ACHIEVING FASTER, BETTER, CHEAPER COMPLIANCE THROUGH INTEGRATED DEMONSTRATIONS AND INTEGRATED PROGRAMS

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ABSTRACT

The driving forces for faster, better, and cheaper technologies to achieve regulatory compliance demand a culture change in the approach to technology development. The focus in the past has been site-specific technology with little effort to maximize the potential for implementation across the DOE complex. It often resulted only in regional compliance. The need is clearly for complex-wide and nationwide implementation and compliance. Integrated demonstrations and integrated programs have been designed to achieve a more synergistic and cost-effective way to solve a problem end-to-end or specific aspects of a problem.

This paper describes the concept of Integrated Programs and Integrated Demonstrations. It discusses the objectives to be achieved through integration and of the major program elements. It also briefly describes the Savannah River Integrated Demonstration.

BACKGROUND

The Department of Energy (DOE) has made a commitment to bring its facilities and associated waste sites into compliance with national environmental laws within the next thirty years. The DOE's environmental problems are far ranging in technical scope and in geographical distribution. The effort includes addressing both waste streams from existing facilities and their future production as well as cleanup associated with wastes resulting from the past 40 years of operations. The waste steams include radioactive materials, hazardous chemicals, and mixtures of both. DOE has sites located across the US in over thirty states.

Associated with the technical breadth of this problem are the regulatory issues that DOE must address to comply with the applicable Federal, state, and local regulations and other agreements. Not only does DOE have to comply with regulations that vary from jurisdicition to jurisdiction, but these regulations are subject to change. Thus, as new information becomes available, currently accepted practices may have to be changed. Complications also arise when regulatory requirements overlap or, alternately, do not adequately address situations resulting from combinations of problems, such as mixed wastes. Initiatives to develop technologies that will be accepted for use across jurisdictional boundaries is highly desirable. Establishing national compliance goals for developing technologies is a major challenge and will require the coordination and cooperation of numerous organizations and individuals of diverse areas of expertise.

Currently technologies that could solve DOE's problems are in many cases not readily available or require development efforts to improve production efficiency, production rates, or other aspects of their performance to make them more economical and to refine their safety aspects. DOE's 30-year compliance goal has key milestones associated with obtaining regulatory approval for implementing a technology. This time constraint limits the interval available for technology development and makes the efficient development and testing of new technologies critical. It also makes identifying, refining, and innovatively using existing or developing technologies desirable.

Historically, much of the technology development efforts associated with the DOE sites has been conducted as independent efforts. This is in part due to the classified nature of the weapons development and production work that is conducted at DOE sites and also to an atmosphere allowing intellectual freedom and associated independence. This culture poses potential limitations for correcting environmental and waste management problems and in meet regulatory requirements. Efforts to define and assess the nature of these problems, if done on an independent site and/or waste specific basis, must be coordinated to understand them on a global scale. These efforts address questions, such as what are the key problems, where are there common issues, where are there technology gaps, and how are problems addressed cost-effectively? Independent technology development efforts typical of the historical culture pose the potential for duplication of efforts. Historically, the technical interests of individuals could result in a program that is defined from the bottom up instead of a systems approach that is driven by requirements from the top down. Other potential difficulties arise if the response to potential solutions is considered inadequate because it was "not invented here." Finally, there are the inherent complexities with development efforts that span time frames in which delays associated with funding and/or administrative activities, such as contracting efforts, can jeopardize the timely development of a product.

The Integrated Program and Integrated Demonstration Concepts

The need for a cultural change in the manner in which technology development efforts are conduced is evident from the discussion above. The Office of Technology Development is in the process of trying to make this cultural change through the management concept of integrated programs and integrated demonstrations. Each of these concepts is discussed below, but some common considerations regarding the development of technology products and the nature of the operational steps for solving an environmental remediation or waste management problem are discussed first.

The Technology Development Process

The development of a technology product to be applied to solve a problem can in general be seen to pass through sequential stages (Fig. 1.). These stages consist of basic research; applied research and development; demonstration, testing, and evaluation; and final implementation in addressing the problem. The focus is on the criteria to progress from one stage to the next. The criteria for moving from basic research to applied R&D is typically one of technical feasibility and the potential to achieve regulatory acceptance. The next milestone at the completion of the applied R&D stage requires the development of the necessary engineering data to indicate that scale up of the technology is viable and to address other engineering and cost/benefit issues. The DT&E stage establishes proof of concept through testing of a prototype at which the technology product is ready for full-scale implementation.

Central to the concepts of integrated programs and integrated demonstrations is that there are multiple candidate technologies that can potentially be developed to meet a requirement or need. The criteria for progressing from one development stage to the next are used to filter the candidate technology products to implement those that best meet the requirements. The integration of the development efforts allows for advantages in comparing technologies on a common basis and possible testing at a common test site. There are other potential advantages in the ability to transfer relevant information from one development effort to another and to more rapidly filter less effective options. This approach allows for a more rapid and cost-effective focusing of the development efforts.

