GAO

United States General Accounting Office

Report to the Chairman, Committee on Governmental Affairs, U.S. Senate

April 1992

NUCLEAR HEALTH AND SAFETY

More Can Be Done to Better Control Environmental Restoration Costs

GAO/RCED-92-71

GAO
United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-246432

April 20, 1992

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

Dear Mr. Chairman:

As requested, we examined the degree of cost growth associated with the Department of Energy's environmental restoration program and the steps the Department can take to better manage, and thereby control, cost growth.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees; the Secretary of Energy; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

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

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

For more than 40 years, the Department of Energy's (DOE) nuclear weapons complex has disposed of large quantities of hazardous and/or radioactive wastes at numerous sites across the United States. DOE environmental restoration is a process for assessing and cleaning up previously used sites and facilities to meet prescribed standards derived from federal and state laws. DOE estimated, in 1988, that it may take from $35 billion to $64 billion to clean up the weapons complex. Since 1988 the Department has not revised these overall cost projections but has acknowledged that the overall cleanup cost has been growing. As a result, the Chairman, Senate Committee on Governmental Affairs, asked GAO to examine the (1) degree of cost growth associated with DOE's environmental restoration program and (2) steps DOE can take to better manage, and thereby control, cost growth. By cost growth, GAO is referring to the percent deviation between an estimated cost and a revised estimated cost (or actual cost).

Background

DOE officials do not know exactly how much waste has been disposed of as a result of previous operations. However, available information indicates that over the past 40 years DOE has disposed of more than a billion cubic feet of radioactive and/or hazardous wastes in a manner that has led to contamination at many locations. In 1989 DOE established the environmental restoration program under the direction of the Office of Environmental Restoration and Waste Management. This office has issued a series of annual 5-year plans and has been given the responsibility for overseeing numerous DOE cleanup projects throughout the country, many of which have been under way for several years.

Results in Brief

Although sufficient data are not available to determine the aggregate cost growth associated with DOE's environmental restoration program, indications are that considerable cost growth is occurring. For instance, a comparison of DOE's 5-year plans shows, in constant 1991 dollars, a 48-percent increase over the past 2 years in estimated funds necessary for fiscal years 1991-95. On selected subprograms and projects, the cost growth has been more dramatic.

In response to these increases, DOE—beginning in the fall of 1990—has reviewed the causes of cost growth to determine if the continued escalation of cost estimates could be minimized. This continued escalation has led DOE to conclude that certain cost growth is to be expected but that other cost growth has been unnecessary and should be better controlled.

To accomplish this, DOE has implemented the following initiatives: (1) conducting program cost reviews, (2) developing procedures that require preparing documentation to support cost estimates, and (3) instituting cost estimating review procedures.

GAO's review raised questions regarding the direction and pace of DOE's actions. Specifically, DOE still does not have some basic management tools in place, such as baselines for individual projects and an information system for monitoring cost growth, to properly understand and analyze environmental restoration cost growth. Those tools would help DOE better know the total costs, schedule, and technical progress for all of its individual projects; that costs have been consistently estimated; when cost estimates have changed and why; and if better ways are being used across the DOE complex to clean up projects. These basic management tools in themselves will not reduce the substantial cost growth the environmental restoration program has experienced. However, they should help DOE better identify and understand the reasons cost growth is occurring and, thereby, allow DOE management to deal with it.

Principal Findings

Cost Growth in DOE's Environmental Restoration Program

An aggregate cost growth analysis of DOE's environmental restoration program is not possible because DOE has not updated or revised its 1988 estimate of the total costs needed to complete all environmental restoration work. However, indications are that considerable environmental restoration cost growth is occurring. For instance, a comparison of DOE's 5-year plans shows, in constant 1991 dollars, a $3.5 billion, or 48-percent, increase over the past 2 years in estimated funds necessary for fiscal years 1991-95. An examination of certain subprograms—series of similar projects—shows a corresponding cost growth—61 percent between 1988 and 1991.

GAO's review also noted that some specific projects have experienced a relatively high estimated cost growth. For instance, documentation supporting DOE's 5-year plans shows that a cleanup project at Oak Ridge, Tennessee, has experienced, in constant 1991 dollars, a $67.8 million increase, or a 5,679-percent cost growth. According to a 1991 DOE study, there appears to be an upward trend toward greater cost growth in cleanup projects. The study further concluded that most cost growth is

controllable—primarily by better defining the scope of the cleanup and better determining the contamination problems present. GAO also believes that in some instances insufficient DOE management oversight has led to poor contractor performance and cost growth.

Some Basic Management Tools Have Been Lacking

DOE lacks some important management tools. These tools include comprehensive performance baselines for individual projects, a process for consistently estimating project costs, an information system capable of monitoring project-specific cost growth, and a system for sharing, across the DOE complex, lessons-learned information.

One of the management tools is a performance baseline. The Office of Management and Budget and DOE guidance require that acquisitions (or major systems) that are important to an agency's mission have the total costs, schedule, and technical progress necessary to acquire the systems estimated (commonly referred to as baselining). The baseline can then be used, relative to actual experience, to measure performance. GAO found, however, that DOE has prepared baselines only for four subprograms—representing 28 percent of the environmental restoration program. In addition, GAO found that, for three of the four subprograms with baselines, the baselines are several years old and understate total project costs by hundreds of millions of dollars. Contrary to departmental policy, DOE senior management has not reviewed and approved the cost increases above these baselines.

DOE considers cost estimating to be essential in comparing projects and controlling costs. However, DOE has yet to implement a consistent process of estimating environmental restoration costs across the DOE complex. In addition, though DOE guidance recommends that it be done, the Department has not regularly prepared cost estimates to check the quality of the estimates generated by its contractors. DOE officials could identify only a few cases prior to November 1991 in which check estimates had been done, and these checks showed that DOE contractors had greatly overestimated project costs. In November 1991 DOE completed detailed check estimates on all projects supporting its fiscal year 1993 budget. It is unclear if such a process will be continued in the future.

A reliable management information system capable of monitoring and reporting on environmental restoration cost growth is critical, in GAO's view, to understanding the degree of and the reasons for cost growth. DOE has spent more than $3.8 million over the past 3 years in developing an

information system for the program called the Waste Information Network. This system is still not fully operational and contains only partial cost growth information on DOE's environmental restoration cleanup projects. Furthermore, because the system has taken more than 3 years to become fully operational, some DOE operations offices have been developing their own tracking and monitoring systems. At least one system is not compatible with the Waste Information Network.

DOE's policy is that lessons-learned information about environmental restorations should be generated and shared to let managers better know what is working well and what is not. In practice, however, GAO found that DOE contractors performing environmental restorations are, only to a limited extent, exchanging lessons-learned experiences. During this review, GAO noted two instances in which such information was not generated and shared, thereby increasing the problems encountered and costs incurred at one DOE site. In one instance, mistakes made in cleaning up solar ponds at Rocky Flats were essentially repeated in cleaning up solar ponds at Oak Ridge. To DOE's credit, officials recognize that the Department could do a much better job of sharing lessons-learned information. Consequently, the Department has recently contracted for the development of a system containing such information, with the system scheduled to be operational by spring 1992.

Recommendations

GAO is recommending that the Secretary of Energy take several actions that would ensure that the Department (1) completes baselining of its environmental restoration program as soon as possible and monitors this baseline to ensure that changes made are in accordance with departmental guidance, (2) develops guidance that clearly specifies a consistent cost estimating process to be used throughout DOE, (3) establishes a reliable management information system that would monitor the degree of and the reasons for environmental restoration cost growth, and (4) once a system is developed to exchange lessons-learned environmental restoration information throughout DOE, monitors its use to ensure that "bad" as well as "good" experiences are entered into the system and that mistakes are not repeated because the system is not used.

