Chapter Four

Issues Related to DOE's Cleanup Program

Although appreciable uncertainty surrounds the total cost of the Department of Energy's cleanup effort, the department can make choices as it proceeds with the cleanup that may reduce the cost of the program. This chapter explores four areas of DOE's current programs that have been the subject of Congressional, departmental, or public concern--DOE's efforts to develop new cleanup technologies, the schedule for cleanup activities dictated by interagency agreements, DOE's high overhead costs, and its large number of surplus facilities.

Investing to Develop Better Technologies

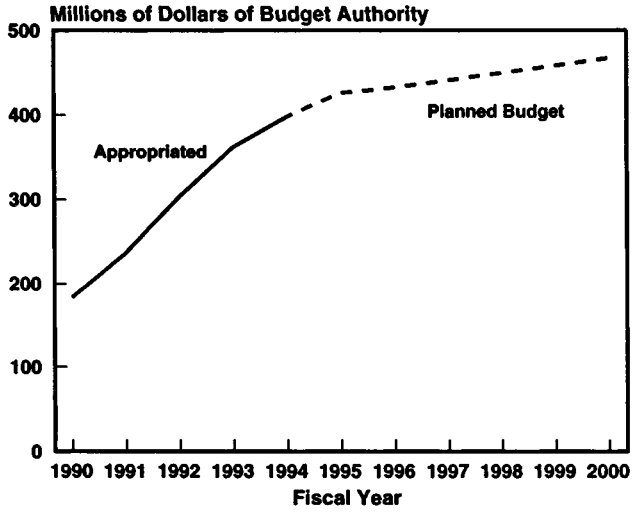
Cleaning up the Department of Energy's nuclear weapons complex could, by some estimates, take 30 years or more and cost hundreds of billions of dollars. To reduce both the cost and duration of the cleanup effort, DOE has initiated several programs to develop new technologies and processes for characterizing and cleaning up its sites. Based on research and analyses that have been completed, DOE feels that it can save potentially large amounts of money in the course of its cleanup by using new technologies. Yet the share of its budget that DOE devotes to developing new technologies is low compared with its own target and may be insufficient to fund development of some new cleanup techniques that could reduce costs.

DOE's Funding for Technology Development

DOE has already invested considerable amounts of money to develop new techniques for characterizing and cleaning up contaminated sites. Since fiscal year 1990, when it created a separate Office of Technology Development within the Environmental Restoration and Waste Management program, DOE has allotted about $1.5 billion to research in environmental technologies, including nearly $400 million in funds for fiscal year 1994.

Annual funding for DOE's Technology Development (TD) program will probably increase above the level appropriated for fiscal year 1994, though the growth may be slower than envisioned in previous five-year plans. DOE has asked for $426 million for fiscal year 1995 to fund technology development and plans to increase funding to $467 million by 2000 (see Figure 3). Previous budget plans, however, had included higher levels of funding for technology development through the end of this decade. The five-year plan submitted in August 1991 included two budget levels that would have increased that funding to about $500 million and about $540 million, respectively, by 1997. Indeed, the Administration's plans as of June 1993 also included levels of funding for technology development that were higher for the years after 1996 than those currently planned, reaching $500 million by 1999.

Figure 3.
Funding for Technology Development Within the Office of Environmental Restoration and Waste Management



SOURCE: Congressional Budget Office based on data from the Department of Energy.

Research and Development Projects. Within the budget for technology development, the research, development, demonstration, testing, and evaluation (RDDT&E) account commanded slightly more than half of TD funding in 1992 and 1993. This account includes funds for research on particular cleanup and assessment techniques in three broad areas--groundwater and soils cleanup, waste retrieval and processing, and pollution prevention. In each of these categories, DOE is conducting individual projects called integrated programs and integrated demonstrations to investigate specific techniques and methods (see Table 5).

Because detailed plans outlining how the funds for technology development will be spent for the next five years are not available, it is impossible to say specifically what the funding will buy. Based on previous spending and the request for funding for 1995, however, the two research and development areas most likely to receive the largest shares of the research funds are groundwater and soils cleanup, and waste retrieval and processing. Funding for these two categories accounts for more than two-thirds of the RDDT&E funding from 1992 through 1995 (see Table 6).

Other Activities in the Technology Development Program. Although more than half of the TD funds support activities in RDDT&E in the years from 1992 through 1995, the remaining funds--an average of 42 percent of total funding--go to other accounts that do not support research activities directly but that DOE feels are necessary to support other technical needs within the EM program (see Table 6).[1] One program provides laboratory and analytic support to characterize waste, water, and soil samples. Another program seeks to develop a scientific, technical, and educational system to ensure that an appropriately educated work force will be available in the future.

The Benefits of New Technologies

DOE feels that it has already benefited from its $1.5 billion investment in technology development. Indeed, it often points to two examples of the direct benefits of that effort. The first is a $15 million savings realized by capping the radioactive waste stored in a silo at the Fernald installation. (Capping involves covering the waste in the silo with bentonite to seal it and reduce the amount of radon released to the surrounding environment.) These savings were achieved by using a remotely controlled robot to measure accurately the three-dimensional contours of the solid waste in the silo. Using the three-dimensional map, DOE could then be very efficient in depositing the bentonite on top of the waste, resulting in minimum wastage and the most complete seal. The second example DOE often cites is the anticipated reduction in treatment time--from an estimated 200 years with old techniques to as little as six months--that could result from the introduction of new techniques for treating a gasoline spill at Lawrence Livermore National Laboratory.

1. The other accounts in the TD budget include Supporting Technologies and Infrastructure Programs, Technology Integration and Educational Development, Program Support, Program Direction, the Environmental and Molecular Sciences Laboratory, and the Hazardous Materials Training Center.

