Chapter One

Overview of DOE's Environmental Problems

The Department of Energy (DOE) presides over a vast complex of facilities with massive environmental problems. These problems have accumulated over the past 50 years as a by-product of producing nuclear weapons. From the inception of the Manhattan Project in 1942 through the 1980s, DOE and its predecessor agencies focused on developing, producing, and testing nuclear weapons. Protecting environmental safety and health took a back seat to that primary mission. In recent years, however, concerns about environmental contamination have mounted. At the same time, the end of the Cold War has diminished the perceived urgency of maintaining ambitious production goals. Together these factors have led to a shift in emphasis from production to environmental cleanup.

The nuclear weapons complex consists of 15 major facilities and a dozen or so smaller facilities at which production, research, and testing have occurred over the past five decades. In addition, DOE is responsible for environmental cleanup at thousands of sites formerly used in the weapons program and sites where uranium was processed. Altogether DOE must contend with more than 100 million gallons of highly radioactive waste, 66 million gallons of waste contaminated with plutonium, and larger volumes of low-level radioactive waste. It also must deal with huge volumes of other toxic materials, including heavy metals, chemicals used as solvents, acids, and other materials that are difficult and costly to clean up.[1]

Six of DOE's 15 major facilities--Hanford, Savannah River, Oak Ridge, Fernald, Idaho National Engineering Laboratory, and Rocky Flats--account for more than 60 percent of the budget of DOE's environmental cleanup program. Hanford alone is responsible for nearly a quarter of the budget. The major facilities are shown on the map in Figure 1 and are profiled in Appendix A.

Although all of the weapons facilities present cleanup challenges, they differ in ways that may affect goals, methods, and timetables of cleanup efforts. Some facilities are near population centers where releases of toxic materials might pose imminent hazards to public health; other facilities are remote and present less near-term risk. Yet the latter may still impose long-term effects on human health and the environment. Soil and drainage conditions vary, leading to differences in how toxic releases might migrate into the groundwater and ultimately to supplies of drinking water. All of these factors affect both the costs and benefits of cleanup.

The potential cost to the federal government of cleaning up the nuclear weapons production facilities is large, and the cost estimates keep rising. No one knows what the ultimate cost will be, in part because the dimensions of the problem are still not clear. One estimate widely cited is $160 billion over the next 30 years--assuming technological breakthroughs to reduce the costs of dealing with radioactive wastes. Recently, however, the head of the cleanup program has referred to that effort as "our trillion-dollar program."[2]

1. A thorough description of the nuclear facilities and their environmental problems is contained in Office of Technology Assessment, *Complex Cleanup* (February 1991).

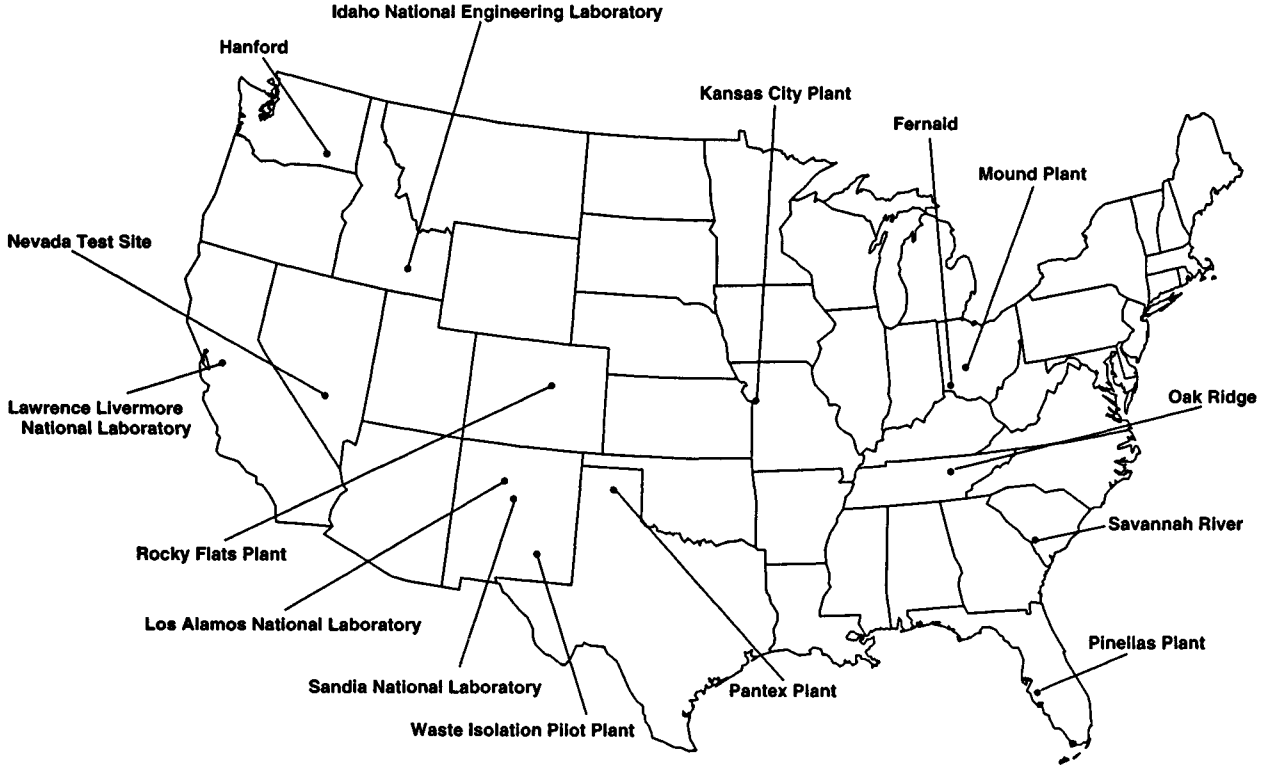
2. Thomas Grumbly, Assistant Secretary of Energy for Environmental Restoration and Waste Management, as quoted in *Inside Energy/with Federal Lands* (newsletter published by McGraw-Hill, Inc., New York, July 19, 1993), p. 10.