Agency Comments

As requested, GAO did not obtain written agency comments. However, GAO discussed the contents of the report with DOE staff and incorporated their views where appropriate. DOE officials stated that the environmental restoration program has only been in existence since 1989 and that they

have come a long way in instituting the necessary management systems. DOE also said it is taking action to correct the cost-related problems associated with the program. GAO recognizes in this report that DOE is taking certain actions to understand and control cost growth. However, GAO also highlights issues regarding the direction and pace of DOE's actions.

Contents

Abbreviations

DOE	Department of Energy
EM	Office of Environmental Restoration and Waste Management
EPA	Environmental Protection Agency
GAO	General Accounting Office
OMB	Office of Management and Budget
OTA	Office of Technology Assessment
WIN	Waste Information Network

Introduction

For more than 40 years, the Department of Energy's (DOE) nuclear weapons complex has disposed of large quantities of hazardous and/or radioactive wastes at various facilities and sites across the United States. The history of DOE's operations shows that its past waste disposal practices, under today's regulatory structure and knowledge of the effects of these wastes on the environment, were not acceptable. DOE has recognized that its facilities and sites must be cleaned up and that large volumes of wastes from its facilities and sites must be effectively managed. Toward that end, DOE committed in 1989 to a 30-year goal of cleaning up its facilities and sites by the year 2019.

DOE's environmental restoration program is concerned with the assessment and cleanup of facilities and sites that are no longer a part of active operations.[1] This program may involve two sets of activities: remedial actions and decontamination and decommissioning. Remedial actions include inactive release site discovery, characterization, cleanup, and monitoring the site for compliance with regulations. The number of DOE inactive release sites is currently estimated to be more than 3,700.[2] Decontamination and decommissioning is concerned with the safe caretaking of surplus nuclear facilities, including their cleanup, which may necessitate their complete dismantling and removal. Approximately 500 contaminated facilities have been currently identified for decontamination and decommissioning. Other DOE facilities will also become inactive and surplus in the future and will require comparable decontamination and decommissioning action.

DOE's fundamental goal for environmental restoration is to ensure that risks to the environment and to human health and safety posed by inactive and surplus facilities and other sites contaminated by radioactive and/or hazardous wastes are either eliminated or reduced to established safe levels. In some cases, DOE intends to return facilities and sites to a condition suitable for unrestricted use. However, in certain instances, depending on (1) specific-site conditions; (2) the type, nature, extent, and amount of contaminants present; (3) availability of suitable cleanup technologies; (4) regulatory factors; or (5) other agreed to (with regulators) considerations, in-place stabilization and disposal may be the

[1]This GAO report reviews DOE's environmental restoration program. Facilities and sites that are a part of DOE's ongoing waste activities were not included in this review.

[2]A release site is a location at which a hazardous, radioactive, or mixed waste release has occurred or is suspected to have occurred. These sites range in size from a portion of an acre to many thousands of acres. In addition, there are more than 5,000 properties associated with DOE's Uranium Mill Tailings Remedial Action Project and 33 sites associated with the Formerly Utilized Sites Remedial Action Project, which are also a part of the environmental restoration program.

alternative selected. In-place stabilization, according to DOE officials, offers certain advantages, including that it avoids transportation risks, reduces the risk to workers in handling material, and avoids the need to develop and build new disposal facilities.

The only attempt by DOE in recent years to estimate a total cost for completion of its environmental restoration program was published in a December 1988 report. That 1988 estimate gave no year-by-year breakdown but put the cleanup cost at $35 billion to $64 billion.[3] Since 1988 DOE has not published an estimate of costs for the entire cleanup program. The reason given for the Department not doing so is the existence of too many unknowns—especially about the nature and extent of all contamination problems and the types of remediation that would lead to acceptable results.[4]

Environmental Restoration Problems

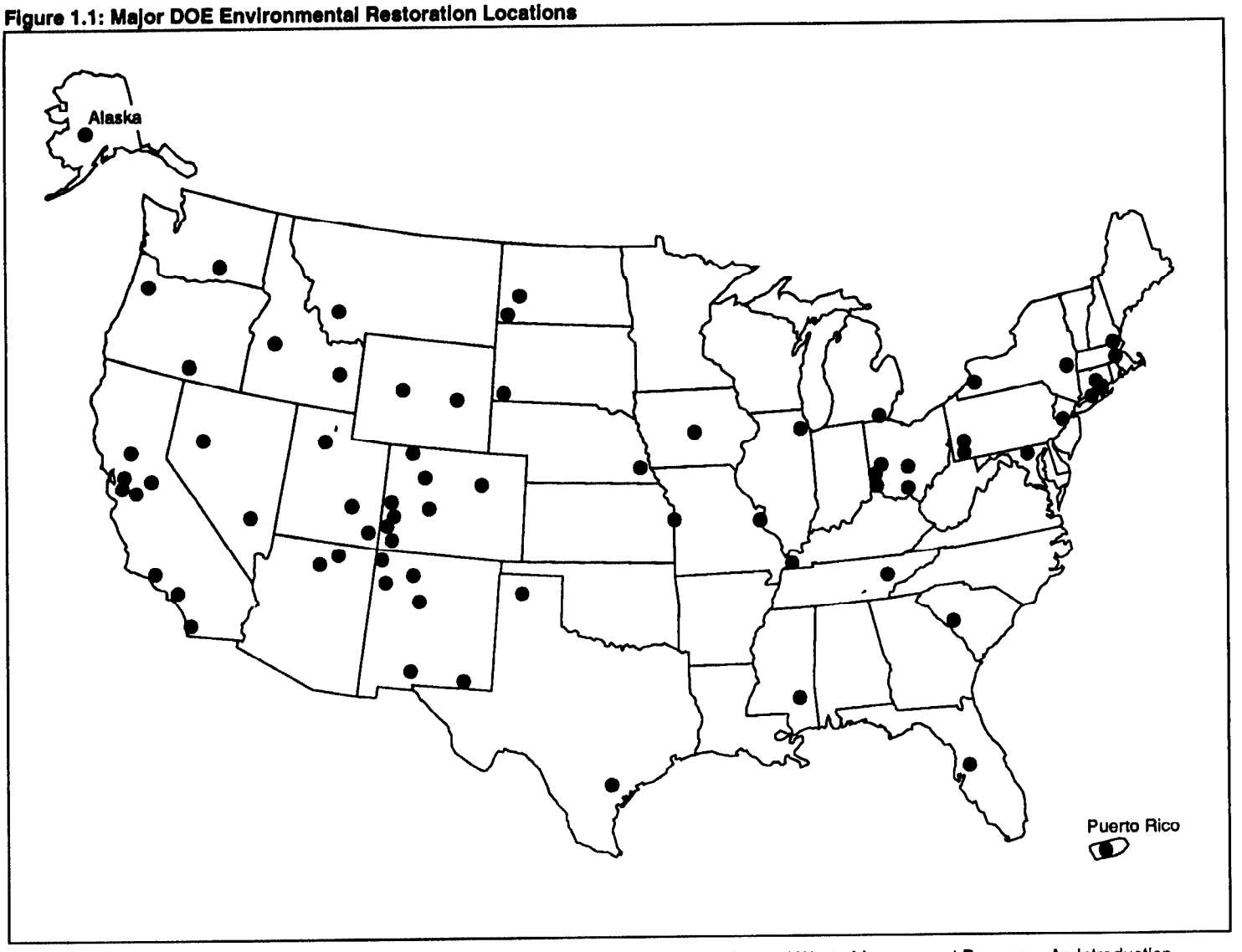
DOE's nuclear weapons operations have long used and generated a wide variety of hazardous and/or radioactive substances that have resulted in hazardous waste, radioactive waste, and mixed waste containing both hazardous and radioactive materials. Some of the hazardous wastes include acids, nitrates, oils, reactive metals (e.g., sodium), fluoride, heavy metals (e.g., mercury), and high explosives. Exposure to some of these materials in large doses can pose immediate health threats, long-term illness, or even death. Some of the radioactive waste, because of its lethal levels of radiation and high heat generation, must be remotely handled with special shielded equipment to prevent worker exposure. Other waste, while much less radioactive, is very toxic and can present a health hazard if inhaled or ingested. Finally, DOE's operations generate mixed waste—various combinations of hazardous and radioactive materials, such as oil contaminated with plutonium or acids contaminated with radioactive materials. These mixed wastes pose handling and disposal problems because workers and the environment must be protected from both the hazardous and radioactive material.