DOE expects to reap the bulk of the benefits of newly developed technologies in the future, however, when it begins to undertake remedial action in earnest. In some cases, new technologies may make possible the cleanup of contaminants for which technologies are not yet available. In addition, DOE has estimated that savings over the next 30 years, compared with the cost of using current technologies to complete the cleanup, could amount to almost $100 billion if technologies now under investigation can be applied successfully throughout the DOE complex.

The department's estimates of the savings that could result from introducing new technologies must be viewed with a certain amount of skepticism. First, DOE has not been able to show that it can estimate accurately the cost of cleaning up its facilities using today's technologies (see Chapter 2). That alone makes it difficult to calculate future savings. Second, many of those estimates are based on multiple assumptions. For example, to estimate the savings that might result from new remediation techniques that can be used with contaminants still in place, DOE calculates the cost to pump out con-

Table 5.
Individual Initiatives in DOE's Research, Development, Demonstration, Testing, and Evaluation Program, by Key Problem Area

Type of Initiative	Groundwater and Soils Cleanup	Waste Retrieval and Processing	Pollution Prevention
Integrated Demonstration	Volatile Organic Compounds in Nonarid Soils	Buried Waste	Waste Component Recycling,Treatment, and Disposal
	Volatile Organic Compounds in Arid Soils	Underground Storage Tank	Environmentally Conscious Manufacturing
	Plutonium in Soils	Decontamination and Decommissioning	
	Uranium in Soils		
	Mixed Waste Landfill		
Integrated Program	In Situ Remediation Technology	Efficient Separations	
	Characterization, Monitoring, and Sensor Technology	Mixed Waste	
Program	Dynamic Stripping	Supercritical Water Oxidation	DOE/U.S. Air Force Memorandum of Understanding
	Resource Recovery		
	Minimum Additive Waste Stabilization		

SOURCE: Congressional Budget Office using data from Clyde W. Frank, "Technology Development Is a Strategic Investment" (presentation by the Department of Energy to Congressional Budget Office staff, February 5, 1993).

taminated groundwater or dig up contaminated soil --costs that would not be incurred using new technologies. In order to arrive at savings that could be realized during the entire cleanup process, DOE must then apply the estimated savings per gallon of water or ton of soil to its estimate of the total number of gallons or tons that would need to be treated.

Calculations of savings based on these methods may represent upper bounds and should be viewed with caution. Rather than predictions of actual savings, these estimates might better be viewed as indications of the technologies that DOE sees as having the greatest potential. The following discussion examines some of DOE's technology development efforts, including both broadly applicable integrated programs and more narrowly focused integrated demonstrations.

Integrated Programs. Integrated programs (IPs) are DOE's technology development efforts with the broadest potential application. They are designed to explore basic technologies and techniques that can be applied to many cleanup projects throughout the

Table 6.
Summary of Funding for the Office of Technology Development, 1992-1995
(In millions of dollars of budget authority)

Activity	1992	1993	1994	1995[a]
Research, Development, Demonstration, Testing, and Evaluation				
Groundwater and soils cleanup	54	77	76	72
Waste retrieval and processing	54	69	104	99
Pollution prevention	6	3	1	1
Innovation and support	55	34	49	61
Other	0	8	23	20
Subtotal	169	191	253	253
Supporting Technologies and Infrastructure Programs[b]	30	45	57	75
Technology Integration and Educational Development[c]	37	38	36	29
Program Support	35	44	37	38
Program Direction	15	16	15	17
Environmental and Molecular Sciences Laboratory	17	28	0	0
Hazardous Materials Training Center	0	0	0	14
Total	303	362	398	426

SOURCE: Congressional Budget Office using data from Department of Energy, Office of Technology Development, *FY 1993 Program Summary* (February 1994); and Department of Energy, *FY 1995 Congressional Budget Request*, vol. 5, *Environmental Restoration and Waste Management* (February 1994).

a. Request.

b. Includes programs for liaison and communications, analytical laboratory management, robotics, decision support, and emergency management.

c. Includes programs for educational development, technology integration, and international technology exchange.

DOE complex and thus have the potential to generate large savings.[2]

One IP is investigating ways to separate waste efficiently from its surrounding medium, be it groundwater or soil. Since, according to DOE, only 0.5 percent of its more than 3 million cubic meters of cataloged waste actually consists of radionuclides, separating that portion from the noncontaminated portion will greatly reduce the volume of waste requiring disposal. DOE is investigating several processes that are available commercially and in use elsewhere to separate radioactive waste from its substrate. These processes include leaching and washing contaminated soil and incinerating combustibles in waste that contains both radioactive components and solvents.

Another IP is developing techniques for in situ remediation, a process that also can be used to treat waste in either water or soil. Methods being developed would eliminate the need to extract the contaminant from the soil or groundwater in order to treat it, thus avoiding the expense and effort associated with pumping out groundwater or digging up soil. Examples of in situ remediation include the introduction of microbes into the soil to break down contaminants and electrothermal means of turning contaminated soil into glass so that the contamination cannot spread.

DOE's estimates of potential savings from these two integrated programs are based on comparisons between the costs of operations using today's technology and costs that would result from doing things differently using new technologies. DOE estimates that in situ remediation could save $54 billion in cleanup costs throughout the complex compared with current methods. Similarly, the IP designed to develop efficient ways to separate radioactive waste from soil and mixed-waste solutions could save $40 billion according to DOE estimates; these savings would result from the reduction in projected volumes of soil and mixed waste requiring disposal. Thus, the technology developed in these two IPs together, if applied widely, could save more than $90 billion during the cleanup.