Operational Steps to Solving Environmental Restoration and Waste Management Problems

Figure 2 shows the generic operational steps required to address a typical environmental restoration and a waste management problem. The technology development process described above provides technology products to ad-

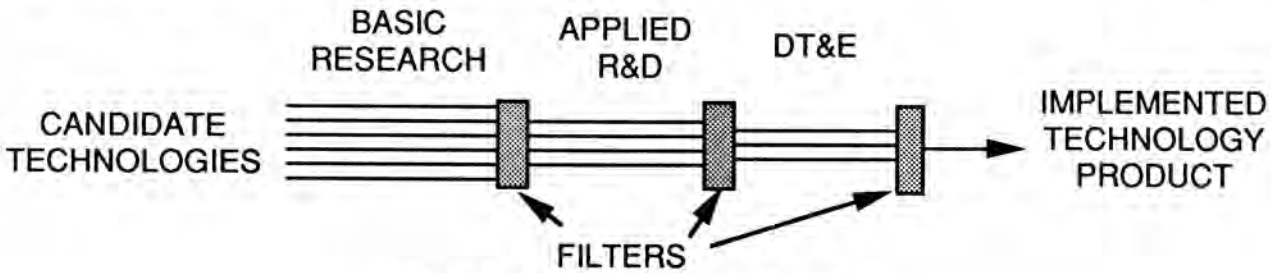

Fig. 1. Technology development process.

Fig. 2. Typical operational steps to problem solution.

dress requirements or needs associated with each of the steps. The steps associated with the two types of problems have some common emphasis; thus technology developed for one type of problem has potential applicability to the other. In addition, the secondary waste treatment itself can be a waste management problem within a larger environmental restoration problem.

Integrated Programs

An integrated program is a program in which a collection of technology development activities with related technical disciplines or potential applications are managed as an integrated development process as discussed above. Typically the technology products associated with an integrated program are applicable to a single or selected related operational steps. An example of an integrated program is one examining RCRA component destruction that includes the technology development process for supercritical water oxidation, molten salt destruction, CEPOD, and supercritical CO_2 reduction. This integrated program provides technology products for the remediation operational step shown in Fig. 2 and potentially for the retrieval/pretreatment and waste form/processing steps as well.

Technologies from outside DOE including academia, commercial industry (both domestic and foreign), and other government agencies can be transferred into the integrated program technology development process. OTD is in the process of developing the procedures and methodologies for executing these collaborative arrangements. Technology transfer out of the DOE technology development process is possible for applications to environmental problems as well as spin offs to other potential applications.

Integrated Demonstrations

An integrated demonstration provides a mechanism for focusing technology development efforts and for defining and developing a system to be implemented to address an environmental or waste management problem. Typically the integrated demonstration will focus on and be conducted at a "host" site addressing a problem that is of high national priority and/or is common to numerous sites. While most of the demonstration efforts will be conducted at the host site, there will be participation by sites that have common or similar problems or resident technical expertise or other capabilities applicable to the demonstration. Thus certain supporting efforts may be conducted at these sites and will be coordinated and integrated into the integrated demonstration.

The integrated demonstration is similar to the integrated program involving the development and filtering of competing technologies. However, an integrated demonstration addresses all the operational steps associated with the problem which is to be resolved. Figure 3 depicts the process. In this concept competing technologies which can potentially address an operational step are examined through a filtering process that results in candidate technologies sufficiently developed to enter the demonstration, testing, and evaluation (DT&E) stage. This allows the technology to formally be part of the integrated demonstration where it is demonstrated along with other technologies, to include those considered the best available technologies.

As with an integrated program, technologies can be transferred into the technology development process associated with an integrated demonstration from outside DOE as well as from within the DOE complex, to include integrated programs. Similarly, technologies developed and tested as part of an integrated demonstration can be transferred out for applications to other DOE sites and to the commercial sector.

An integrated demonstration, in addition to serving as the DT&E stage in the development of individual technologies, also serves as the mechanism to integrate various technologies to form a system to address all the operational steps in resolving the problem. This system view includes examining interface requirements between technologies and support requirements such as training, maintenance, special support equipment, disposal of secondary waste streams, etc. The understanding of the interactions of the various technologies as a system allows for better optimization of the system to be implemented and for the transfer of