[3]Before the release of DOE's report, we indicated in our report entitled Nuclear Health and Safety: Dealing With Problems in the Nuclear Defense Complex Expected to Cost Over $100 Billion (GAO/RCED-88-197BR, July 6, 1988) that the cost to upgrade existing facilities may be $20 billion and the cost for environmental restoration could be as high as $80 billion, which includes $15 billion for decontaminating surplus facilities.

[4]DOE officials added that other reasons complicating their ability to estimate total program costs are that (1) there are no standards on "how clean is clean?"; (2) the identification of final cleanup remedies must be made through a process that is driven by the regulators; and (3) the scope and schedule of the environmental restoration program is too poorly defined to develop a credible total program cost.

Historically, DOE has disposed of much of its own waste at government-owned installations (see fig. 1.1). For more than 40 years, DOE used disposal techniques that were generally the accepted practice at the time but are no longer considered environmentally acceptable. For example, liquid waste, which contains both hazardous chemicals and radioactive material, has been disposed of directly into the soil by means of cribs, ponds, trenches, and ditches at many disposal sites. At these disposal sites, liquid effluents seep down into the soil. As this occurs, some of the contaminants combine with the soil, and thus remain at the site, or if radioactive, decay. Some contaminants, however, can reach the groundwater and migrate with it. Solid waste, in some cases, has been buried in unlined trenches. At these sites, rainwater can percolate through the waste, causing it to migrate into the soil and possibly into the groundwater. According to DOE officials, the Department has phased out the use of disposal sites that allow waste to contaminate the surrounding environment. However, many sites that resulted from past operations, while now inactive, still contain waste that can migrate and cause environmental problems.

Figure 1.1: Major DOE Environmental Restoration Locations



Source: DOE's Environmental Restoration and Waste Management Program—An Introduction (DOE/EM-0005P, December 1990).

Note: DOE's environmental restoration 5-year plan addresses activities at numerous locations. Figure 1.1 shows only the major locations.

DOE officials do not know exactly how much waste has been disposed of as a result of past operations. However, available information indicates that environmental restoration activities will result in a projected total of over

1.6 billion cubic feet of waste.[5] The following instances illustrate how contamination has occurred.

- At its Idaho National Engineering Lab installation, DOE used deep injection wells and ponds to dispose of billions of gallons of wastewater containing hazardous and radioactive wastes, as well as shallow pits to bury millions of cubic feet of radioactive wastes. DOE officials have identified over 200 release sites at the Idaho lab—some of which could be a continuing source of contamination to the Snake River Plain aquifer.
- At its Hanford Reservation, which has more than 1,000 release sites, a wide variety of disposal techniques has been used over the past 40 years, ranging from shallow land burial to injection wells into the groundwater. As a result, large volumes of soil (more than 20 million cubic feet) have been contaminated with low-level radioactive and hazardous wastes from discharging liquids into the soil. Approximately 37 million gallons of mixed waste containing high-level and low-level radioactive materials is stored in about 150 single-shell tanks. Approximately 750,000 gallons of waste from the tanks, according to DOE estimates, has leaked to the surrounding soil.[6]
- At the Nevada Test Site, hundreds of aboveground (until 1963) and underground nuclear tests have been conducted. Each test, by the nature of the nuclear explosion, produces a large amount of radioactivity. A total of about 775 waste sites have been identified and about 3,000 acres of soil have been contaminated to a shallow depth with plutonium.

Compounding these and other environmental problems over the years have been management problems within DOE, including an attitude among some DOE personnel to overlook the environmental implications of their actions. DOE historically has emphasized production objectives over environmental and safety concerns.[7]

[5]Integrated Data Base for 1991: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics, DOE/RW-0006, Revision 7, Oct. 1991.

[6]In our report entitled Nuclear Waste: Hanford Single-Shell Tank Leaks Greater Than Estimated (GAO/RCED-91-177, Aug. 5, 1991), we indicated that the actual volume of waste that may have leaked from Hanford's single-shell tanks is not precisely known but greater than previously estimated and that DOE has a 2-year contract underway to reestimate the leakage.

[7]According to DOE officials, it is incorrect to suggest that today there are DOE managers that overlook environmental problems. We agree that DOE managers today are more attuned to environmental problems. We also believe that further attention to such problems is necessary. As noted in the November 1991 report of the DOE Advisory Committee on Nuclear Facility Safety, deficiencies continue to persist in DOE programs designed to protect the health and safety of workers, the public, and the environment, in part, because of inadequate management attention.

DOE's Efforts to Address Its Environmental Restoration Problems

During the past few years, DOE has acted to change its management focus toward environmental problems. These changes have included restructuring programs within DOE, issuing annual 5-year plans for environmental restoration and waste management, and acknowledging that the Department can do a better job in controlling cost.

Creation of the Office of Environmental Restoration and Waste Management

To help manage environmental cleanup, compliance, and waste management activities, DOE established in October 1989 an Office of Environmental Restoration and Waste Management (EM). EM is responsible for directing DOE headquarter's control and validation of cost, schedule, and priority of environmental restoration and waste management projects at sites across the DOE nuclear complex. These projects were formerly under the Offices of Defense Programs, Nuclear Energy, and Energy Research.

In accordance with Department policy, DOE field offices are responsible for the day-to-day management and implementation of the environmental restoration program. EM approves the scope of the program; makes budget allocations; provides policy guidance and program oversight; establishes, with input from the field offices, overall priorities; and approves key documents and decisions—about planning, management, and implementation—designated in program plans.

Issuance of 5-Year Plans

In 1989 DOE began issuing a 5-year plan to establish an agenda for environmental restoration against which progress could be measured. DOE has revised this plan annually, with each plan containing a 5-year planning horizon and DOE's policy, goals, objectives, constraints, and current and planned activities.

The 1989 5-year plan, DOE's first, outlined its fiscal year 1989-95 schedule for cleaning up the weapons complex.[8] The plan stated DOE's goal of cleaning up all its sites within 30 years. The plan also laid out EM's approach to organize environmental restoration activities into four discrete categories, ranked by priority: activities that (1) limit immediate or short-term health risk and contamination; (2) ensure compliance with regulatory agreements that are in-place or pending; (3) reduce long-term risk and promote compliance, address public concern, and protect DOE missions; and (4) accelerate overall compliance. In addition, the plan stated DOE's commitment to an aggressive research and development

[8]Each of DOE's 5-year plans provides funding data for a 7-year period of time: 2 years representing actual or estimated funding and the remainder representing a 5-year planning horizon.

program keyed to developing innovative environmental technologies that solve disposal problems and lower costs.

DOE's second 5-year plan covered fiscal years 1990-96. This updated plan reaffirmed DOE's commitment to a 30-year goal of fully complying with laws, regulations, and agreements aimed at protecting human health and the environment. It also incorporated a revised plan to develop new technologies critically needed to solve the Department's environmental problems and emphasized DOE's plan to increase the involvement of other agencies and the public in DOE's planning efforts.

DOE's third 5-year plan, issued in August 1991, covers fiscal years 1991-97. This plan incorporated information designed to comply with the Secretary's directive that increased emphasis be placed on strategic planning. The plan also shows the most significant milestones at each DOE site and states the environmental restoration objectives for each site through fiscal year 1997.

DOE's Efforts to Control Costs

According to DOE's second 5-year plan, prepared in 1990, cost growth—or the percent deviation between an estimated cost and a revised estimated cost (or actual cost)—is to be expected as a normal consequence of updating its environmental restoration planning efforts. However, the second 5-year plan also noted that the estimates reflected in that plan exceed what might be considered a manageable rate of cost growth. With that recognition, DOE initiated a series of reviews, conferences, meetings, and workshops—which began in the fall of 1990—to better understand the causes of cost growth and determine if the continued escalation of cost estimates could be minimized.