Of course, DOE has not yet proved that the technologies under investigation in its integrated programs can actually yield the results it anticipates or that the techniques can be applied at all sites. Nor is it possible to know precisely how much it will cost to develop the technologies envisioned in the IPs. Since 1990, DOE has allotted about $275 million to develop remediation techniques for contaminated soil and groundwater; its annual expenditures in this area have been on the order of $60 million to $80 million. Even if a 10-year investment at this level is required to develop appropriate technologies and even if DOE has overestimated its savings by an order of magnitude, savings would still greatly exceed the cost to develop the technology. DOE therefore is pursuing a number of technology projects that appear to show promise--that is, projects that will yield net savings when the present value of their cost is subtracted from the present value of the savings and other benefits that they make possible.

Integrated Demonstrations. Integrated demonstrations (IDs) are technology development efforts that are more narrowly focused than integrated programs. They are designed to apply and prove the feasibility of all technologies needed to conduct a cleanup from beginning to end--that is, from characterization to postclosure monitoring of a particular site.[3] DOE is currently conducting at least 10 demonstrations.

At the Fernald installation, for example, an ID is investigating the application of a technique for separating wastes, developed in the integrated program discussed above, to treat the contaminated soil. DOE estimates that this technique--referred to as leaching--would reduce by 80 percent the volume of waste requiring disposal. Including the costs of treatment, savings of 36 percent in the cost to clean

2. These programs are in some ways analogous to the basic technology programs within the Department of Defense, such as stealth research, that can, in theory, be applied to many weapons programs.

3. Again using an analogy with the Department of Defense's research programs, integrated demonstrations are similar to programs that develop specific weapons. Thus, if stealth research is analogous to an integrated program investigating in situ remediation, then the B-2 bomber development program would be an appropriate analogy for the integrated demonstration at Hanford using in situ bioremediation to clean up groundwater contaminated with nitrates and organic matter.

up Fernald would result. Using new excavation techniques rather than the current method of bulldozing could again, according to DOE estimates, reduce the amount of soil to be treated by almost two-thirds, yielding additional savings. Using both of these techniques could result in total estimated savings of 80 percent in the cost to clean up Fernald, compared with the current technology of excavation followed by disposal off-site.

Other integrated demonstrations also deal with cleaning up soils (for example, using a "rotomill" machine that monitors soil as it is excavated and removes less soil requiring subsequent treatment) or with cleaning up groundwater (for example, using an air-stripping method that pumps compressed air into an aquifer to flush out some of the contaminants). Still others deal with retrieving and processing waste: some seek better, cheaper means of identifying buried waste; others seek to reduce the cost of stabilizing and storing highly radioactive wastes. Appendix C discusses DOE's integrated demonstrations in more detail and presents the department's estimates of potential savings assuming the demonstrations are successful.

DOE estimates that the technologies under investigation in its integrated demonstrations could save a total of $12 billion, much less than the more than $90 billion in savings it ascribes to just two integrated programs. The savings associated with the integrated demonstrations are smaller than those of the integrated programs because IDs are more narrowly focused and their application is not so universal as technologies resulting from IPs. The estimates of savings associated with technologies being investigated in demonstrations might also be more realistic than those DOE associated with its integrated programs, because the demonstrations are tied to specific problems at specific sites and so have a closer association with actual experience than with predicted savings. Furthermore, DOE has conducted extensive cost-effectiveness analyses of some of the specific techniques under investigation in its demonstrations.[4] Thus, although these estimates also must be viewed with caution, they suggest a potential for savings with some basis in reality.

Possible Increases in Funding for Technology Development

The Department of Energy is spending a significant, but still relatively small, portion of its budget on the technology development programs designed to help the department realize these savings. The level of funding for technology development from 1990 through 1994 represented an average of 7 percent of the annual EM budget--roughly the same average share reflected in the Administration's latest plan, for 1995 through 2000.[5]

Compared with other major cleanup programs, DOE devotes a substantial share of its cleanup (EM) budget to technology development. For example, it exceeds the share of the Superfund budget that the Environmental Protection Agency spends to develop cleanup technologies. EPA administers Superfund, a federal program that provides funds for cleaning up pollution in the private sector and then attempts to recoup all or part of the cleanup cost from the responsible private parties. EPA allotted 4 percent of its total cleanup funds from 1988 through 1993 to research and development compared with 7 percent for DOE. In addition, DOE's absolute level of funding for technology development, which was almost $400 million in 1994, is appreciably larger than that of EPA's Superfund. In fact, DOE's 1992 allocation of $303 million is more than 4.5 times Superfund's investment of about $64 million in that year.

The share of funding that DOE allocates to technology development is, however, significantly below that of other government agencies engaged in complex technical projects. The Department of Defense invested an average of 13 percent of its total funding from 1988 through 1993 in research and development of new weapons. DOE itself, within

4. Joyce D. Schroeder, Steven R. Booth, and Linda K. Trocki, *Cost Effectiveness of the Site Characterization and Analysis Penetrometer System* (Los Alamos, N.M.: Los Alamos National Laboratory, December 1991).

5. In contrast to the discussions of the EM budget in Chapter 2, the total EM budget used as a basis for determining TD's share includes funding for the Uranium Enrichment Decontamination and Decommissioning program.