People do not even agree on what is meant by "cleanup": some argue that the term should refer only to environmental restoration of sites that are no longer in use; others would have it include such activities as managing wastes currently being generated and developing technologies to promote environmental goals. This study adopts the broader definition, which encompasses all the activities of DOE's Office of Environmental Restoration and Waste Management--the office charged with the prodigious task of planning and managing environmental policies for the weapons complex and for some nondefense nuclear facilities.

The Office of Environmental Restoration and Waste Management spent $13.8 billion from 1990 through 1993. Most of this money has been used for managing waste streams associated with ongoing operations. At inactive waste sites designated for cleanup, most of the work to date has been to characterize the contaminants and assess what remedial work is needed.

The relatively small amount of visible results has led to complaints that DOE is wasting money. DOE may have promised too much early in the program, before realizing the extent and complexity of its contamination problems. The department also may have been overly optimistic about technological breakthroughs to aid in assessing and cleaning up waste sites and overly ambitious in agreeing to meet certain goals and schedules. A reassessment of program objectives and priorities could result in a redirection of resources to achieve greater environmental benefits.

Figure 1.
Department of Energy's Weapons Complex



SOURCE: Congressional Budget Office.

The cost of DOE's cleanup program largely depends on the ultimate goals. One goal is reducing health and safety risks to humans and damage to the environment. Another is restoring land and making it available for other uses, which could range from industrial or commercial to residential or recreational. The choice of the ultimate goal will affect the type and extent of cleanup at individual sites, as well as the cost and schedule of the entire cleanup program.

The Department of Energy has expressed a commitment to cleaning up the nuclear facilities by the year 2019.[3] That entails bringing operating facilities into compliance with all applicable laws and regulations and cleaning up the contamination at inactive sites. With current technologies, however, the cost of such a complete cleanup would be extremely high. It may be appropriate to invest in developing better technologies, and wait until they are available, before undertaking some cleanup efforts. Even if improved technology can reduce costs, which is not guaranteed, the cost of a complete cleanup program may be judged unacceptable when competing demands for resources are considered. A more limited program of remediation could free up resources to provide greater benefits elsewhere.

Institutional Factors and Constraints Affecting Cleanup Policies

In addition to budgetary limitations, the Department of Energy faces a number of constraints that affect its cleanup policies. Three factors are particularly influential: nuclear weapons policies, legal requirements, and public opinion.

Nuclear Weapons Policies

Questions about the role of nuclear arms in national security policy in the aftermath of the Cold War lead to uncertainty about the future mission of some of the nuclear weapons facilities, which in turn complicates the task of setting policies for environmental restoration. Reduced reliance on nuclear weapons has prompted DOE to terminate production at some facilities. Fernald, where uranium was processed, was the first facility to be turned over entirely to environmental restoration. Production has also ceased at Hanford and Rocky Flats. At some facilities, production has been halted temporarily but may resume, depending on plans for the strategic arsenal.

Some facilities are likely to remain in production for some time, although the size of the production area may shrink if output is reduced. If DOE decides to consolidate production at a few facilities and close the rest, however, then production could occur on a relatively large scale at those sites. DOE is developing a programmatic environmental impact statement that addresses these issues and plans to issue a draft of the statement early in 1995. Whether a facility is actively producing weapons makes a difference in carrying out environmental restoration. Cleanup is more complicated at active production sites for a variety of reasons, including the need to keep production and cleanup activities from interfering with each other and the need for greater security in production areas.

Legal Constraints

Current cleanup plans call for meeting all federal and state environmental laws, regulations, and requirements by 2019. DOE can make some changes in cleanup plans unilaterally, but most changes would require approval by the Congress, the Environmental Protection Agency (EPA), or state regulators. The department must comply with a host of federal environmental laws and regulations and must adhere to terms of agreements negotiated with states. It is also constrained by authorization and appropriation legislation.

3. Department of Energy, *Environmental Restoration and Waste Management Five-Year Plan, Fiscal Years 1994-1998*, vol. 1 (January 1993), p. I-9.

The major federal environmental laws governing cleanup of DOE's nuclear facilities are the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, the law that set up Superfund) and the Resource Conservation and Recovery Act (RCRA). These laws establish requirements and procedures for dealing with hazardous wastes. CERCLA focuses on cleaning up inactive sites, and RCRA imposes "cradle-to-grave" requirements for tracking and properly dealing with hazardous materials throughout all stages of production. DOE must also comply with the National Environmental Policy Act, which sets forth requirements for analyzing the likely impact of any activity that would significantly affect the environment, as well as the Clean Air Act, the Clean Water Act, the Atomic Energy Act, and numerous other environmental statutes.

DOE is also subject to state environmental laws and related requirements. The Federal Facility Compliance Act of 1992, for example, clarified the states' authority over disposal of solid or hazardous waste by federal facilities. Many specific requirements, including interim milestones for accomplishing certain objectives, are set forth in agreements between DOE, the Environmental Protection Agency, and state regulatory authorities. These agreements are commonly referred to as triparty agreements.

The department considers complying with triparty agreements to be one of its highest priorities. Analysis of data made available by DOE indicates that about 54 percent of the 1994 budget for environmental restoration and waste management is for activities required by such agreements. The percentage driven by these agreements differs substantially among facilities, ranging from 3 percent at the Nevada Test Site to 89 percent at Savannah River. At five facilities--Savannah River, Rocky Flats, Hanford, Oak Ridge, and Fernald--more than 70 percent of funding is attributed to meeting interagency agreements.[4]

The Congress has become increasingly concerned about the amount of funding required for DOE to meet its legal obligations. It has directed the department to review compliance agreements and to submit a report to the Committees on Appropriations by June 30, 1995. The report is to evaluate the risks to the public health and safety posed by the conditions at weapons complex facilities that requirements in the compliance agreements address.[5]

Triparty agreements typically have been based on the best information available at the time they were signed--information about types of contaminants, potential risks, expected cleanup capabilities and resources, and so on. In many cases, however, this information was quite limited. Parties to the agreements could only make educated guesses about potential hazards and risks, and their estimates of abilities to handle difficult cleanup problems were optimistic. In some instances, the estimates of risks may have been pessimistic, and further investigation may reduce concern about adverse effects on public health.

