressed the desire for the Complex to evaluate and implement technological solutions and processes that allow site cleanup to be accomplished better, faster, and cheaper. In response, OST has established the ASTD program, formerly known as the Technology Deployment Initiative (TDI). The ASTD program is designed to accelerate the use of new technologies and innovative approaches to achieve the goals identified in the *Accelerating Cleanup: Paths to Closure*.

The DOE OST has been funding and supporting research, development, and demonstration of environmental technologies since its inception. These efforts include development of technology systems necessary to clean up the environmental legacy resulting from nuclear weapons production during the cold war. Additionally, commercial industry has developed technologies that could be very beneficial to the DOE Complex cleanup effort. If deployed effectively and systematically through the DOE Complex, many of these technological solutions can be used to achieve the "Paths to Closure" goals, resulting in an overall accelerated cleanup.

The ASTD program will provide the means and incentives to the DOE sites for identifying and deploying technologies and processes for cleanup throughout the DOE Complex. Specifically, the mission of the ASTD is as follows:

To deploy technologies and processes that reduce the DOE EM costs, accelerate site cleanup, and support the goals and schedules identified in *Accelerating Cleanup: Paths to Closure*.

The primary objective of the ASTD Program is to accelerate the implementation of previously demonstrated technologies or processes in EM cleanup activities. The program has the following secondary objectives:

- Provide for deployment of technologies or processes to conduct cleanup and reduce EM cleanup costs in support of the *Accelerating Cleanup: Paths to Closure* goals.
- Break down barriers that prohibit implementation of technologies or processes.
- Achieve closer coordination through joint ownership and funding of projects across the DOE EM organizations.

PROGRAM PROBLEMS

DOE EM has identified several root causes for its limited success in deployment of technologies. First, when DOE established OST, the primary emphasis was placed on technology development. The basic concept was that OST would develop technologies, and EM Operations end-users (i.e. EM-30/40/60) would deploy them, as needed. However, the significant effort, technical expertise, and resources required to transition a technology from the "development and testing" phase, to "deployment", were not fully understood by DOE EM. This is particularly true for mixed waste treatment technologies, which require substantial regulatory and stakeholder involvement and approval. Second, communications between OST and potential end-users has been limited. The fact that the rate of deployment of technologies has been less than expected indicates that EM and OST may not have fully understood the extent and complexity of actual EM Operations technology issues. DOE EM established the Site Technology Coordination Groups (STCGs) to help alleviate this situation, but implementation of the STCGs across the DOE complex has been fragmented; consequently, communication of site needs has been incomplete.

STEPS TO IMPROVEMENT

The need for DOE EM to successfully demonstrate and deploy treatment technologies has become increasingly important. Recognizing that fact, DOE EM has evaluated the current situation and developed a strategy for enhancing the OST program such that the DOE clean-up

goals can be achieved. The underlying element of this strategy is to provide a continuum of activities that addresses needs ranging from basic and applied research to technology development, through technology demonstration and deployment.

Several steps are required to achieve this type of program. First, OST must decompartmentalize its infrastructure. The existing programs have the necessary expertise and capabilities to successfully address and resolve the technology deployment needs of the DOE complex. And, DOE EM does not want, or need, to start over. Instead, DOE EM must establish comprehensive programs that effectively integrate individual program elements to establish a cohesive waste management strategy. For example, if operated as designed, the Mixed Waste Program collaboratively uses the capabilities and resources of the existing Focus Area, Industry and University Programs, Crosscut Programs, ASTD, and EMSP to develop and implement the appropriate technology continuum.

Second, OST must understand and address EM Operations end-user needs. Most sites have identified STCG needs, and many OST projects have been linked to these needs. However, EM must work with end-users to fully understand the technology development, demonstration, and deployment needs and appropriately incorporate them into the technology continuum. The recent effort of the EM Integration Program, with support of the MWFA, to status the science and technology needs associated with the *Accelerated Cleanup: Paths to Closure* disposition maps has resulted in clarification of existing STCG needs, documentation of new needs, and identification of opportunities for program enhancements and near term deployments. In addition, the Paths to Closure guidance document provided by DOE EM instituted several systems that directly affect how the OST identifies technology needs, establishes technology solution strategies, and appropriates funding to support these strategies. The Integrated Planning, Accountability, and Budget System (IPABS) implemented by DOE EM establishes the Project Baseline Summary (PBS) documents as the sole budget drivers. Any activities funded by OST must be linked to at least one PBS. This is accomplished through the Needs Management System (NMS), which is a database that is used by the sites to document the STCG needs identified for each PBS. Focus Areas then link their work packages and associated activities with the appropriate needs. However, the PBS managers have final authority to validate that a technology development, demonstration, or deployment activity does, indeed, support the PBS. The sites have evaluated their needs and documented them, through the STCGs, in the DOE NMS database. As a result of these changes, the Mixed Waste Program elements, particularly the MWFA, must work harder than ever to ensure that the activities being supported by the program have "buy-in" from the operations end-users.

Finally OST must establish a balanced portfolio that targets appropriate portions of the budget to projects throughout the technology continuum, including demonstration and deployment, based on the end-user needs. This will ensure end-user support and collaboration, and greatly increase the likelihood of deployment of the OST technology programs. Consequently, the MWFA must coordinate its activities closely with those of the EMSP, ASTD, and Crosscutting Programs, as appropriate, to ensure that the supported work offers a balanced approach to defining a technology solution for a deficiency.

One way to help reach this goal is through proper development and management of requests for proposals. For example, research applications for EMSP are solicited on the basis of the identified site-specific needs. Linkages between environmental challenges faced by EM and the EMSP basic research efforts are ensured through the project selection process that includes a “relevance component”.

Another attempt to better integrate the various Mixed Waste Program elements occurred in early FY1999. The ASTD program was modified to more fully solicit participation from the focus areas in the development of proposals and project operations. Industry and University Programs have been very effective at engaging the MWFA into their proposal technical review process.

CONCLUSIONS

The initial step in resolving any problem is, first, recognizing that a problem exists. DOE EM and OST are aware of the need for improvement in deploying technologies for meeting the goals of the *Accelerated Cleanup: Paths to Closure*. Thorough analysis and evaluation of the root causes of this problem have been completed and DOE EM has developed and implemented a new process for identifying site needs, linking OST activities to site needs (through PBSs), and getting “buy-in” or validation from the site PBS managers. This new system will take some time before improved success (i.e. increased deployments) can be quantified. However, if the system is implemented as it is designed, success is inevitable.

REFERENCES

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