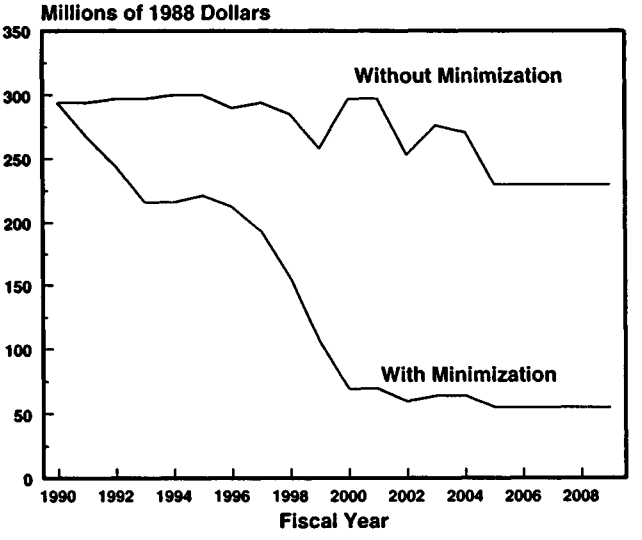
its weapons-related programs, invested an average of 24 percent of the funds in research, development, and testing during the same period. The weapons projects of both DoD and DOE are, of course, very different undertakings from the DOE cleanup program. Nonetheless, the difference in shares devoted to technology development is striking.

The planned 7 percent of DOE's cleanup funding earmarked for technology development is also well below DOE's own goal and the goal set by the Congress. DOE's first five-year plan, submitted in 1989, included a goal of devoting 10 percent of EM funding to developing new technologies for cleanup.[6] The Congress has also stipulated that at least 10 percent of EM funding for 1994 be devoted to that effort.[7] Achieving that goal would cost an additional $200 million to $250 million annually, from 1995 through 2000, based on the Administration's plan for spending levels in the out-years.

Availability of Suitable Projects. If the Congress is going to allocate additional funds for technology development, that money should be devoted only to projects that will ultimately result in significant net savings and other benefits. The Congressional Budget Office cannot evaluate candidate projects, but some evidence suggests that a number of projects would meet that test.

Various sources have identified several areas in which new technology could produce large savings. Representatives of DOE's Office of Technology Development have identified the contamination of soil by heavy metals as an area that is currently not being investigated for lack of funds.[8] The Department of Defense, which often works in partnership with DOE to develop cleanup technologies, has identified many projects it deems worthwhile but cannot fund at this time. The Office of Technology Assessment (OTA) and representatives of the Natural Resources Defense Council have pointed out the lack of technology for removing dense organic compounds that are not soluble in water from soil or groundwater.[9] DOE's latest detailed accounting of how it plans to spend its technology development funds does not specify any planned investment in technology to remediate such contaminants, but new approaches in this area may offer benefits that exceed the cost to develop them.

Figure 4.
Cost of Treating, Storing, and Disposing of Low-Level and Transuranic Waste, With and Without Minimization of Waste



SOURCE: Congressional Budget Office based on data from Department of Energy, *Environmental Restoration and Waste Management Five-Year Plan, Fiscal Years 1992-1996* (June 1990).

OTA identified waste minimization as another area deserving attention. Research in waste minimization or pollution prevention attempts to find ways to change manufacturing processes in DOE's plants so that they generate less waste requiring treatment or disposal. Reducing the volume of waste saves the cost of treating or disposing of it in the future, potentially saving billions of dollars (see Figure 4). During its deliberations on the fiscal year 1993 bud-

6. Department of Energy, *Environmental Restoration and Waste Management Five-Year Plan* (1989), p. 30.

7. House Committee on Armed Services, *National Defense Authorization Act for Fiscal Year 1993*, Report 102-527 (May 19, 1992), p. 342.

8. Personal communication from the Department of Energy, February 1993.

9. Office of Technology Assessment, *Complex Cleanup* (February 1991), p. 177; and statement of the Natural Resources Defense Council before the Western Governors Association Waste Task Force, Denver, Colo., October 7, 1992, p. 2.

get, the Congress also encouraged increased emphasis on research into ways to minimize waste.[10] DOE's funds to investigate such technologies, however, were reduced in 1993 by 50 percent from the previous year's level and have been further reduced to $1 million annually for 1994 and 1995.

Possible New Role for National Laboratories. Assuming that a number of projects are worthwhile, DOE would need to have enough trained personnel available to warrant an additional investment of $200 million to $250 million annually. That should not be a problem for two reasons. First, DOE's investment in developing weapons technology is decreasing from $1.7 billion in 1994 to $1.6 billion in 1995, and this reduction in effort might make personnel available for projects in other areas. Second, DOE has been discussing redirecting some of the more than 20,000 people employed at its labs from weapons research to research on environmental cleanup.[11] Thus, there should be sufficient personnel to perform the research.

Despite the availability of the labs and associated personnel for research in environmental cleanup, questions arise concerning the suitability of using the labs for this purpose. Transition from research in nuclear weapons design to research in cleanup technologies may not be all that easy. Nevertheless, the national labs are a potential source of scientists with experience in dealing with nuclear materials.

Possible Role for Other Agencies. Finally, DOE need not be the sole recipient of any additional funds made available for research into ways to deal more efficiently with cleanup problems. Many federal agencies are involved in remediation efforts, including the Environmental Protection Agency and the Department of Defense. Some cleanup tasks are unique to DOE, but many are common to all three agencies. Thus, a more productive approach might be to encourage collaboration among the three agencies, something the Congress promoted when it established the Strategic Environmental Research Development program in 1993 to coordinate environmental research and development efforts among federal agencies. Another approach would be to provide additional funds for technology development efforts at EPA or DoD rather than to DOE alone. A discussion of changes in budgets at EPA and DoD is, however, beyond the scope of this study.

Time Sensitivity of Investing in New Technology

If added investments are to be made in technology development, DOE argues that they should be made soon. The time available to develop promising new technologies that could reduce the cost of DOE's cleanup is relatively short if the department is to fulfill the terms of its agreements with the states and the Environmental Protection Agency. Recent statements by DOE indicate that if it is to realize significant returns on its investment in technology development and still meet its scheduled cleanup obligations, some new techniques must be ready for application by the late 1990s.[12]

This deadline is a consequence of DOE's agreements with various states and EPA that include timetables for initiating and completing cleanup tasks at various sites. An important milestone in the cleanup process is the filing of the records of decision for cleaning up specific sites. These documents outline how the cleanup will be accomplished and what technology will be used. The optimal time to develop and prove productive new technologies is therefore before the records of decision have been filed.