This collective review of cost growth led DOE officials to conclude that certain management weaknesses did exist and that correcting them could help control cost growth. Those weaknesses included, among other things, (1) the lack or absence of documentation to support detailed environmental restoration cost estimates; (2) estimates, once prepared, not receiving sufficient DOE and contractor review; and (3) the absence of a reliable departmentwide system for collecting environmental restoration cost information.

Acting on these identified weaknesses, DOE undertook—during the end of 1990—several initiatives. Those initiatives included (1) developing procedures that require preparing documentation to support cost

estimates, (2) instituting cost estimating review procedures, and (3) working with several other federal agencies in developing a means of collecting estimated and actual costs.

More recently, EM has put into place a three-part effort to address cost issues. The first part is an attempt to identify the means for reducing the cost and shortening the time required to do environmental restoration work. Specifically, EM has, among other things,

- completed program cost reviews,
- conducted a survey of the DOE complex to identify specific technological needs for facilitating environmental restoration, and
- commenced two studies to examine factors that could improve schedules and reduce costs.[9]

The second part of the effort is an attempt to improve the agency's knowledge of environmental restoration cost and schedules. Specifically, EM is, among other things, currently

- participating on an interagency working group to develop a set of standards for organizing cost information on environmental restoration projects,
- analyzing the effects of regulatory and institutional activities on costs and schedules, and
- researching the causes of cost and schedule uncertainties.

The third part is an attempt to manage the environmental restoration program more effectively. Specifically, EM is, among other things, currently

- developing program management guidelines and procedures,
- implementing systems for prioritizing activities and for managing the basis for environmental restoration costs, and
- establishing a system for tracking environmental restoration program accomplishments.

As a separate effort, EM is also conducting cost estimating audits. As part of these audits, EM will be reviewing the cost estimating process across the DOE complex, begin drafting site visit critiques by mid-December 1991, and preparing a summary report by June-July of 1992.

[9]One study will examine the adequacy of the infrastructure to support planned environmental restoration activities. The second study will identify critical areas for reducing costs through interviews with experts from industry, academia, and government.

In addition, two recent events have occurred. The Office of Management and Budget (OMB) has expressed concern about the quality of the environmental restoration project estimates supporting DOE's fiscal year 1993 budget request and has asked the Army Corps of Engineers to analyze the overhead, administrative, contingency, and other costs associated with those estimates. The Corps is scheduled to complete its work by spring 1992. Concurrent with the Corps' effort, DOE's Secretary in September 1991 asked the Department's Office of Procurement, Assistance, and Program Management to conduct an independent cost evaluation of all project-specific data supporting the 1991 5-year plan. The evaluation determined that EM's estimated fiscal year 1993 funding needs of $6.9 billion for environmental restoration and waste management contained excessive amounts of contractor overhead and contingency and needed to be reduced to $5.3 billion, which corresponds to EM's official budget request for the fiscal year.

Objectives, Scope, and Methodology

As a result of discussions with the office of the Chairman, Senate Committee on Governmental Affairs, we examined (1) the degree of cost growth associated with DOE's environmental restoration program and (2) the steps DOE can take to better manage, and thereby control, cost growth.

We focused our work on both DOE headquarters' and field offices' efforts to deal with cost growth. At DOE headquarters, we (1) reviewed DOE's 1989-91 5-year plans and project-specific information supporting these plans; (2) analyzed cost data from DOE program officials on those environmental restoration subprograms with a detailed cost history predating DOE's 1989 5-year plan, which included the Formerly Utilized Sites Remedial Action Project (former weapons sites),[10] the Uranium Mill Tailings Remedial Action Project (uranium processing sites),[11] the Weldon Spring, Missouri, Site Remedial Action Project (Weldon Spring site),[12] and the Fernald, Ohio, Feed Materials Production Center Environmental

[10]The former weapons sites project was initiated in 1974 to identify sites formerly used by the Manhattan Engineering District and Atomic Energy Commission (a predecessor of DOE), reevaluate the sites' radiological condition, affect appropriate response action and controls consistent with existing legislative authority, and certify the sites for appropriate future use.

[11]The uranium processing sites project was initiated in 1978 to undertake remedial action at designated inactive uranium processing sites and associated properties nearby containing uranium mill tailings and other residual radioactive materials derived from the processing sites.

[12]The Weldon Spring site project will remedy radiological and chemical conditions by conducting remedial actions at the quarry, the chemical plant, and nearby properties.

Remedial Action Project (Fernald site); [13] (3) examined efforts to develop the Waste Information Network (WIN)—a system intended as a national communication network for environmental restoration program activities—and DOE's internal 1990 review of the WIN system; (4) assessed DOE's efforts to more clearly discern the reasons for cost growth, which included, among other things, reviewing the work of a DOE contractor on the causes of cost overruns and schedule slip; (5) analyzed various DOE reports that have cost control implications including, among other things, the results of EM's program cost reviews that led to development of cost estimating and initial baseline guidance; and (6) examined DOE's efforts to independently review contractor-generated environmental restoration cleanup estimates.[14]

We also interviewed numerous DOE headquarters officials in various offices—EM; the Office of Financial Management and Controller; the Office of Procurement, Assistance, and Program Management; the Office of Planning and Analysis; the Office of Facilities, Fuel Cycle, and Test Programs; the Office of Health Physics; and the Advisory Committee on Nuclear Facility Safety. In addition, we discussed various cost growth issues with officials of other federal agencies that also are examining the effect of nuclear and/or hazardous waste on the environment, including the Environmental Protection Agency (EPA), Nuclear Regulatory Commission, and OMB.

To obtain DOE field offices' perspective on environmental restoration cost growth, we visited DOE's Savannah River, S.C., Oak Ridge, Tn., Idaho Falls, Id., Albuquerque, N.M., and Richland, Wa., Operations offices. At each operations office visited, we interviewed DOE and contractor officials responsible for the environmental restoration program and reviewed information that detailed (1) the reasons for individual project cost growth, (2) the means used to track and report on cost growth, (3) the process used to estimate project costs, and (4) the dissemination of information gained, or "lessons-learned," about environmental restorations.

We discussed the facts presented in the report with DOE headquarters officials and incorporated their views where appropriate. However, as requested, we did not obtain written agency comments on this report from DOE or other parties. We conducted our review from November 1990

[13]The Fernald site project will assess and clean up release sites for the production center, including associated decontamination and decommissioning.

[14]Over the next few years, we plan to conduct more detailed audit efforts to ensure that DOE is adequately addressing potential contractor problems.

through February 1992 in accordance with generally accepted government auditing standards.

Cost Growth in the Environmental Restoration Program

Currently, sufficient data are not available to determine what has been the aggregate cost growth associated with DOE's environmental restoration program. As stated earlier, DOE prepared, in 1988, a total cost estimate for completing all environmental restoration work but has not updated or revised that estimate since then. DOE has acknowledged, however, that the overall cleanup cost has been growing.

Absent a revised total cost estimate, an aggregate cost growth analysis is not possible. However, there are indications that the program has been experiencing considerable cost growth. For instance, a comparison of DOE's first and third 5-year plans shows a 48-percent increase in estimated costs for fiscal years 1991-95.[1] On selected projects, the cost growth has been even more dramatic. For example, an Oak Ridge solar ponds cleanup project[2] has experienced a 5,679-percent increase in estimated costs for fiscal years 1991-95. Furthermore, according to a DOE-contracted study, there appears to be an upward trend, in recent years, toward greater cost growth in cleanup projects.

Cost Growth Reflected in DOE's 5-Year Plans

Environmental restoration cost estimates, in 1991 constant dollars, have increased considerably between DOE's 1989 and 1991 5-year plans.[3] In 1989 DOE estimated it needed about $7.4 billion for fiscal years 1991-95. In 1990 DOE estimated it needed about $9.3 billion for this same time period—a growth of 26 percent. In 1991, for the same time period, DOE estimated it needed $10.9 billion[4] —a growth of 17 percent from the 1990 estimate. In total, these estimations represent a 48-percent increase in environmental restoration costs (see fig. 2.1).