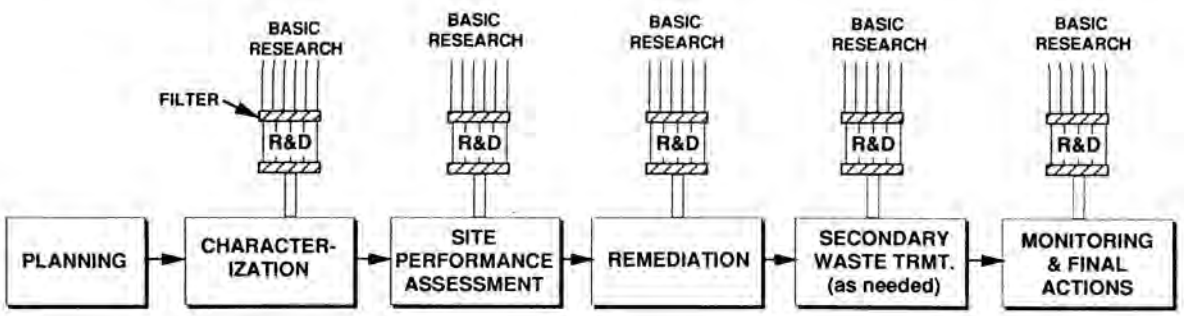

Fig. 3. Components of an Integrated Demonstration.

the system or component technologies to other applications or to other sites.

Savannah River Integrated Demonstration

The integrated demonstration concept has been initiated in efforts to address groundwater contamination with chlorinated solvents at the Savannah River Site in South Carolina. This is the first integrated demonstration undertaken by the Office of Technology Development and serves as a prototype for future integrated demonstrations. The objectives of this integrated demonstration not only include the development and ultimate implementation of technologies for this and related remediation problems but also better defined coordination requirements and management approaches for future integrated demonstrations.

The principal technical focus of the Savannah River Integrated Demonstration to date has been on the demonstration and evaluation of technologies for characterization, monitoring, and removal of volatile organics in soils and ground water. Table I summarizes the technologies being examined under the respective operational step they would support in a system for remediation.

The environmental horizontal well technology has been demonstrated at Savannah River. Two horizontal wells have been drilled, and vacuum extraction and air stripping methods have been used with encouraging results. As of December 1990, 16,000 pounds of chlorinated solvent have been removed using these methods.

Fiber optic sensors and a cone penetrometer have been demonstrated at the site. These technologies are applicable to both characterization and to monitoring.

The integrated demonstration has included technologies which have been developed at several DOE sites (LANL, SNL, BNL, ORNL, and others) and other government agencies (such as Army Corps of Engineers). Collaboration between these organizations and the technology developers has been cooperative and productive. This coordination avoids the potential for duplication of R&D and DT&E efforts and provides the opportunity to compare technologies at a common test bed under common conditions.

The successful demonstration of various technologies, in particular the environmental horizontal wells, at Savannah River has resulted in interest by NASA for their potential application to similarly contaminated sites. The technical collaboration among the technology developers facilitates such technology transfer to applications at other sites.

In addition to the technical integration, there has been very effective coordination with the regulators from both EPA and from South Carolina. This coordination has helped reduce the lead time required for permitting the demonstration of new technologies. Effective coordination among regulators ultimately will support a change of culture toward achieving national regulatory acceptance and compliance.

SUMMARY

The need for a technology development approach that will address requirements derived from DOE's commitment to regulatory compliance in 30 years has been discussed. This approach must be capable of development of faster, better, cheaper, and safer technologies. An approach has been formulated in the integrated program and integrated demonstration concepts for achieving these goals. The integrated program and demonstration concepts will provide for both faster development of technologies and technologies which are faster themselves. The faster development is facilitated by a variety of factors that include the

TABLE I

Technologies Under Examination at Savannah River

Savannah River Integrated Demonstration is the Prototype

Characterization	Remediation	Secondary Waste Treatment	Monitoring and Final Action
Fiber Optics Sensors	Horizontal Well	Off-Gas Treatment	In Situ Flow Sensors
	• In situ air stripping	• Surface remediation	
	Bioremediation		Geophysical Tomagraphy
Cone Penetrometer			
	Vertical Wells		
	• Vacuum extraction		Fiber Optics Sensors
			Cone Penetrometer

integrated nature of the development process resulting in cross fertilization of ideas; infusion of technologies from the commercial sector; efficiencies associated with the rapid winnowing down to optimal technologies through coordinated RDDT&E; etc. The development process also strives to produce faster technologies with improved processing speeds or through puts.

Better technologies will be developed through integrated programs and demonstrations. A few of the factors that will result in these improvements are better definition of system requirements, improved collaborative efforts, and improved testing and evaluation.

Both the development process and the technologies should be cheaper. Reductions in duplications of RDDT&E efforts through integration efforts will provide cost savings. More efficiency in meeting permitting and other regulatory requirements with integrated demonstrations reduces costs. A significant consideration in the evaluation of the technologies under development will be their life-cycle costs for implementation.

Safety will be another consideration in the evaluation of the technologies themselves. The integrated demonstration will examine safety in a more comprehensive manner than would otherwise be considered because of the system view being taken. Considerations such as interfaces with other components, training, and other support requirements will provide safer technologies.