Moreover, in the time since some agreements were signed, the mission of the facility has changed. At Rocky Flats, for instance, the agreement was negotiated when the plant was still producing plutonium components of weapons; now that the facility has been turned over to environmental restoration, a different set of cleanup options is available. Some local citizens have suggested a reordering of priorities--for example, placing more emphasis on restoring buildings to make them usable by other employers than on cleaning up all the outside areas.

As time has passed and DOE has gained a greater appreciation of the overwhelming size, complexity, and potential costs of the cleanup problem, some facets of the triparty agreements have come to be viewed as unrealistic and even counterproductive. For example, some agreements require removing and treating certain contaminants by fixed dates, but assumptions about the timely availability of treat-

4. These findings should be treated with caution because the data set from which they were derived has not been verified. Some obvious errors throw into doubt the reliability of the data. They appear to be the best data available, however. DOE is attempting to gather better data on the role of legal requirements. For purposes of this analysis, Oak Ridge includes the K-25 Site, the Y-12 Plant, Oak Ridge National Laboratory, and administrative spending at Oak Ridge; it excludes off-site facilities managed by the Oak Ridge field office.

5. U.S. House of Representatives, *Making Appropriations 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), p. 94.

ment technologies and disposal facilities have proved wrong. As a result, DOE would like to renegotiate those milestones and requirements.

In January 1994, DOE reached agreement with EPA and the Washington State Department of Ecology to revise the triparty agreement at Hanford. The regulators allowed DOE to slip some of its milestones in return for a commitment to act more aggressively on the most pressing safety problem--the storage tanks containing a mixture of radioactive and hazardous wastes. The new agreement reflected not only revised views about the relative seriousness of different waste problems but also a realization that new technologies for treating wastes were more elusive than originally anticipated.

Because each facility is unique, the Hanford renegotiation may or may not serve as a useful model for others. Still, as additional information becomes available, the parties to other agreements may find that they too could gain by revising the agreements. For example, new information may lead the parties to conclude that some problems they initially thought to be most serious are less grave than others, and vice versa. In addition, the initial agreements relied on assessments of when remedial technologies would be available. But treatment methods have not always emerged as anticipated. Reordering priorities to deal first with problems for which treatment technologies are available, safe, and effective--and postponing work on problems for which no treatment exists--may benefit all parties. The troublesome issue of what to do about a serious problem for which no remedy is known remains.

Renegotiating an agreement also provides an opportunity to explore the question of the eventual use of the land. Resolution of this issue will have a bearing on the appropriate remedy as well as the speed of restoration. If the local community is eager for DOE to make a facility available for industrial use, it may be willing to accept somewhat lower cleanup standards than if the land was designated for residential use. Cleanup might be expedited at facilities that could be put to commercial use. Some of DOE's facilities are so large that a variety of future land uses may be appropriate for different sites at those facilities.

DOE faces formidable obstacles to getting EPA and the states to renegotiate triparty agreements. In the typical case in which DOE has made commitments it cannot keep, it is hard pressed to find something to offer in return for forbearance. Moreover, the department suffers from a serious credibility problem. One legacy of the secrecy in which DOE conducted business over several decades was a culture of not being held accountable to outsiders for meeting health, safety, and environmental commitments. Although current management is trying to change this, shaking a reputation formed over many years is not easy.

Public Opinion

The triparty agreements responded in part to growing public concerns about what hazards might lurk at DOE facilities. DOE's nuclear weapons program had been cloaked in secrecy since its inception during World War II, leaving neighboring communities in the dark about potential environmental risks. The high level of secrecy shielded DOE from the public scrutiny that might have forced it to keep environmental problems from getting out of control. The department itself has acknowledged that "the secretive, unresponsive nature of DOE during the weapons production years of the Cold War [has] undermined the public trust and created long-term suspicion of DOE operations."[6] Moreover, its credibility suffered as more information about environmental problems became available to the public.

Two factors converged in the late 1980s to increase public interest and involvement in environmental remediation. DOE began to lift the veil of secrecy at the nuclear facilities, and a few well-publicized events--spills, releases, exposures of workers--alarmed citizens (especially those in neighboring areas, but also many environmental activists) about risks to health and safety. DOE recognizes that its credibility suffers when it withholds vital information about its environmental and safety problems, and it has stepped up efforts to inform the public.

6. Department of Energy, "Perspective on DOE's Environmental Restoration Program," Section III of briefing materials for Benchmarking for Cost Improvement Initiative (June 1993), p. 4.

In addition to environmental concerns, many communities fear loss of jobs as neighboring nuclear facilities are shut down. In the short run, employment may actually increase at plants as they shift from production to environmental cleanup. Over the longer term, however, unless facilities can be cleaned up enough to be safe for other uses, the local economic base may be severely weakened. Neighbors of several facilities want DOE to speed up the decontamination of buildings to make them available for employers who can use the skills of displaced workers.

Factors Affecting Cleanup Decisions

What should DOE do about remedying the environmental problems it has sown? The answer is not at all clear, and the possible responses are numerous. At a minimum, DOE could focus on ensuring that no significant amounts of contaminants migrate into drinking water or otherwise pose imminent threats to human health. At the other extreme, DOE could attempt to restore all sites to their original pristine condition. In between lie such options as cleaning sites up to a level acceptable for industrial or commercial use.