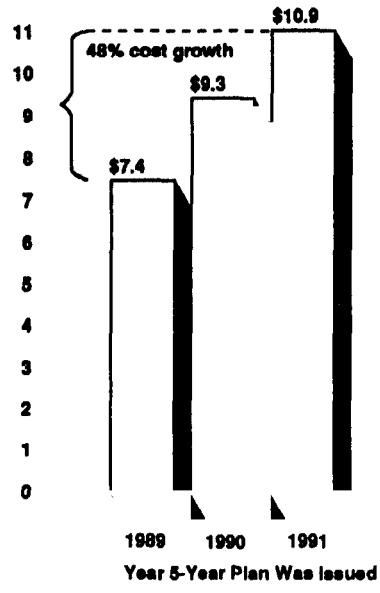
[1]Throughout this report we adjusted for inflation and used 1991 constant dollars. Fiscal years 1991-95 were used in this analysis because it represents the span of years common to each of DOE's 5-year plans.

[2]A solar pond is a surface excavation used at a site for storing and evaporating low-level radioactive and hazardous liquid waste.

[3]The funding presented in DOE's 5-year plans represents the Department's estimation of need. Actual budget funding, for example, for fiscal year 1993, will depend upon further priority setting in the context of the annual budget and appropriation process.

[4]DOE's 1991 5-year plan presents two funding cases: a fiscally constrained case, which allows a 10-percent annual cost increase over the previous 5-year plan, and an unconstrained case, which represents DOE's best estimate of the funding needed for the environmental restoration program. To provide for a comparable analysis based on similar considerations expressed in each of DOE's three 5-year plans, funding estimates presented here and throughout the remainder of this report are from the unconstrained case in DOE's 1991 5-year plan.

Figure 2.1: Cost Growth in Constant Dollars Reflected in DOE's 5-Year Plans



Source: GAO generated.

In response to these increases, DOE cited various reasons—in its 1990 5-year plan—to help explain why a growth in environmental restoration cost estimates from 1989 to 1990 was unavoidable. Those reasons included (1) the identification of new cleanup projects; (2) the need for additional cleanup at existing projects; (3) new regulatory requirements; and (4) the transfer of facilities from other DOE programs to the environmental restoration program.

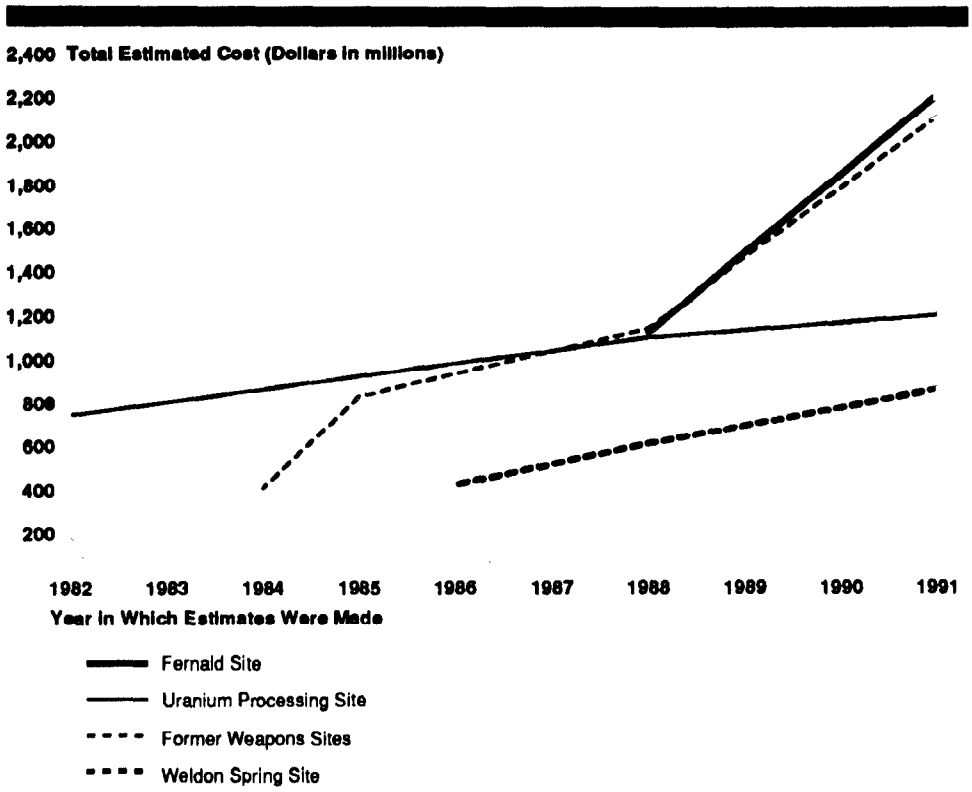
In its 1991 5-year plan, DOE indicated that much of the cost growth can be attributed to increased responsibilities in areas not envisioned in the first 5-year plan. These increased responsibilities include recognition of the need for support mechanisms to accomplish the EM mission, such as a new technology development program and cleanup agreements with states and other entities. Other responsibilities, the plan states, derive from EM's need to decontaminate and decommission an increasing number of inactive or surplus facilities.

Cost Growth Experience With Environmental Restoration Subprograms

While an aggregate cost growth analysis of the entire environmental restoration program is not possible, cost growth calculations are possible for certain subprograms (or series of projects). For those subprograms—which include the former weapons sites, the uranium processing sites, the Weldon Spring site, and the Fernald site—a detailed cost history exists showing that, between 1988 and 1991, overall estimated costs increased 61 percent (see fig. 2.2).[5] These subprograms, on the basis of funds requested in DOE's 1991 5-year plan, represent 28 percent of the environmental restoration program for the fiscal year 1991-95 time period.

[5]The combined cost growth of 61 percent has the following breakdown—former weapon sites (93 percent), uranium processing sites (8 percent), Fernald (94 percent), and Weldon Spring (41 percent). This percent of combined cost growth does not include the total estimated cost of $1.1 billion for groundwater restoration work that DOE, in 1991, administratively separated from the uranium processing site project and established as a separate project. For fiscal years 1991-95, these subprograms have increased in cost by 69 percent according to information presented in DOE's 5-year plans. Most of this cost growth is due to the Fernald project with the former weapons sites project and the Weldon Spring site project actually showing negative cost growth but not because cleanup costs have decreased. Rather, it is because more costs have been allocated to years beyond the fiscal year 1991-95 time period.

Figure 2.2: Cost Growth Experience With Environmental Restoration Subprograms[a]



[a]Points on this graph reflect amounts shown in DOE project plans.

For these subprograms, reasons vary why costs have grown. For the former weapons sites, the total estimated costs, in 1991 constant dollars, increased from $1.1 billion in 1988 to $2.1 billion in 1991. According to an April 1991 project plan, the increase is primarily due to (1) discovering that the volume of waste to be removed and stored is greater than originally thought; (2) having delays in some work; (3) performing chemical characterization and remedial investigation/feasibility studies; and (4) adding new sites and risk assessment work.

For the uranium processing sites, the total estimated cost, in 1991 constant dollars, increased from $1.124 billion in 1988 to $1.218 billion in 1991.[6] According to DOE's project manager, the increase is primarily due to (1)

[6]An additional $1.1 billion for groundwater restoration work was administratively separated from this project and established as a separate project in 1991. If this $1.1 billion were considered as part of the uranium processing sites project, then project costs after adjusting for inflation have increased to $2.318 billion.

changes to remedial action techniques and site schedules, (2) compliance with EPA's revised groundwater standards, (3) provisions for long-term surveillance and maintenance, and (4) additional technical requirements and reassessment of contingency requirements.