Based on the filing dates of records of decision stipulated in its agreements with the states and EPA, DOE has identified windows of opportunity for developing promising technologies in six areas in which it is conducting integrated demonstrations (see Table 7). Three windows--those associated

10. Senate Committee on Armed Services, *National Defense Authorization Act for Fiscal Year 1993,* Report 102-352 (July 31, 1992), p. 352.

11. "Environmental Cleanup Role Considered for A-Weapons Lab," *The Washington Post,* March 9, 1993, p. A10.

12. Statement of Paul D. Grimm, then Acting Assistant Secretary of Energy for Environmental Restoration and Waste Management, before the Subcommittee on Energy and Water Development of the House Committee on Appropriations, April 26, 1993, p. 47.

Table 7.
Schedule for Records of Decision in Selected Technology Areas

Activity	Records of Decision Completed			DOE Window[a]
	First	Half	Last	
Volatile Organic Compounds in Arid Soil	1990	1995	2005	1991
Buried Waste	1995	1999	2010	1992
Volatile Organic Compounds in Nonarid Soil	1991	1999	2010	1992
Uranium in Soil	1992	1999	2013	1997
Plutonium in Soil	1992	2000	2007	1998
Underground Storage Tanks	1990	2008	2025	1998

SOURCE: Congressional Budget Office based on Clyde W. Frank, "Technology Development Is a Strategic Investment" (presentation by the Department of Energy to Congressional Budget Office staff, February 5, 1993).

a. Optimum time by which introducing a new technology for cleanup will have the greatest impact in terms of reducing the costs of remediation.

with volatile organic compounds in arid soil and in nonarid soil, and with buried waste--were identified by DOE as opening in 1991 or 1992. Those dates have already passed, and DOE has stated that for every year that research is delayed, the benefits that can be reaped from the new technologies diminish. According to DOE, the best time to introduce improved technologies in the remaining three areas--uranium in soil, plutonium in soil, and underground storage tanks--is by 1997 or 1998.

Improving the Accountability and Management of DOE's Technology Development Program

If additional funds are to be appropriated for technology development, the Congress must have confidence that the funds will be spent wisely. But DOE's Technology Development program has been criticized for poor management. In an April 1992 report, the General Accounting Office (GAO) identified several shortcomings in that program that it felt hampered an efficient use of funds devoted to research.[13] In particular, GAO criticized DOE's lack of performance goals for its development programs. Furthermore, GAO pointed out that DOE has not estimated likely costs for its development projects or established schedules for program milestones or completion. In conclusion, GAO stated that the development of new technologies was important for DOE to accomplish its goals but felt that the department lacked the management tools to conduct an efficient program.

The General Accounting Office and others have made several recommendations for ways in which DOE could improve the management of its Technology Development program. To correct the problems of overall vagueness and lack of accountability, GAO suggested that DOE establish measurable performance goals, timetables, and key decision points for each technology development project. In its report, GAO noted that effective program management requires that estimates of the overall cost of each project be made early and updated and validated as the project matures. GAO felt that establishing a structure for each project, with cost and

13. General Accounting Office, *Cleanup Technology: Better Management for DOE's Technology Development Program*, GAO/RCED-92-145 (April 10, 1992).

performance goals and prescheduled evaluation points, would focus DOE's technology development efforts and help to identify both projects that succeed and those that fail.

Detailed Budget Reporting. As a first step toward making the Technology Development program more accountable, the Congress could reiterate its request that DOE provide more detailed information on how the department plans to spend its annual allocation of funds for research into new cleanup methods. The EM program has provided this information to the public and the Congress in the past--in its 1991 annual report to the Congress and its August 1991 five-year plan.[14]

The Congress, however, apparently has not been given detailed data on spending for individual research projects since 1991, and certainly not on a routine annual basis. DOE has failed to provide this information even though the Congress established the requirement for such a report in the National Defense Authorization Act for Fiscal Years 1990-1991. The report was to detail DOE's efforts to develop new techniques designed to reduce environmental hazards and contamination resulting from defense waste and to expedite environmental restoration efforts at inactive waste disposal sites. The Congress has obviously long recognized the need for additional information from DOE in order to perform its oversight function properly. Given the numerous concerns expressed by the Congress in reviewing DOE's cleanup budget, it may be time for the Congress to ask again for additional data to support DOE's request for research and development funds.

A New Management System. To provide structure, direction, and accountability for DOE's development programs, the Congress could also encourage or require the department to create an evaluation and reporting system for major projects that is similar to the one employed by the Department of Defense for its major weapon systems. Under the scheme used at DoD, all systems requiring more than $200 million to develop, or $1 billion to buy--both figures in 1980 dollars--are subject to internal review at four specific points in their maturation process: initiation, concept validation, initiation of full-scale development, and before entering production.[15] (See Appendix D for a detailed description of DoD's weapons acquisition process.) The status of each of these major systems is summarized annually in Selected Acquisition Reports, which DoD then submits to the Congress.

DOE and the Congress could establish a similar system for major projects in the cleanup arena, particularly those that require the development of new technologies to enable their completion. The system would cover an entire cleanup project--from definition of the site or operational unit, development of new technologies, and characterization and assessment, through completion of remedial action. This system would be particularly applicable to the narrowly focused integrated demonstrations, each of which would be only one part of an overall cleanup effort.