Underlying the laws requiring DOE to clean up its facilities is the premise that the nuclear weapons facilities pose risks to public health and the environment and that these risks should be eliminated as rapidly as possible. As suggested in Chapter 3, however, the DOE sites probably encompass a wide range of risks. Some sites may pose substantial, imminent threats; others may be relatively benign, at least compared with other environmental risks. The state of knowledge about potential risks is limited, and until environmental and health assessments of DOE's nuclear weapons facilities are completed, one can only make informed guesses about the extent of those risks. More information is needed about the nature and extent of contamination, whether and how contaminants are migrating into the air or groundwater, and how they affect the health of people exposed to them.

A better understanding of the risks would permit informed debate among the public and policymakers about how much risk is acceptable. Eliminating all risks is not only very costly but also virtually impossible, since reducing one risk often entails increasing another. Identifying the trade-offs between risks and costs can help policymakers set appropriate goals and priorities for the cleanup program.

Debate on acceptable risk should consider not only ultimate cleanup levels but also how soon those levels should be reached. DOE could adhere as closely as possible to the schedules set forth in agreements with EPA and the states. Alternatively, it could seek permission to delay cleanup at sites where existing technologies are ineffective and costly, while moving forward with "easier" cleanups and with the development of technologies to solve the harder problems. If its budget becomes tighter, DOE, in consultation with regulators, stakeholders (people who work at or live near nuclear weapons facilities, taxpayers, and others with an interest in cleanup), and the Congress, will have to decide which activities to defer.

Short of a fundamental reexamination of the goals and scheduling of the cleanup program, DOE could take several measures to make the existing program more effective. These measures, discussed in Chapter 4, include stepping up efforts to develop new technologies that would make cleanup safer, cheaper, and more effective, and cutting administrative and overhead costs. Attention to these measures and to the fundamental objectives of the program could bring about significant improvements in benefits per dollar spent.

Chapter Two

DOE's Cleanup Program

The United States has produced nuclear weapons for the past 50 years, and for most of that time environmental activities have been subsumed under production activities. But as the extent of environmental problems became clearer and as public concerns mounted, Department of Energy officials decided in 1989 to form a separate office with primary responsibility for environmental cleanup. The Office of Environmental Restoration and Waste Management (EM) assumed environmental responsibilities that previously had been handled within the Offices of Defense Programs, Nuclear Energy, and Energy Research.

The environmental cleanup program is the largest and fastest-growing part of DOE's budget, having risen from $1.6 billion in 1989 to nearly $5.9 billion in 1994 (see Table 1).[1] Over this period, the Congress has appropriated more than $23 billion for environmental restoration and waste management. DOE runs the largest environmental cleanup program in the federal government, surpassing funding for the Environmental Protection Agency's Superfund program and the cleanup of installations run by the Department of Defense.

Some of the growth of EM's budget is not new funding but rather reflects a shift in responsibilities to EM from other DOE offices, primarily the Office of Defense Programs, which runs the nuclear weapons production program. Before EM was formed, that office managed all activities at the weapons facilities, including production, security, and environmental and safety activities. It continues to handle operations and maintenance responsibilities as long as environmental management activities are a relatively small part of a facility's work, but as the mission of a facility shifts to environmental restora-

Table 1.
Appropriations for Environmental Restoration and Waste Management, 1989-1994 (In millions of dollars)

Year	Appropriation
1989	1,580[a]
1990	2,274
1991	3,600
1992	4,308
1993	5,520
1994	5,888[b]

SOURCE: Congressional Budget Office using data from the Department of Energy, Office of Environmental Restoration and Waste Management.

a. Budget authority.

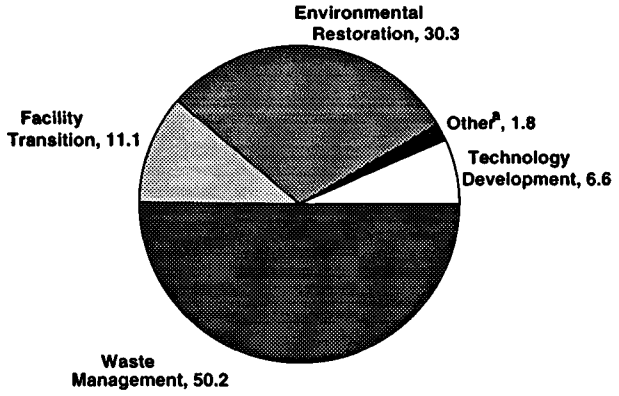
b. Excludes funding for the Uranium Enrichment Decontamination and Decommissioning program.

1. The budget data throughout this chapter exclude the new Uranium Enrichment Decontamination and Decommissioning program, whose 1994 appropriation is $286.3 million, in order to facilitate comparisons with spending in earlier years. This program is separate from the cleanup at the weapons complex. The total also excludes the use of balances from prior years.

tion and waste management, EM picks up these managerial and administrative functions--and a corresponding budget. This shift makes it difficult to track the growth of funding for DOE's cleanup efforts on a consistent basis.[2]

The $5.9 billion budget for 1994 includes $707 million, or 12 percent of the total, for cleaning up DOE's facilities involving civilian uses of nuclear energy. Over the years, the defense component has been by far the larger share, accounting for between 85 percent and 90 percent of the budget each year since EM's inception. Although this study is primarily concerned with the cleanup of defense facilities, the budgetary data included in the following description of the program reflect the nondefense part as well.

Figure 2.
Department of Energy's 1994 Budget for Environmental Management, by Program (In percent)



SOURCE: Congressional Budget Office.

a. Includes Transportation Management and Program Direction.

Program Components

The Office of Environmental Restoration and Waste Management is divided into several functional programs. They include Environmental Restoration, Waste Management, Technology Development, Facility Transition and Management, Transportation Management, and Program Direction.