For the Weldon Spring site, the total estimated cost, in 1991 constant dollars, increased from $608 million in 1988 to $857 million in 1991. According to a March 1991 status review, the increase is primarily due to (1) added costs to comply with environmental regulations, (2) a greater number of DOE employees to line-manage the project, (3) increased costs to respond to EPA's involvement with the project, (4) additional document review requirements, and (5) additional site characterization activities.

For the Fernald site, the total estimated cost, in 1991 constant dollars, increased from $1.1 billion in 1988 to $2.2 billion in 1991. According to a February 1991 status report, the increase is primarily due to (1) added activities to comply with revised DOE orders; (2) increases in the scope of the remedial investigation/feasibility study; (3) inclusion of funding to support and respond to regulatory agencies; and (4) inclusion of funding estimates for the check-out, start-up, and operation of the remedial action technique used.

During our review, DOE was unable to indicate the amount of cost growth specifically attributable to the various reasons provided for the four subprograms discussed. Without that information, we were unable to determine if the reasons offered us fully account for the cost growth that occurred or were the result of other reasons. In this regard, we noted that an August 1991 report[7] by the DOE Office of Inspector General reviewed the contract administration involving the remedial investigation/feasibility study at the Fernald site and determined that costs for that work have increased from $1.7 million to $72 million principally because of two reasons. First, the small-business contractor selected was not qualified to perform the work, and second, DOE delegated most of the contract administration responsibility to the major Fernald site contractor, which was not an effective arrangement.

[7]Contract Administration Involving the Remedial Investigation and Feasibility Study at the Feed Materials Production Center, DOE/Office of Inspector General, ER-B-91-18, Aug. 28, 1991.

Cost Growth Experience With Selected Projects of the Environmental Restoration Program

Approximately 72 percent of the environmental restoration program does not have a detailed cost history like the previously discussed subprograms.[8] Available information, however, shows some projects of the program have experienced a relatively large estimated cost growth. For instance, documentation supporting DOE's 5-year plans shows that the Rocky Flats, Colorado, solar ponds cleanup project has experienced a 898-percent cost growth over the past 2 years in funds necessary for fiscal years 1991-95. The cost of a similar project at Oak Ridge, Tennessee, has gone up an even more dramatic 5,679 percent, while the cost of a similar project at Richland, Washington, has increased 24 percent.

In an earlier GAO report,[9] we documented the problems associated with the Rocky Flats solar pond cleanup project. During this review, we also selected two other solar pond projects to assess cost growth because (1) solar ponds have been a common means of storing radioactive and hazardous waste across the DOE complex and (2) the cleanup of such ponds has been viewed by DOE as a relatively simple technological task.

During the Rocky Flats solar pond cleanup operation, which began in 1985 and is still underway, DOE has attempted to drain the liquids from the ponds and process the pond sediment by mixing it with cement and pouring it into large tri-fiberwall boxes having plastic liners. The resulting solidified form, referred to as "pondcrete," was to be disposed of at DOE's Nevada Test site. Various problems have been identified, beginning in May 1988. The DOE contractor conducting the operation improperly mixed the cement and sediment in making the pondcrete, causing thousands of pondcrete blocks to subsequently crumble and crack. Finally, the packaging material deteriorated when subjected to the weather.

In our 1991 report on the Rocky Flats solar pond cleanup, we reported that a lack of program control mechanisms, including provisions for quality assurance, detailed cost data, and systems for managing and planning the cleanup, has contributed to the project's problems. The result has been that estimated cleanup costs for fiscal years 1991-95 have increased, in 1991 constant dollars, from $10.1 million to $101.1 million, or a 898-percent cost growth.[10]

[8]A detailed cost history for a project would include documentation showing the total project cost, any major revisions to that cost, plus the reasons for those revisions.

[9]Nuclear Safety and Health: Problems With Cleaning Up the Solar Ponds at Rocky Flats (GAO/RCED-91-31, Jan. 3, 1991).

[10]According to July 1991 data provided by DOE, the total estimated cost to complete the project in 2009 is about $169 million.

During the Oak Ridge project, which began in 1987 and also is still underway, DOE has attempted to process the pond sediment by mixing it with cement and pouring it into unlined steel drums. The drums would then be transported to an undetermined final disposal location. All of the sediment was placed in about 78,000 drums by 1989 but, in April of that year, several problems were detected. Some drums were found to contain free corrosive liquids, some drums had corroded and were already leaking wastes, and about 32,000 drums contained only raw sediment unmixed with cement because the contractor desired to keep the placement of sediment into drums on schedule.[11]

The DOE manager of the Oak Ridge operations office requested a compliance investigation to determine the causes of these problems. The investigation revealed that (1) detached, unstructured project management led to poor communication, unclear lines of authority, and poor technical oversight; (2) project documentation was deficient; (3) the quality assurance program was totally inadequate to identify likely processing problems; (4) information had not been transferred among DOE facilities; (5) most of the operators involved in mixing the sediment with cement did not receive training in operating procedures or quality assurance/quality control procedures; and (6) the unlined steel drums used to contain the sediment were left unprotected from the weather and were incompatible with the waste, leading to numerous corroded and leaking drums. The result has been that estimated cleanup costs for fiscal years 1991-95 have increased, in 1991 constant dollars, from $1.2 million to $69 million, or a 5,679-percent cost growth.[12]

During the Richland project, which began in 1985 and also is still underway, DOE has attempted to process the basin sediment by mixing it with cement and pouring it into lined steel drums. The drums would then be taken to a central waste complex at Richland for interim storage. In 1990, after about 11,000 of 13,000 drums to be filled had been processed, problems were found during a routine inspection of the drums. Specifically, several of the drums showed signs of corrosion and minor leaking. DOE's critique of the situation disclosed that, apparently for some

[11]Liners, or plastic bags, were used for the approximately 32,000 drums containing only raw sediment. In about 2,700 of these drums, the liners were determined to be too short to ensure that they did not collapse into the drums. For the remainder, longer liners were used but there is some evidence the liners were penetrated by rocks and mechanical forces during the drum filling process.

[12]The $69 million is the estimated cost of an interim remedy to move the drummed sediment indoors to secure facilities, thereby eliminating the potential for environmental contamination. Subsequent actions (and costs) will also be necessary to address the final disposition of the sediment, as well as any remaining problems posed by conditions at the solar pond site.

of the drums, there was an inadequate mix of sediment and cement, liners used in the drums were too short to twist and seal and did not prevent waste material from migrating to the inner drum surface, and drums were left improperly exposed to the environment. As many as 1,600 drums may have to be overpacked and placed in larger steel drums.[13] The result has been that estimated cleanup costs for fiscal years 1991-95 have increased, in 1991 constant dollars, from $13 million to $16.2 million, or a 24-percent cost growth.

Our examination of the cost increases for each of the three projects to clean up solar ponds revealed a common theme. There was an improper mix of sediment and cement, and when the containers containing the waste were left exposed to the environment, problems developed. We believe that greater DOE technical oversight of contractor work may have precluded these problems from occurring.

DOE's Contracted Study of the Causes for Cost Growth

In July 1991 a contractor for DOE completed a study entitled The Hazrisk Cleanup Report, which assessed the causes of environmental restoration cost growth. In conducting this study, the contractor examined over 98 completed cleanup projects performed by DOE, EPA, and industry, and reached several conclusions. For instance, the study concluded that there has been a poor record of estimating the actual costs necessary for individual projects. The study also disclosed that, on average, cleanup estimates—from project authorization to project completion—has experienced a cost growth, or overrun, of about 40 percent. In addition, the study concluded that during the 1980s, estimates for cleanup had become less accurate with a trend toward higher cost growth.

The study further concluded that the major sources of cost growth are not uncontrollable or related to external factors such as inflation, changes in the project scope, or changes in regulations. The introduction of new regulations, the study concluded, may initially lead to greater cost growth, but estimators eventually adapt and account for these new regulations. Most of the reasons for cost growth, about 80 percent,[14] are controllable and similar to those identified in our Rocky Flats solar pond cleanup report—the projects need to be better defined and there needs to be a

[13]According to a DOE/Richland official, the problem with its waste drums is by no means resolved. In September 1991 about 60 more drums were found to be bulging, and the matter is currently being studied.

