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CLEANUP TECHNOLOGY

Better Management for DOE's Technology Development Program

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Resources, Community, and
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The Honorable George E. Brown, Jr.
Chairman, Committee on Science,
Space, and Technology
House of Representatives

The Honorable James H. Scheuer
Chairman, Subcommittee on Environment
Committee on Science, Space, and
Technology
House of Representatives

As requested, we reviewed the Department of Energy's (DOE) management of its technology development (TD) program for environmental cleanup. Specifically, we agreed to (1) provide an overview of the TD program and (2) identify management improvements needed to increase the effectiveness of the program as it gets under way. DOE established the TD program in 1989 to help solve its cleanup problems. DOE believes that existing cleanup technology is not sufficiently mature or cost-effective to meet its 30-year cleanup goal and that, without technological breakthroughs, the cleanup costs could increase significantly over the current estimate of $160 billion. On February 26, 1992, we testified before the Subcommittee on Environment, House Committee on Science, Space, and Technology, on the preliminary findings of our review.[1] This report summarizes our findings and makes specific recommendations to DOE for improving the management of the TD program.

Results in Brief

DOE has implemented the TD program and funded major research and development (R&D) projects. The program's funding for fiscal year 1992 is about $303 million, and DOE is requesting about $315 million for fiscal year 1993. However, DOE has not developed measurable performance goals, overall cost estimates and schedules, and key decision points for evaluating program projects. Without these fundamental management tools, DOE will have difficulty clearly determining what its objectives are, how best to achieve them, and when it has achieved them. Moreover, the Congress will have difficulty determining what investments the TD program is making and what funding is needed.

[1]Cleanup Technology: DOE's Management of Environmental Cleanup Technology (GAO/T-RCED-92-29, Feb. 26, 1992).

Background

DOE faces one of the largest environmental cleanup efforts in history; it estimates that the cleanup may cost as much as $160 billion over the next 30 years. DOE has identified thousands of sites at its facilities that have been contaminated to various degrees with radioactive and hazardous materials. These sites include areas with contaminated groundwater, soil, sludge in tanks, and buried waste. The problems have resulted largely from the work generated by the Department's nuclear weapons production over the past 40 years.

DOE has stated that existing cleanup technology is not sufficiently mature or cost-effective to meet its 30-year cleanup goal. As a result, DOE identified the need for an aggressive applied R&D program—the TD program—to provide the technological breakthroughs needed to help solve its cleanup problems. Without these breakthroughs, DOE officials believe that the cleanup costs could significantly exceed the current estimate of $160 billion.

DOE's Technology Development Program for Environmental Cleanup

In August 1989 DOE issued its first 5-year plan for environmental restoration and waste management. In the plan, which DOE has updated each year, the Department made a commitment to clean up all its sites and bring its waste management activities into compliance with environmental laws by the year 2019.[2] In November 1989 DOE created the Office of Environmental Restoration and Waste Management to consolidate its efforts to address its massive environmental cleanup problems. Within this office DOE created the Office of Technology Development to manage and implement the TD program, a cornerstone of the agency's cleanup effort. Funding for the TD program in fiscal years 1990 and 1991 was $183 million and $236 million, respectively. Funding for fiscal year 1992 is about $303 million, and DOE is requesting about $315 million for fiscal year 1993.

In implementing its TD program, DOE made some basic assumptions about what cleanup technologies were needed. DOE believes that current conventional cleanup technologies are ineffective and costly. For example, DOE stated in its second annual 5-year plan that conventional groundwater remediation technologies (i.e., pumping and treatment technologies) are time-consuming, expensive, and burdened with uncertainties about their overall effectiveness. DOE also stated that the process of excavation, treatment, and redisposal for remediating contaminated soils can be performed more safely and at less cost with the use of robots and in-place

[2]Recently, DOE's cleanup goal has come under question. For example, in its November 1991 final report, the Advisory Committee on Nuclear Facility Safety stated that under current technology this goal is unattainable.

treatment or stabilization. Furthermore, DOE believes new technologies are needed to minimize or avoid the generation of hazardous waste in the first place. DOE has established three major R&D areas for the TD program—groundwater and soil cleanup, waste retrieval and processing, and waste minimization and avoidance.

DOE also developed an initial strategy to support each major R&D area with "integrated demonstrations." According to DOE, an integrated demonstration would test multiple technologies at a particular DOE site and ultimately deliver an entire system to address a specific cleanup problem at the site. A total system would include site characterization, remediation, and monitoring technologies.