The program most closely associated with environmental cleanup is Environmental Restoration, whose 1994 budget is $1.8 billion, accounting for 30.3 percent of the EM total (see Figure 2).[3] Its mission of cleaning up inactive facilities and sites employs two main types of activities: remedial actions and decontamination and decommissioning (D&D). Remedial actions generally deal with contaminated soil and groundwater, and D&D applies to buildings, tanks, and structures. DOE and its regulators have defined about 3,700 sites subject to remedial action and about 500 contaminated structures that require D&D. (Each major weapons production facility has numerous contaminated sites. A site is essentially a discrete, well-defined unit at which cleanup activity can be self-contained.) In addition, DOE is responsible for cleanup at more than 5,000 properties in the Uranium Mill Tailings Remedial Action Project and the Formerly Utilized Sites Remedial Action Program.[4] Environmental Restoration is the EM program that will be affected the most by decisions about the ultimate goals and objectives of DOE's environmental cleanup mission.

Although restoring the environment is perhaps the ultimate goal of EM, it is not its largest program. That position belongs to the Waste Management program, whose budget of $3.0 billion ac-

2. Some people disagree about whether spending on the DOE cleanup program should be categorized as environmental spending or as national security spending. These categories are not mutually exclusive, however, and DOE cleanup belongs in both. The total life-cycle cost of nuclear weapons includes the cost of disposing properly of the products and by-products. In this respect, DOE cleanup is attributable to spending on national security. But the current objectives and the demands on current resources are environmental.

3. This is the amount specified for environmental restoration in U.S. House of Representatives, *Making Appropriations 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). The legislation called for a general reduction of $280 million but did not specify from which EM programs it should be taken.

4. Department of Energy, *Environmental Restoration and Waste Management Five-Year Plan, Fiscal Years 1993-1997* (August 1991), pp. 210-211.

counts for 50.2 percent of EM's total in 1994. Waste Management is responsible for treating, storing, and disposing of wastes from ongoing production as well as from environmental restoration activities. It also constructs new treatment, storage, and disposal facilities and performs cleanup actions required to bring DOE facilities into compliance with all applicable laws and regulations as soon as possible. These "corrective activities" account for only $26.5 million, less than 1 percent of the 1994 budget for waste management.

Since the inception of the EM program, about 60 percent of the budget has been for waste management and 30 percent for environmental restoration, with the remainder split among the other programs described below. The lines between the two major activities sometimes blur because some waste management activities are attributable to environmental restoration. For example, when wastes are generated as a consequence of environmental restoration, they generally are turned over to the Waste Management program for treatment, storage, and disposal.

Technology Development, with a budget of $397.5 million, accounts for 6.6 percent of EM's budget in 1994. The program is charged with the important mission of developing technologies for safer, more effective, and less costly cleanup (see Chapter 4).

The Facility Transition and Management program was established as a separate function in 1993 with the purpose of planning and implementing the transfer of surplus facilities from defense production to the cleanup program. Its budget rose sharply, from $17.9 million (0.3 percent of the EM budget) in 1993 to $671.8 million (11.1 percent) in 1994. The growth in this program stems primarily from the reclassification of some activities that would have come under Waste Management but are now assigned to Facility Transition and Management.

The remaining 1.8 percent of EM's budget is for Program Direction and Transportation Management. These functions are handled primarily out of DOE headquarters.

Outlook for Spending

As DOE began its environmental cleanup efforts, it attempted to estimate total costs through completion of the program. In 1988, the department estimated it would cost $66 billion to $110 billion to clean up the entire complex.[5] In 1992, the General Accounting Office reported an estimate of $160 billion and said costs could be much higher unless technological breakthroughs were made.[6] At a June 1993 workshop, a DOE official acknowledged that an estimate of $400 billion was not unrealistic.[7] This statement was followed in July by the Assistant Secretary's reference (cited in Chapter 1) to a $1 trillion program.

Perhaps because of the uncertainties about ultimate goals, DOE has stopped publishing estimates of total cleanup costs. Most experts now recognize that uncertainties about requirements, tasks, and technologies make any overall cost estimate unreliable. Thus, nobody knows the potential federal liabilities.

Estimating spending over the next few years is somewhat more tractable because it will be driven primarily by budget constraints. DOE has not published detailed information about its plans but has released budget targets by program. The department assumes that budgets for the EM program will grow about 2 percent annually, from the requested level of $6.0 billion in 1995 to $6.8 billion in 2000 (excluding the Uranium Enrichment Decontamination and Decommissioning program). Spending over the six-year period from 1995 through 2000 would total $38.8 billion (see Table 2), and program shares would remain about the same as in 1994 (see Figure 2).

5. Department of Energy, *Environmental Safety and Health Report for the DOE Defense Complex* (July 1, 1988), p. 35.

6. General Accounting Office, *Cleanup Technology: Better Management for DOE's Technology Development Program*, GAO/RCED-92-145 (April 1992), p. 1. These estimates were not discounted.

7. Department of Energy's Benchmarking for Cost Improvement Kickoff Meeting, Washington, D.C., June 22-23, 1993.

Table 2.
Spending Targets for Environmental Restoration and Waste Management, 1995-2000 (In millions of dollars)

Year	Target Spending Level
1995	5,979[a]
1996	6,315
1997	6,439
1998	6,565
1999	6,694
2000	6,826
Total	38,817

SOURCE: Congressional Budget Office using data from the Department of Energy, Office of Environmental Restoration and Waste Management.

NOTE: Excludes funding for the Uranium Enrichment Decontamination and Decommissioning program.

a. Budget request.

Targets for 1995 through 2000 are also available by field office. Data for field offices that manage environmental cleanup at more than one facility do not show how much each facility would receive. Still, the data provide a general picture of the field offices' spending plans.

The Richland field office, which manages Hanford, would receive $9.6 billion for the 1995-2000 period. That amount represents 24.7 percent of the total, substantially more than any other field office. Richland manages only the Hanford facility, so all of its funding would go toward cleaning up Hanford. Savannah River would receive $4.4 billion, and Albuquerque, Rocky Flats, Oak Ridge, and Idaho would each get about $4 billion over the six-year period.