[14]According to DOE officials, while the Department has considered participation in the study worthwhile, it views the findings from this study as preliminary. Furthermore, DOE is concerned that the study's data base does not adequately represent the universe of the Department's projects.

better understanding of the degree of technological complexity and the variety and type of contaminated media and contaminants present.

Moreover, according to the contracted study, there is some indication that the causes of cost growth will be even more prevalent at sites being cleaned up during the 1990s. The study noted, on the basis of certain analysis and research, the implementation of new and even more complex treatment technologies in the coming years will result in continuing cost growth problems in cleanup projects.

Conclusions

Successful cleanup of DOE's environmental restoration projects will likely cost the American public tens, if not hundreds, of billions of dollars. Given the amount of money involved, it is critical that DOE ensure that the environmental restoration program is being properly managed and all money associated with that program is wisely spent. Already, the environmental restoration program has had cost-related problems. DOE's estimates of funding needed for fiscal years 1991-95 has grown over the past 2 years by about 48 percent, and the cost growth for subprograms and some projects of the environmental restoration program has been higher—in one case over 5,600 percent. While there are many reasons for cost growth, we believe one controllable cause has been a lack of DOE technical oversight. For example, detailed project plans have not been developed and properly reviewed. We also noted that technical mistakes were occurring. DOE, in forming the EM office in 1989, is attempting to get a handle on these problems and elevate management attention to finding solutions.

Basic Management Tools That Could Help DOE Better Control Cost Growth

As recently as 1990, DOE officials concluded that certain management weaknesses did exist and should be corrected and, once corrected, could help control cost growth. For instance, there was a lack or absence of documentation to support detailed environmental restoration cost estimates. Furthermore, once prepared, estimates were not receiving sufficient DOE and contractor review. Acting on identified weaknesses, DOE has undertaken over the past year several initiatives to reduce cost growth.

We found, however, that DOE still lacks some basic tools needed not only to control cost growth but also to effectively manage the environmental restoration program. Those tools pertain to

- establishing baselines expressing the total costs, schedule, and technical progress[1] necessary to complete environmental restoration projects;
- ensuring that consistent cost estimates are developed for environmental restoration projects;
- developing a comprehensive information system capable of tracking cost growth in the program; and
- sharing across the DOE complex the "lessons-learned" about environmental restoration.

DOE, for its part, is taking certain actions toward ultimately having in place these basic management tools. For each tool identified, however, our review raised questions regarding the direction and pace of DOE's actions.

Establishing Baselines to Complete Environmental Restoration Projects

OMB and DOE guidance require that acquisitions (or major systems) that are important to an agency's mission have their total costs, schedule, and technical progress estimated (or baselined) as a means for measuring program performance. While DOE has designated certain projects of the environmental restoration program as major systems, we found it has yet to baseline some of those projects and, for certain subprograms that have been baselined, DOE has not approved changes to the baselines in accordance with departmental policy.

Specifically, OMB Circular A-109 establishes the policies to be followed by federal executive agencies acquiring major systems.[2] The circular contains

[1]Technical progress relates to what is going to be done and how it shall be accomplished.

[2]The circular specifies that major systems are those that (1) are directed at and critical to fulfilling an agency's mission, (2) entail the allocation of relatively large resources, and (3) warrant special attention by management.

several objectives, including that agencies maintain a capability to predict, review, and monitor costs; assess cost, schedule, and performance experience against predictions; make new assessments where significant cost, schedule, or performance variances occur; and estimate total costs over the life of the system.

To implement this OMB circular, DOE issued guidance in 1978 designating the Department's major systems. Since 1978 DOE has revised this guidance on 10 separate occasions, most recently in March 1991. During this time, several projects of the environmental restoration program have received major system designation. Specifically, DOE so designated the former weapons sites and the uranium processing sites in March 1981; the Fernald site in July 1986; and the Weldon Spring site in May 1988. In April 1989 DOE also listed "environmental restoration projects" as a major system but did not list individual projects. The projects were to be identified by DOE's Office of Defense Programs and Management and Administration. DOE's criteria for major system designation consider national urgency, importance, size, complexity, and dollar size. Systems that have a total project cost exceeding $100 million, according to a March 1991 DOE guidance, are considered to be major systems.

Under separate DOE project management guidance, the Department requires that each major system have a project plan that serves as a baseline against which changes in total cost, schedule, and technical progress can be measured. Each plan and formal changes to each plan must receive the approval of DOE's senior management.[3] Prior to August 1990, DOE's guidance was not specific on what necessitated a formal change other than a determination that the plan was no longer an accurate portrayal of the project. In August 1990, however, DOE specified that a cost change of $50 million or greater represented a formal project plan change requiring senior DOE management action.

Many Environmental Restoration Projects Have Not Had Baselines Prepared Yet

Our review found that even though DOE listed environmental restoration projects as a major system in 1989, no DOE office followed through by identifying the individual projects or preparing a project plan with baselines. Consequently, when DOE reissued, in March 1991, its guidance that designates the Department's major systems, it included the former weapons sites, the uranium processing sites, the Fernald site, and the Weldon Spring site, but DOE had no listing for other environmental

[3]The DOE Under Secretary is responsible for designating EM major system acquisitions and reviewing and approving project plans for those systems.

restoration projects even though many were estimated to exceed the $100 million DOE cost threshold for consideration as a major system.

DOE officials offered us various reasons as to why no additional environmental restoration projects were identified as major systems in 1989 or thereafter. One DOE official said that when EM was created, this office assumed responsibility for the Department's environmental restoration projects but did not want to designate any of its projects as major systems because it did not know if the Department's guidance for major systems was totally applicable to its projects. Other DOE officials told us EM has been working very hard to manage its environmental restoration projects as major systems but has not had sufficient time to do so.

Whatever was the reason for not listing other environmental restoration projects as major systems, EM officials informed us during our review that the entire environmental restoration program would be designated a major system(s), have baselines, and managed in accordance with applicable departmental guidance. In January 1991 an EM official said the program would be listed as a major system and have baselines by October 1991. In January 1992 EM officials said the program would be segregated into 17 major systems and have baselines by spring 1992. The reason offered us for slipping the schedule for baseline completion was that the earlier schedule simply was not doable.

If the current schedule is kept, it will have taken DOE nearly 3 years to prepare baselines for its environmental restoration projects.[4] In the meantime, as many as 15 environmental restoration projects, according to DOE cost data, will each have exceeded $100 million in cost. These projects include, for instance, the cleanup of the plutonium-contaminated soil at the Nevada Test site, and the solar ponds at Rocky Flats, Colorado. For these many projects, costs may continue to grow but until baselines are established, it will be difficult to determine to what degree.

[4]The period of nearly 3 years referred to extends from when environmental restoration projects were designated as a major system (April 1989) to when baseline completion is expected to occur (spring 1992). If the date EM was established (November 1989) were used as a starting point, the lapse of time would be about 2 years and 3 months.

Some Environmental Restoration Subprograms With Baselines Have Not Had Changes Approved in Accordance With Departmental Policy

As stated previously, environmental restoration subprograms representing approximately 28 percent of the program have already been designated as major systems. We found, however, that DOE has managed only one of the four subprograms in accordance with departmental policy by reviewing and approving a project plan that accurately reflects the changes in cost, schedule, and technical progress that have occurred. For the other three, the approved project plans are several years old and understate costs by hundreds of millions of dollars. Though costs have grown substantially, this cost growth has not been reviewed and approved in accordance with departmental policy.

The one subprogram with a current and accurate project plan is the former weapons sites. Designated as a major system in March 1981, the former weapons sites' first total estimated cost baseline was $411 million. Because costs have grown steadily, DOE revised the baseline in April 1985 (to $830 million) and in March 1988 (to $1.1 billion). In recognition of even higher total estimated costs, DOE again revised and approved a new baseline of $2.1 billion in August 1991.