The first integrated demonstration project began in 1990. Through this project DOE is testing and evaluating various technologies to clean up chlorinated solvents in soils and groundwater at the Savannah River Site. DOE has demonstrated directional drilling technologies for improving access to the contaminants in order to characterize, remediate, and monitor them. DOE also has demonstrated in-place, air-stripping technologies for removing the contaminants. DOE is planning to demonstrate technologies that use microorganisms to remove or destroy the contaminants.

In 1991 DOE began seven more integrated demonstration projects for such problems as plutonium-contaminated soil at the Nevada Test Site, Nevada; uranium-contaminated soil at the Feed Materials Production Center, Ohio; buried waste at Idaho National Engineering Lab, Idaho; and underground storage tanks at Hanford, Washington.

Recently, DOE officials realized that the integrated demonstration approach requires more funding and resources than are now available. Thus, they plan to scale down to two or three integrated demonstrations and take the more narrowly scoped approach of delivering individual technologies instead of entire systems. DOE plans to focus on developing technologies in such areas as characterization and monitoring, in-place remediation, and mixed-waste processing.

DOE Lacks Fundamental Management Tools to Implement the TD Program

Although DOE has begun to implement the TD program and to fund major R&D projects, the agency has not taken important, fundamental steps to establish measurable performance goals, determine the cost of accomplishing these goals, and ensure that the R&D projects continue to be beneficial.

Program Lacks Measurable Performance Goals

Measurable performance goals are key management tools because they provide a clear focus and direction for a program and a sound basis for developing program strategies. They identify what achievements are desired or expected and, consequently, act as benchmarks for measuring program success.

Experts in the R&D field recognize the importance of establishing measurable performance goals. For example, according to officials of the National Research Council and the Gas Research Institute (which the Research Council praised as having a competent and effective R&D program), identifying the basis (i.e., issues and benefits) for R&D programs and formulating quantitative goals are essential first steps to effective program management. Not all research, such as basic research, lends itself to having quantitative goals because the fundamental concepts may have not yet been defined. However, applied R&D projects, particularly demonstration projects, should be well defined and characterized by quantitative parameters, according to R&D experts.

DOE has not established measurable performance goals for the TD program. DOE states that the TD program supports the agency's environmental cleanup goals by identifying or developing cleanup technologies that are better—safer, faster, less costly, and more effective—than currently available technologies. However, DOE does not specify in its planning documents what level constitutes "better" and how "better" is to be measured. For example, in its most recent 5-year plan for environmental restoration and waste management, issued in August 1991, DOE identified the technologies that it is developing. However, DOE did not identify specific limitations that it expects the developed technologies to overcome or the level of improvements it is seeking.

Without measurable performance goals, DOE will have difficulty discerning what it wants to achieve, how best to achieve it, and when it has achieved it. For instance, in demonstrating directional drilling and air-stripping technologies to improve on conventional groundwater-pumping

technologies, program officials have difficulty providing consistent goals for this effort. On the one hand, program officials state that groundwater pumping is ineffective in restoring groundwater to drinking water, or health-based, standards. On the other hand, in assessing the success of the directional drilling and air-stripping technologies, DOE is focusing on cost, not effectiveness. Specifically, DOE states that through the combination of air stripping and directional drilling, contaminant removal is faster and cheaper than before, and it anticipates millions of dollars in savings. However, the Advisory Committee on Nuclear Facility Safety cautioned, in its November 1991 report on DOE's nuclear facilities: "Initial results showing removals of large amounts of contaminants in short periods can not be reliably extrapolated to longer-term removals from lower concentration sources."

Overall Project Costs and Schedules Are Not Established

Project cost estimates and schedules are also key to effective program management. DOE needs such information to help it evaluate its progress toward its cleanup goals and to provide a basis for making project adjustments. Estimates and schedules can also help the Congress make more informed decisions about the investments being made and the funding needed for the technology development program.

In its project management system order (DOE 4700.1), DOE requires that project cost estimates and schedules (or baseline information) be established for its projects. In the order DOE defines a project as a unique major effort and a basic building block within a program that is individually planned, approved, and managed. DOE states that baseline information is the key to proper project management.

The integrated demonstration projects represent the TD program's major focus to date. DOE expects that each integrated demonstration project will provide an entire system for addressing a specific cleanup problem by demonstrating and evaluating multiple technologies for characterization, assessment, remediation, and monitoring at a particular site. Program plans and budget information are presented in terms of integrated demonstration projects.

Nevertheless, DOE has not established overall cost estimates and schedules for the integrated demonstration projects—those in the planning stages or the more-than-2-year-old integrated demonstration project at the Savannah River Site. DOE plans to use this project as a model for all other integrated demonstrations. Furthermore, the rough estimates given by program

officials for the integrated demonstration projects vary widely. For example, according to the Deputy Assistant Secretary for Technology Development, each integrated demonstration project will cost about $35 million to $50 million and will last about 4 to 6 years. However, other program officials have different opinions, with one stating that a demonstration project could last as long as there are efforts that will support the integrated demonstration objectives.