Including the development of technologies as part of a specific task to be completed, such as cleanup of the tanks at Hanford, would focus the research efforts and put them on rigorous schedules. Indeed, a report prepared for DOE in January 1993 on technology needs recommended that milestones in technology development projects be linked to schedule requirements of specific problems in environmental restoration.[16]

Possible Decision Scheme. To set up such a reporting and evaluation system, DOE would first need to establish milestones for the major decision points. For its cleanup activities, DOE could use four milestones:

1. establishing a cleanup project,
2. justifying the need for a new technology and initiating the applied research and development work,

14. Department of Energy, Office of Environmental Restoration and Waste Management, Office of Technology Development, *Annual Report to Congress, Fiscal Year 1991*; and Department of Energy, *Environmental Restoration and Waste Management Five-Year Plan, Fiscal Years 1993-1997* (August 1991).

15. These thresholds correspond to about $350 million in development funds and about $1.8 billion in procurement funds when converted to 1995 dollars.

16. Chem-Nuclear Geotech, Inc., *Technology Needs Crosswalk Report*, DOE/ID/12584-117, 1st ed. (prepared for the Department of Energy, January 1993), p. xv.

3. beginning assessment and characterization, and

4. filing a record of decision and beginning remedial action.

In justifying the need for new technologies at the second milestone, DOE would need to establish criteria against which to judge the new methods. In particular, new techniques should save money or time compared with current techniques. To focus resources on the most promising technologies, estimated savings in cost or time resulting from use of the new technology should exceed thresholds established by DOE. The department would also need to establish and approve preliminary schedules and cost estimates at the second milestone.

Reaching the third milestone--initiation of assessment and characterization--would depend on completing the research and development efforts for projects that require new techniques. For example, cleaning up the highly radioactive waste in the Hanford tanks requires new assessment techniques that should be developed and proved before characterization of the site begins. Furthermore, it is at the third milestone that DOE should establish final cost and schedule baselines, so most of the development work should be completed before these baselines are set.

The fourth and final milestone would involve filing the record of decision and selecting cleanup techniques. At this point, the characterization of the problem and development of cleanup techniques should be essentially completed.

DOE would need to establish a panel of senior managers within the EM program to approve transition of a project from one milestone to the next in the scheme outlined above. Projects making insufficient progress, demonstrating substantial cost overruns, or meeting unexpected technical problems would be restructured before proceeding. In this way, problems could be identified before they became too costly.

Reporting on major projects using a milestone format would also permit the Congress to judge their progress. For example, at some point (probably at the third milestone) estimates of the cost required to complete a project should be available. Once such baseline estimates are in place, the Congress can compare subsequent cost estimates with the baseline and focus on projects whose costs are growing.

The Congress has already mandated that parts of this management system be established. In its bill authorizing appropriations for national security functions for 1994, the Congress directed DOE to submit reports that provide schedules for and the estimated cost to complete many of the projects within the EM program. The initial reports--or baselines--for environmental restoration activities are due by March 1, 1995; similar reports for all activities for waste management, transition of operational facilities to safe shutdown status, and research and development activities are due by June 1, 1995.[17] The Congress also directed DOE to submit, following the initial report, annual status and variance reports that would inform the Congress of the amount of funds expended for any project during the prior fiscal year, as well as any growth in costs or schedule slippages with respect to the initial report.

These Baseline Environmental Management Reports, as they are called in the authorization bill, would be similar to the reporting requirements envisioned in the decision scheme described above. They would not, however, require DOE to establish an internal review system, nor would they integrate research and development efforts with cleanup tasks. But they attempt to address the same problem as the postulated management scheme--that is, the lack of justification, continuity, and visibility within the EM program of individual projects designed to develop new and beneficial technologies for cleanup.

Not all projects in the EM program need to be subject to this management system. Some TD projects are not tied to a specific cleanup problem but instead represent efforts to develop techniques

17. The Department of Energy has made a partial response to the request in the authorization act with the information contained in its report *Environmental Management 1994* (February 1994). That report contains some data on funding, milestones, and performance by installation. The report does not, however, fulfill DOE's obligation to submit the Baseline Environmental Management Reports, as specified in the authorization act.

that are applicable to many environmental programs. The integrated programs, which represented about 10 percent of TD funds in 1991, fit this description and are more analogous to DoD's basic research programs that are not tied to specific weapons programs. Some or all of those programs might therefore be excluded from this management system, as might small projects.

DOE and the Congress will need to set thresholds for cleanup tasks so that only those of sufficient total or annual cost are subject to enhanced scrutiny. DoD's experience in this area might be used as an example. Acquisition programs that are subject to extensive reporting requirements represented historically about half of DoD's annual procurement funding and 15 percent of the research and development budget. By comparison, all of DOE's integrated demonstrations together received about 20 percent of EM's total funds for technology development in 1991.

A scheme similar to DoD's may not be the final answer for DOE's EM program. But it does represent a system for establishing goals, schedules, and specific decision points that is currently lacking in DOE's Technology Development program. By setting up a mechanism for keeping the Congress abreast of the progress and problems that arise in its cleanup program, DOE could help to answer charges of poor management and lack of accountability within that program. Addressing these concerns would be particularly important if the Congress decided to increase funding for technology development in an effort to reduce the total cost and duration of the cleanup.

Delaying Cleanup Until New Technologies Are Available

Even with additional funding, developing new technologies that expedite the cleanup effort or reduce its costs will not always be possible. Some research and evaluation efforts take a certain amount of time to come to fruition, and some techniques must be evaluated over fixed amounts of time and so cannot be hurried. Thus, in certain cases, no amount of added resources will yield earlier results.