DOE headquarters accounts for $5.8 billion (14.9 percent) of target funding. Some of that money will be distributed to the field offices as DOE determines which ones have the most pressing needs.

Accomplishments of the Program

What has the Office of Environmental Restoration and Waste Management accomplished since its creation five years ago? Some critics complain that the results are scant. For example, in its report on the 1994 appropriation bill for energy and water development, the House Committee on Appropriations expressed concern about the increasing costs of the program and the apparent lack of significant progress in cleaning up contaminated sites. The committee warned DOE not to expect unlimited funding for the EM program, especially if DOE is unable to show concrete results from the investment to date.[8] Defenders of the cleanup program respond that it has had to overcome resistance to change from a culture in which environmental, health, and safety factors were subordinated to weapons production to one in which they are the central mission.

Assessing the Cleanup Program

The EM program has faced the growing pains common to a new and rapidly growing organization. As the budget has spiraled upward, the structure of the organization has changed, with new program offices being formed. Decentralized operations at the facilities that produce weapons and reliance on contractors to run the facilities--legacies of the weapons production program--have hampered attempts by headquarters to establish and coordinate effective cleanup policies. Although decentralized decision-making can offer many advantages, differences in standard operating procedures among the facilities have made it difficult for headquarters to obtain cost

8. House Committee on Appropriations, *Energy and Water Development Appropriations Bill, 1994*, Report 103-135, to accompany H.R. 2445 (June 17, 1993), p. 111.

and budgeting information on a consistent basis. That makes it exceedingly difficult to decide how to allocate resources to best advantage throughout the complex.

Some of the accomplishments of the EM program are, by their very nature, hard to recognize. The bulk of EM spending has been on waste management activities, many of which are not visible unless something goes wrong. An accidental release of hazardous substances is noticed, but the successful control of wastes on a daily basis is not.

Likewise, successes in the Technology Development program may receive little public attention. Innovations that cut costs or enhance the safety of workers are critical to the success of cleanup efforts but do not directly result in a cleaner environment. Even where innovations yield more thorough remediation, the results may not be evident for many years to come. The inability to show immediate success may lead DOE to underinvest in technology development, a problem that is discussed further in Chapter 4.

Environmental Restoration Activities

The program that most people associate with cleanup is environmental restoration. Environmental restoration is a popular activity because it promises results that people can see and enjoy. Many people fear the potential consequences for their health and the environment from toxic wastes, especially radioactive materials. They also recognize that DOE's nuclear facilities will be off-limits to other uses until they are cleaned up. Accomplishments in the Environmental Restoration program, therefore, are what many people look for in assessing the success of DOE's overall cleanup efforts.

The legal requirements governing environmental cleanup may explain in part why accomplishments seem elusive. Much of DOE's Environmental Restoration program comes under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), although federal and state regulatory agencies have given primary jurisdiction to the Resource Conservation and Recovery Act at some DOE sites. Both statutes impose specific procedural and substantive requirements on polluters; the triparty agreements among DOE, EPA, and state regulators generally include the completion of these requirements as milestones.

Before remedial actions or decontamination and decommissioning can begin at a site, DOE must study it to see what contaminants are present and what kind of treatment or disposal is appropriate. At sites on Superfund's National Priorities List, this stage is known as the remedial investigation/feasibility study. These studies have accounted for the bulk of spending in the ER program and will probably continue to consume a substantial amount of resources for the foreseeable future.[9] Data supporting DOE's budget request for 1994 indicate that about 53 percent of the funding for environmental restoration would be spent for studies, about 35 percent for cleanup, and the rest to support a variety of management functions, including oversight of compliance, program direction, and landlord responsibilities.[10] Inadequate records of past manufacturing and disposal processes increase the cost of studies and the length of time they take.

After DOE completes the remedial investigation/feasibility study, the Environmental Protection Agency prepares a record of decision, which sets forth what DOE must do to clean up a site. Only a few DOE sites have reached the record-of-decision stage. That has two implications for the department as it tries to respond to criticisms of the cleanup program. First, it means that DOE has relatively few tangible results, such as decontaminated buildings or restored sites, to show for the money spent on environmental restoration. Second, it means that DOE does not have a clear idea about the magnitude of the problem nor the extent of remediation that will be required at individual sites.

9. DOE's August 1991 five-year plan was the last to identify assessment and cleanup separately. At that time, assessment spending was projected to be about equal to cleanup spending in 1993 and only slightly less through 1997.

10. The data did not contain an explicit categorization. Categories were inferred from the description of the activity; many included the term "assessment" or "cleanup" in the title. For a small number of activities, accounting for less than 1 percent of the budget, the category could not be inferred from the information available.

The often-heard criticism that the environmental cleanup program is being studied to death is not unique to DOE. The Environmental Protection Agency has come under similar attack and has launched an effort to accelerate cleanup at sites where the appropriate remedy seems clear.[11] DOE has begun to explore interim remedies at such sites, but for many of them it has too little information about the scope of the problem to determine the best approach for remediation. Achieving the right balance--conducting the assessment that is needed but no more--is more easily said than done.

Perhaps the brightest spot in DOE's cleanup record is the Uranium Mill Tailings Remedial Action Project (UMTRAP), although the growth of its costs has exceeded estimates.[12] This project was authorized by the Uranium Mill Tailings Radiation Control Act of 1978, well before the EM office was established. The act directed DOE to stabilize and control uranium mill tailings at 24 designated sites and about 5,000 properties near those sites in 10 states and on two Indian tribal lands.[13]

UMTRAP has completed surface remediation at 20 sites and plans to complete remedial action on all surface sites by the end of 1998.[14] It still faces the challenging task of cleaning up the groundwater. But DOE is confident that it can meet regulatory requirements for groundwater in a timely, cost-effective manner. The success of this program cannot serve as a model for DOE's other cleanup programs, however, because UMTRAP's sites do not have the vexing problems of the larger, more complicated weapons facilities.