Major Decision Points Are Lacking

Finally, decision points for when and whether to continue a project are also key to effective program management. They are critical to identifying and weeding out poorly performing projects, such as those that no longer provide cost savings or benefits, and to helping to ensure that projects continue to be beneficial.

Experts in the R&D field recommend that decision points be established for determining when an R&D project should be continued or terminated. For example, according to a National Research Council official who reviews R&D programs, decision points are endpoints to help weed out projects whose potential benefits no longer offset costs and thus do not provide a return on investment. Similarly, a Gas Research Institute official stated that an important step in project evaluation is establishing critical decision points for deciding when to continue or discontinue a project. When a project is about 3 years old, the Institute generally begins to determine whether all technical goals have been reached and whether someone has made a commitment (in terms of dollars, licensing actions, or participation agreement) to use the developed technology. The Institute specifically identifies go/no-go decision points in its multiyear plans.

DOE has not established such clear decision points. The Office of Technology Development reviews proposed and ongoing projects annually. The projects are reviewed at a 1- to 2-week conference during which DOE headquarters, field, and contractor officials discuss program activities. At the conference, peer review panels, consisting of DOE officials and experts in the technical areas, are given a checklist for evaluating the projects. The checklist is primarily used to determine whether a project supports the objectives of one of the integrated demonstration projects or addresses a program need and should be funded. However, the list does not include major decision points, like the Gas Research Institute's, for assessing the continued benefits of ongoing projects and determining whether they should be continued or discontinued.

Conclusions

DOE faces the monumental task of cleaning up its nuclear weapons complex. To do so in a cost-effective manner, DOE believes that it needs improved cleanup technologies. As a result, it has begun the TD program and started funding eight integrated cleanup R&D projects. The number of integrated demonstration projects is expected to change as DOE reassesses its program strategy. Nevertheless, DOE's focus to date has been on setting up the program, not on its future management.

While it is important that DOE is getting the technology development program under way, DOE has not developed key management tools that are fundamental to ensuring the effectiveness of the program. These management tools include measurable performance goals, overall project cost estimates and schedules, and major decision points. Without these management tools, DOE will have difficulty clearly discerning what its objectives are, how best to achieve them, and when it has achieved them. Also, DOE will have difficulty measuring the TD program's progress toward helping it meet its cleanup goals, informing the Congress about the investments being made and the level of funding needed, and weeding out poorly performing projects that are no longer beneficial.

Recommendations

To help ensure the effectiveness of the technology development program, we recommend that the Secretary of Energy

- establish measurable performance goals for the program that include identifying the limitations of conventional cleanup technologies and how DOE plans to improve on these limitations;
- establish overall costs and schedules for the program's projects, including the integrated demonstration projects; and
- develop explicit decision points for determining when to continue or discontinue the program's projects in order to justify the projects' continuation or termination.

Scope and Methodology

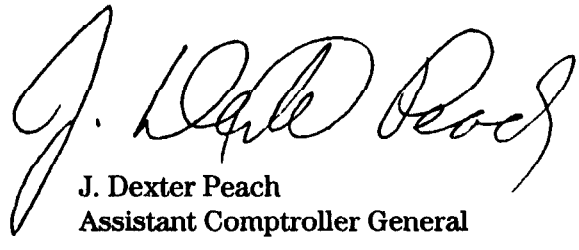
To implement our review, we obtained and reviewed pertinent documents, including DOE's 5-year plans for environmental restoration and waste management and the TD program's planning, project funding, and project evaluation documents. We also interviewed responsible program officials, including headquarters, field, and contractor officials. In addition, we interviewed experts in the R&D field, such as officials of the National Research Council and the Gas Research Institute, to identify management tools that are fundamental to an effective R&D program. Furthermore, we

visited the location of the TD program's first integrated demonstration project at DOE's Savannah River Site in South Carolina. We performed our review between June 1991 and February 1992 in accordance with generally accepted government auditing standards.

As requested by your office, we did not obtain written agency comments on a draft of this report. However, we discussed the information presented in the report with responsible DOE program officials, who agreed that it was accurate. Moreover, DOE officials testified at the February 26, 1992, hearing before the Subcommittee on Environment that they agreed with our findings and plan to take corrective actions.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Secretary of Energy; the Director, Office of Management and Budget; and other interested parties.

This work was performed under the direction of Victor S. Rezendes, Director, Energy Issues, who may be reached at (202) 275-1441. Other major contributors to this report are listed in appendix I.



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