In such cases, a weighing of costs and benefits--the method discussed in Chapter 3 as a means for setting priorities among cleanup tasks--may favor renegotiating the agreements DOE has with the states. Otherwise, these agreements will force DOE to undertake difficult projects on a stringent schedule rather than devote additional time and resources to accelerate research efforts. If all parties to an agreement concede that no promising technology is likely to be available before the deadline to commence cleanup, they could arrange an extension, assuming, of course, that the problem in question poses no immediate threat to human health or the environment. By renegotiating these agreements, DOE could avoid the expense of either additional research and development work or inefficient cleanup efforts.

Budgetary Effects of Delay

The Environmental Restoration (ER) program within the Office of Environmental Restoration and Waste Management is responsible for the actual cleanup of DOE's inactive sites. ER's activities include identifying and measuring contamination at DOE facilities, taking subsequent remedial action, and continuing to monitor a site after cleanup has been completed. In DOE's request for funds for 1995, ER's share was $1.8 billion, representing 29 percent of the total EM request. According to the Administration's plan, annual funding for the ER program would grow to $2 billion by 2000.

Delaying projects that are difficult to execute with today's technology would lessen the need for ER funds during the next six years. If delays of technically difficult projects were judged appropriate, how many projects might be affected? And how would such delays affect the budget?

Many of the projects that DOE is undertaking in its ER program are difficult or expensive to complete with today's technologies. According to the Office of Technology Assessment, cleaning up groundwater and soil may be extremely expensive or require a long time even if contaminants can be removed with current technology.[18] Almost all of

18. Office of Technology Assessment, *Complex Cleanup.*

DOE's major installations suffer from some sort of groundwater contamination. And cleaning up buildings contaminated with highly radioactive materials, referred to as decontamination and decommissioning, may present technical difficulties because current methods are costly, inefficient, and produce large quantities of waste material requiring disposal. Furthermore, DOE has already identified 500 surplus facilities that must be cleaned up before they can be demolished or released for other uses, and expects to add at least 1,000 more to its list. The challenge in decontamination and decommissioning is to develop methods that minimize the exposure of the workers to radiation and hold down costs.

To determine how many of DOE's projects would be difficult to perform with today's technology, the Congressional Budget Office (CBO) examined almost 1,000 activity data sheets in the Environmental Restoration program in the August 1991 five-year plan.[19] CBO designated the following types of projects in that plan as "technically difficult":

- characterizing very large land areas or highly radioactive waste in tanks,
- cleaning up contaminated groundwater or soil, and
- decontaminating and decommissioning buildings that contain radioactive waste.

That designation reflects the fact that DOE is conducting projects to develop new techniques in those areas. In the process, CBO also determined the portion of DOE funds that is slated for technically difficult projects.

Cost of Technically Difficult Projects. CBO's examination of DOE's August 1991 five-year plan identified 134 projects that were technically difficult. Results for the two budget levels included in that plan were similar; the share of ER funds devoted to technically difficult projects during the five-year period rose from about one-quarter in 1993 to about one-third by 1997. Total funding for these projects for the 1993-1997 period accounted in both budget levels for an average of nearly 30 percent of funding for the Environmental Restoration program. Such consistent results for both budget levels suggest that DOE would allocate the same proportion of ER funds planned for the 1995-2000 period to technically difficult cleanups. Based on the assumption that 30 percent of ER funding is allotted to such projects, DOE could spend up to $3.4 billion from 1995 through 2000 on characterizations and remediations that are difficult to conduct with today's technologies.

Illustrative Budgetary Effects. Delaying the execution of these projects until newer and better ways of carrying them out have been developed could reduce the funds needed for the Environmental Restoration program over the next six years. It is impossible for CBO to determine which of the 134 technically difficult projects should be pursued using today's technology and which should be delayed. To illustrate the budgetary effects, however, CBO assumed that half of these projects were delayed. In that case, funding for environmental restoration would be reduced by 15 percent over the next six years. Annual savings associated with such a slowdown would increase from almost $270 million in 1995 to almost $300 million in 2000. These savings would exceed the additional amount needed to increase funds for technology development from the current 7 percent of the Office of Environmental Restoration and Waste Management's total budget to 10 percent, should that be judged a desirable option.

Reduced Funding Would Affect Agreements

Any delay in the cleanup process would cause problems. DOE feels compelled to move ahead, even with technically difficult projects, because it has entered into agreements with various states and the Environmental Protection Agency that dictate the schedule for cleaning up sites within the complex. Some schedules call for beginning the cleanup process soon without regard to the availability of technologies that would facilitate its execution. Indeed,

19. None of DOE's five-year plans submitted since August 1991 include a detailed breakdown of ER funding planned for five years by individual cleanup project. Therefore, CBO had to rely on the five-year plan submitted in August 1991 for its analysis.

for projects involving many of the types of cleanup tasks for which DOE is attempting to develop new technologies, the first record of decision, which specifies how the cleanup is to be accomplished, has already been submitted (see Table 7). For projects involving the cleanup of volatile organic compounds in arid soils, for example, half of the records of decision are due by 1995. DOE therefore plans to proceed apace with many efforts in the next five years using current technologies to clean up some sites as specified in various agreements, even though that might not be the best or cheapest way to conduct the cleanup in the long run.

DOE is also required by law to request funding for its programs that is sufficient to meet the milestones included in the agreements to which it is a party. That would apply primarily to funding for the Environmental Restoration program, since most of the deadlines stipulated in agreements pertain to the beginning and completion of feasibility studies, assessments, and remedial actions. For this reason, officials at DOE feel that they have little discretion to delay or terminate ER projects. Failure to meet the terms of the agreements may result in the levy of fines by the states against DOE, something that the state of Ohio has already done.

Not only is DOE bound by many triparty agreements to timetables that dictate the start and finish of specific cleanup tasks, but it is also legally responsible for preventing the spread of contamination from its facilities to the surrounding environment. Thus, in some instances, DOE feels it must contain its waste and prevent it from entering water sources, either above or below ground, even though current techniques for containing such wastes are expensive.