11. For example, at wood-treating sites on the Superfund list, EPA has proposed dispensing with detailed assessments and instead proceeding with the usual remedy--burning soil to break down organic contaminants.

12. Uranium mill tailings are the sandy wastes that result from processing ore to extract uranium.

13. Department of Energy, *Environmental Restoration and Waste Management Five-Year Plan, Fiscal Years 1994-1998*, vol. 2, *Installation Summaries* (January 1993), p. II-68.

14. Ibid., p. II-71.

Initiatives for Managing the Environmental Cleanup Program

The Department of Energy has instituted several efforts to help manage the environmental restoration and waste management activities. It has published a series of five-year plans that provide blueprints for the near term, established a program for controlling costs and improving cost estimates, and stepped up efforts to track progress.

Five-Year Plans

Soon after the Office of Environmental Restoration and Waste Management was established in 1989, DOE published the first of a series of five-year plans that set forth objectives, timetables, and budgets. In addition to serving as management tools, the plans provide a perspective on the growth and evolution of the program, especially the rise and fall of projections for budgetary growth.

The first plan envisioned spending $19.2 billion over the five years it covered, 1991 through 1995. One year later, the 1992-1996 plan called for spending $31.6 billion.

The 1993-1997 plan, published in August 1991, contained two scenarios for budgetary growth. The first, called the preliminary unvalidated case, envisioned spending of $40.7 billion over the five-year period. This was the amount DOE estimated it would need to comply with all legal requirements. The second scenario, called the validated target level, assumed growth of about 10 percent a year--an amount DOE thought possible within overall constraints on the federal budget. Spending in that case would total $28.8 billion over the five years.

The 1994-1998 plan projected budgetary growth of between 5 percent and 10 percent a year, yielding total spending of about $35.5 billion over five

years.[15] It is not clear whether DOE will publish a plan for the 1995-1999 period; it may instead skip to the 1996-2000 period since it has already made preliminary projections for 2000.[16] As noted earlier, these projections assume growth of about 2 percent annually and spending of about $32.8 billion over five years.

Although overall budget constraints are set from the top down, the specifics of the five-year plans depend on estimates made from the bottom up. DOE divides cleanup tasks into basic units called activity data sheets (ADSs). Each sheet shows the cost estimates, regulatory requirements, milestones, and other useful information for each year in the five-year plan. ADSs should provide an effective way to track growth in costs, schedule slippages, and other developments over time and, indeed, they are the building blocks of DOE's Progress Tracking System (discussed below).

The usefulness of the ADSs has been limited, however, because DOE has continually changed the scope of work contained in individual sheets. For example, for each of the principal sites needing environmental restoration at Rocky Flats, the 1993-1997 plan contained two ADSs--one for assessment and one for cleanup--but the 1994-1998 plan collapsed them into one ADS per site, covering both activities. That change is easy to track, but other changes involved folding several ADSs into one or splitting one ADS into two or more, thereby making it virtually impossible to track progress. Overall, roughly 2,000 ADSs in the 1993-1997 plan were consolidated into 850 in the 1994-1998 plan.

Some realignment is inevitable in a relatively new program. Undoubtedly some of the consolidations have resulted in more logical groupings of tasks. But continual change thwarts efforts to identify the factors that cause costs to grow and schedules to slip, and to analyze how to facilitate progress in cleaning up the environment.

Improving Cost Control and Cost Estimates

Rapidly escalating costs are a perennial problem for large-scale programs, and DOE's cleanup effort is no exception. Two independent reviews by analysts outside the EM office--DOE's Independent Cost Estimating (ICE) team and an interagency group led by the Office of Management and Budget (OMB) and the Army Corps of Engineers--underscored the problems of estimating and controlling costs.[17]

Team members visited DOE's field offices and reviewed a large sample of activity data sheets. The OMB/Corps analysts found that DOE had overestimated direct program costs for about 12 percent of ADSs and that the estimates contained relatively high overhead and contingency costs. For a sample of ADSs, the OMB/Corps group found that DOE had estimated overhead costs to be 139 percent higher than for comparable Corps projects; the ICE team found an estimated $350 million of seemingly excessive overhead costs and $450 million in excessive contingency costs.[18] These findings are discussed in greater detail in Chapter 4.

In response to the independent cost reviews, DOE has launched a "Benchmarking for Cost Improvement" initiative.[19] This project will gather and examine detailed information about costs in an attempt to make cost estimates more reliable and to keep costs under firmer control. If successful, this

15. This plan, published on January 19, 1993, was somewhat sketchy because it was completed during the Presidential transition, when policy changes appeared likely.

16. Alternatively, the department may abandon five-year plans in favor of other managerial tools and reporting mechanisms, such as the progress report required by the National Defense Authorization Act for Fiscal Year 1994.

17. Interagency Review Group, *Interagency Review of the Department of Energy Environmental Restoration and Waste Management Program*, Final Report (April 29, 1992); Army Corps of Engineers, *Supplemental Report on Cost Estimates* (Report to the Associate Director for Natural Resources, Energy and Science, Office of Management and Budget, April 29, 1992); and Gilbert/Commonwealth, Inc., *Independent Cost Estimate for the Environmental Restoration and Waste Management Five Year Plan, Fiscal Years 1993-1997* (Reading, Pa.: Gilbert/Commonwealth, Inc., November 1991).

18. Interagency Review Group, *Interagency Review*, p. iii.

19. Department of Energy, Office of Environmental Restoration and Waste Management, *Benchmarking for Cost Improvement: Final Report* (September 1993).

effort will provide useful information about which factors drive costs and are responsible for cost increases at the site or project level.

Perhaps as important as the numerical findings of the independent reviews is the more general conclusion that DOE needs to improve its procedures for estimating costs. Whether improvements in cost estimating by themselves can hold the line on future increases in program costs is debatable, but improvements can certainly help to illuminate the trade-offs involved in developing alternative program plans.