Risks of Delay. A decision to delay some of its projects would mean that DOE would have to renegotiate its agreements with various states and EPA. If renegotiations were not successful and DOE breached existing agreements, it could face both financial and political costs. States could levy fines on the federal government that could, cumulatively, be substantial. Indeed, an Administration official testified in 1991 that subjecting federal facilities to the same environmental regulations as the private sector could create an atmosphere that would cause the federal government to commit its limited cleanup resources at the courthouse rather than in the field.[20] The state of Ohio levied a $750,000 fine against DOE in 1989, and DOE could face similar fines if it does not comply with state agreements or renegotiate them.

Benefits of Delay. Nevertheless, fines of this magnitude are small compared with the annual savings of approximately $300 million that DOE could realize by delaying some cleanup projects. Moreover, many of the concerned parties are becoming increasingly aware that some of the agreements are untenable. Many agreements were signed in the late 1980s and early 1990s before DOE knew much about the scope of its environmental problems. In the past few years, DOE and its contractors have conducted numerous exploratory samplings and investigations and now have a better idea of the magnitude of the problem facing them. In light of this new information, some of the goals and deadlines established in the agreements may be unrealistic.

Delaying some cleanup projects could also buy DOE time to gather the information needed to make informed decisions concerning the management and direction of its cleanup program. Recent statements by Administration officials indicate their awareness that DOE needs more information to manage its cleanup program efficiently.[21] The types of information needed include data concerning health hazards posed by the pollutants at its sites and the ultimate use of its surplus land and facilities.

Need to Reevaluate Priorities. Perhaps for these reasons, several parties, including Members of Congress and DOE officials, have suggested that DOE reevaluate its priorities, which could ultimately result in the need to renegotiate DOE's agreements.[22]

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20. Statement of Thomas E. Baca, Deputy Assistant Secretary of Defense for the Environment, before the Environmental Restoration Panel and Nuclear Facilities Panel of the House Committee on Armed Services, June 6, 1991.

21. "OMB Provides No Figures on Environmental Cleanup," *Congress Daily*, September 21, 1993, p. 4.

22. Senator J. Bennett Johnston raised this issue during a hearing held by the Senate Committee on Energy and Natural Resources on the Department of Energy's cleanup budget on July 29, 1993. It is also mentioned in U.S. House of Representatives, *Making Appro-*

The Assistant Secretary for EM, Thomas Grumbly, has testified that in some cases, the department has learned through site investigations that the problems uncovered are larger than anticipated or have no effective long-term technical solutions.[23] He asserted that in these cases, the best course of action may be to stabilize the site and invest in appropriate research to solve the problem more effectively in the long run. He emphasized that the department is committed to complying with its agreements. But he held open the door to conducting the cleanup in the most effective way possible through mutual renegotiation of those agreements.

Events at the Hanford installation provide an example of such a renegotiation. The Department of Energy, the Environmental Protection Agency, and the Washington State Department of Ecology recently updated and revised the original agreement they had signed in 1989. Under the renegotiated agreement, the date for beginning the cleanup of the highly radioactive waste has been delayed 10 years, and priorities for various cleanup tasks have been reordered. In particular, DOE has agreed to give higher priority to the treatment of low-level waste and to convert the waste into a form that is more durable and therefore poses less risk over the long run.

In their conference report on appropriations for 1994, the appropriations committees provided funds to implement the revised accord at Hanford and encouraged the department to review all of its compliance agreements.[24] The Congress acknowledged that DOE needs to develop a mechanism for establishing priorities among its cleanup tasks. To that end, the Congress directed DOE to submit to the appropriations committees a report evaluating the risks to public health and safety posed by conditions at the complex's sites that are addressed by requirements in the compliance agreements.

Problems Associated with Targeting Specific Cleanup Tasks for Delay

Both the Administration and Members of Congress have stated that the current regulatory environment, and particularly the large number of compliance agreements to which DOE is party, limit DOE's ability to carry out its cleanup program in the most effective way possible. The agreements create a set of priorities and demands that may be at odds with the limitations presented by technological and fiscal realities.

The Keystone process described earlier in this study was developed in recognition of these constraints and is intended to provide a framework for dealing with fiscal limitations. The Keystone report, which was prepared by a committee composed of representatives from the environmental community, recommended an approach for addressing funding shortfalls caused by Congressional appropriations that fell below DOE's request. If the approach recommended by the Keystone group is adopted--and it has been endorsed by DOE--then reducing funding for difficult projects may not have the desired effect of delaying them.

The Keystone group recommended that when the Congress appropriates less than what DOE requested for its environmental restoration activities, the funding shortfall be distributed equally among all sites. Thus, if the Congress reduced ER funding by 15 percent, as discussed in the section on illustrative budgetary effects, then each of DOE's 15 major installations would receive 15 percent less funding for ER activities. The committee further recommended that if DOE could absorb funding cuts without affecting the scope or schedule of established, legally binding agreements, then it could do so without consulting the regulators, affected tribes, and other stakeholders. But if DOE could not meet its obligations after absorbing a significant cut, the group strongly recommended that the states and EPA renegotiate DOE's obligations and milestones rather than take punitive actions.

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priations for Energy and Water Development for the Fiscal Year Ending September 30, 1994, and for Other Purposes, Conference Report 103-305, to accompany H.R. 2445 (October 22, 1993); and Senate Committee on Armed Services, *National Defense Authorization Act for Fiscal Year 1994*, Report 103-112 (July 27, 1993), pp. 239-240.

23. Statement of Thomas P. Grumbly before the Subcommittee on Energy of the House Committee on Science, Space, and Technology, July 15, 1993.

24. See U.S. House of Representatives, *Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1994.*