Experience at DOE and Superfund sites can serve as a guide for estimating costs of many common remedial activities.[20] The problems at some DOE sites are so difficult, however, that there is little experience to draw on.

At many sites known to be contaminated, the exact nature, extent, and even types of contaminants are unknown. In many cases, experts must conduct extensive and costly studies before they can determine the kinds of measures needed to correct the problem. The hazardous and radioactive nature of the contaminants may require special methods and technologies with which DOE has insufficient experience to estimate costs with confidence. The cleanup may require special training and equipment, and contractors may insist on being indemnified against responsibility for future cleanup costs.[21] Moreover, the legal requirements concerning the extent and type of cleanup are subject to change. In short, cost estimates made before a site has been analyzed and cleanup requirements have been determined must be viewed as highly uncertain and subject to substantial change. Appendix B describes DOE's process of estimating costs at a site.

Estimating the costs of cleaning up the entire nuclear weapons complex will continue to present challenges for some time. Even though estimates of the costs of cleaning up each site (or other manageable unit of observation, such as the ADS) can be made with increasing confidence, aggregating and coordinating them poses additional problems. For example, experience might suggest that excavating, storing, treating, and disposing of contaminated soil would cost a certain amount per ton. But if vast quantities of contaminated soil from numerous sites are excavated at once, they may overwhelm the capacity of storage, treatment, and disposal facilities. DOE's demands for environmental cleanup services may account for such a large share of the total market that they would create shortages and bottlenecks that would drive up costs and also cause delays.

As increasing numbers of site assessments are completed, DOE will have a firmer grasp of the magnitude of the cleanup actions that lie ahead. And as DOE gains experience with remedial actions, it will be able to refine its estimates of cleanup costs. But cost estimates depend fundamentally on the cleanup standards DOE is required to meet.

Progress Tracking System

DOE has been hampered in its ability to estimate costs and show accomplishments--and to understand why some cleanup projects appear to be more successful than others--by the lack of a comprehensive system for tracking performance. To fill that need, it has been developing the Progress Tracking System (PTS). DOE implemented an initial version of the PTS in October 1991, but that version could perform only a few functions and was not easy to update. The PTS has been under continual development in an attempt to make it the robust management information system needed to ensure managerial and financial control of EM's programs.

As its name suggests, the system is designed to track EM's progress toward meeting its cleanup objectives. The PTS reports information about costs, schedules, and technical performance and eventually

20. For a discussion of estimates of the costs of cleaning up Superfund sites, see Congressional Budget Office, *The Total Costs of Cleaning Up Nonfederal Superfund Sites* (January 1994).

21. Under the Comprehensive Environmental Response, Compensation, and Liability Act, liability for cleaning up a Superfund site is strict, joint, and several. Any company that has owned or operated a site or disposed of wastes on it is potentially responsible for the entire cost of cleaning it up, even if that company contributed only a small fraction of the environmental problem. Section 107(d) of CERCLA provides protection from liability to a contractor engaged in cleanup, except for damages resulting from the contractor's negligence, but some contractors have expressed concerns nonetheless.

should enable DOE managers and others to monitor progress, identify projects that are experiencing problems meeting cost and schedule objectives, and take steps to get such projects back on track.

In September 1993, an independent panel of experts in the management and control of large-scale programs found that the PTS had made substantial progress and "has the potential to be the premier DOE-wide reporting system."[22] The panel made a number of recommendations for improving the system. On the accuracy and timeliness of the data, the panel made the following observation:

> Quality of data should be one of the most important objectives of the PTS. This establishes the credibility necessary for management use of the system and its reports. Quality and accuracy of the data begins with the inputs of baseline budgets, schedules (milestones), and actual cost and schedule data . . . . The field organizations must feel that PTS is an extension of their reporting system and therefore data input and its accuracy is their full responsibility and they are being held accountable for its validity . . . . Correct data at the time of input can add much to the credibility of PTS.[23]

Among its other recommendations, the panel suggested that the PTS be linked more closely to other financial and budget reporting systems at DOE. It also commented that, at present, the PTS is on a current year basis, which does not permit looking forward or reviewing historical trends--capabilities that would provide valuable information for developing cleanup plans. The panel also suggested measures that would enhance technical capabilities, reduce the time and cost of entering data into the system, and make the system easier to use.

The PTS is able to track differences between budgeted cost, work performed, and actual costs. This information is reported on the activity data sheet and presented in an overall summary. The system is not yet able to maintain a history of changes to the budgets and schedules, however. It can report a variance between the most recent budget and actual spending, but it cannot show how much the budget has increased or decreased over the history of the project. Maintaining a baseline history would help analysts track changes in costs--both for individual projects and for the program as a whole--and would better identify factors that increase costs or cause schedules to slip.

Identifying changes in the scope of a project or changes in its management history is difficult within the present Progress Tracking System. DOE is considering incorporating a mechanism for recording and managing such changes, including a formal system of review and approval. The Department of Defense (DoD) uses this kind of approach in managing acquisitions of major weapon systems. Even though requirements, quantities, and other characteristics of a new weapon system may change over time, there are decision points throughout the acquisition process at which estimates of cost and schedule are made. DoD's Selected Acquisition Reports provide a way of tracking deviations from plans and attributing them to such factors as changes in quantities, changes in requirements, and inflation. This kind of information would be very useful for DOE's cleanup program because it would help to identify the factors that drive up costs and delay cleanup.

The Progress Tracking System is a promising addition to DOE's data bank. Pulling together massive amounts of data, ensuring their reliability, and making them readily available and understandable to disparate users is a challenging task, but continuing to upgrade and improve the system appears well worth the effort.

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22. *Assessing the U.S. Department of Energy Progress Tracking System*, Report by the Review Panel (September 24, 1993), p. 1-1.

23. Ibid., pp. 5-10 and 5-11.