The uranium processing sites, like the former weapons sites, were also designated as a major system in March 1981. Since then, total estimated costs have increased steadily from an initial baseline of $784 million, which necessitated a revised baseline in March 1988 (to $1.124 billion). Currently, the total estimated cost for the uranium processing sites is $1.218 billion, according to program personnel. DOE's senior management is due to review and possibly approve a revised baseline for these sites later this year. As of February 1992, however, our review showed that the latest approved project plan, dated March 1988, is 4 years old and understates costs by as much as $94 million.

The Fernald site was designated as a major system in July 1986. Since then, total estimated costs have increased steadily from an initial unapproved baseline of $1.1 billion in September 1988 to a 1991 estimate of $2.2 billion. The Fernald site is currently scheduled for a project status review by DOE's senior management later this year. As of February 1992, however, our review showed that the project plan, dated September 1988, is more than 3 years old and understates costs by as much as $1.1 billion.

The Weldon Spring site was designated as a major system in May 1988. Since then, total estimated costs have increased steadily from a baseline of $608 million in June 1988. During our review, the total estimated cost for the Weldon Spring site was either $687 million, according to DOE

personnel, or $946 million, according to the contractor conducting the cleanup. DOE's senior management is due to review and possibly approve a revised baseline for the site later this year. As of February 1992, however, our review showed that the latest approved project plan, dated June 1988, is more than 3 years old and understates costs by somewhere between $79 million to $338 million.

For the uranium processing sites, the Fernald site, and the Weldon Spring site alike, a DOE official indicated that although DOE senior management was supposed to review any formal changes in project plans, it had not because of the change in administrations and the creation of EM. The result is that each of these environmental restoration subprograms have grown tremendously in cost over the past 3 years without senior DOE management's formal review or consent.

Ensuring That Consistent Cost Estimates Are Developed for Environmental Restoration Projects

DOE considers consistent cost estimating to be essential to cost control. However, DOE has not yet implemented a consistent process of estimating environmental restoration costs across the DOE complex. In addition, DOE has not prepared, on a regular basis, cost estimates to check on the quality of the estimates generated by its contractors. The check estimates that have been prepared suggest that DOE contractors may have overestimated project costs.

A Consistent Process for Estimating Environmental Restoration Costs Is Still Evolving

According to the Office of Technology Assessment's (OTA) February 1991 report entitled Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production, inconsistent cost estimating is occurring across the DOE complex. The OTA report noted, for instance, the DOE/Savannah River's cost estimate for soil excavation work was $8 per cubic yard, whereas DOE/Oak Ridge's cost estimate was $260 per cubic yard.[5] Such inconsistent cost estimating, the OTA report concluded, impacts upon DOE's (as well as outside independent organizations') ability to compare, contrast, and evaluate similar environmental restoration projects to possibly identify better ways of doing environmental restoration work.

To make cost estimating more consistent, we found DOE completed and disseminated a cost estimating handbook at approximately the same time OTA was developing its report. DOE officials said that while the handbook

[5]According to DOE officials, this cost comparison may not be totally accurate because OTA was not able to adjust these costs for indirect charges, project management, or contingencies. DOE believes that this type of comparison does not address all of the relevant issues at these sites.

was a good document for defining commonly used terms, the Department also recognized that the handbook did not contain any specific methodology that could be used to estimate project costs. Therefore, DOE's Office of the Controller recommended in October 1990 that each contractor develop its own cost estimating manual.

Our review of this recommendation's implementation showed that DOE contractors were at different points of compliance. For instance, DOE's contractor at Savannah River had not begun preparing a cost estimating manual because contractor personnel, unaware of the Controller's recommendation, initially questioned the need for such a manual. Subsequently, DOE personnel at Savannah River said a cost estimating manual would be prepared before the end of 1992. Conversely, DOE's contractors at both Albuquerque and Idaho Falls had already drafted a cost estimating manual, which lays out a methodology for estimating costs that can be applied to specific cleanup projects.

In March 1991 the EM Director said there was a need for an accurate and uniform cost estimating process at all DOE sites. Consequently, in September 1991 EM issued initial guidance intended to provide a consistent method or process for estimating environmental restoration project costs. The guidance outlined the format for DOE field offices to use in presenting information to DOE headquarters about an environmental restoration project and advocated a conventional "bottoms-up" technique for determining environmental restoration cost estimates.[6]

We noted, however, that a DOE-contracted study entitled The Hazrisk Cleanup Report indicated that a continuing reliance on a conventional bottoms-up approach has led to a wide variation in cost growth and does not fully consider the unique risks and uncertainty of cleanup projects. Further, the DOE-contracted study concluded that, in order to improve estimating accuracy in the future, a consistent system measuring the thoroughness of project definition, the degree of technological complexity, and the variety and type of contaminated media and contaminants present should be developed and implemented at DOE.[7] In December 1991 a peer review panel of experts convened by DOE issued a report and confirmed

[6]A "bottoms-up" technique refers to the use of a set of drawings or specifications to determine the material quantities required to perform a discrete task and adding to these quantities, direct labor, equipment, and overhead costs.

[7]DOE officials said that, in certain cases, we excerpted statements from the DOE-contractor study and used them in improper context. However, as part of our work, we discussed the contents of that study with one of the study's authors, who agreed with our presentation of the facts.

the soundness of the approach advocated in the DOE-contracted study. The peer review report is currently being reviewed by DOE.

Check Estimates Have Not Been Routinely Prepared

A "check estimate" is an estimate developed by DOE that has the express purpose of serving as an analytical tool to validate, cross-check, or analyze an original estimate usually developed by the DOE contractor undertaking the project.[8] DOE guidance recommends that a check estimate be prepared for validating project estimates. We found during our review, however, while DOE has sought to validate the project estimates supporting its 1991 5-year plan, few check estimates have been prepared.[9] Moreover, those few check estimates that have been prepared suggest that DOE contractors may be overestimating project costs.

DOE site contractors have estimated the costs of approximately 1,600 projects supporting the funding requested in the Department's 1991 5-year plan. Of that number, EM officials could only identify relatively few cases in which DOE or others have prepared an estimate to check the quality of the contractors' estimates.[10] The cases that were checked included the following:

- Oak Ridge/K-25 site solar pond cleanup: The contractor's cost estimate to DOE was $157 million compared with the DOE program office's cost estimate of $50 million to $70 million.
- Pantex: EM audited subparts associated with three projects and check estimates showed that each was overstated in cost. Collectively, the site's cost estimate for the three project subparts was $9.7 million compared with the audit's estimate of $8.2 million.
- Los Alamos National Laboratory: EM audited three projects but was able to prepare check estimates on only two because of insufficient supporting

[8]According to a DOE official, a check estimate is prepared by the DOE program office proposing a project. An independent cost estimate is prepared by DOE's Office of Independent Cost Estimating and is done only for a project that has been designated as a major system. Of the four environmental restoration subprograms that have been designated as major systems, the former weapons sites and the uranium processing sites had independent cost estimates prepared in 1991, which corresponded to the contractor's estimates; the Fernald site has not had an independent cost estimate prepared since 1988; and the Weldon Spring site is scheduled to have an independent cost estimate prepared later this year.

[9]EM has been conducting cost estimating audits and plans to prepare a summary report by June-July of 1992. As part of that audit effort, EM intends to prepare check estimates, on a sample basis, for 15 to 20 environmental restoration projects. The results of EM's check estimates at selected sites are discussed later in this report.

[10]DOE officials also advised us that, at the field office level, some offices have initiated the development of check estimates. For example, DOE officials said, the Albuquerque field office reviews and conducts spot check estimates of unit costs for environmental restoration projects.

information on the third.[11] One check estimate showed an understatement in cost and the other showed an overstatement. Collectively, the site's cost estimate for the two projects checked was $12.2 million compared with the audit's estimate of $4.9 million.

- Various Richland environmental restoration projects: EPA Region X and the State of Washington Department of Ecology jointly determined that the management and budgeting practices of DOE/Richland and its contractors were inadequate to ensure the development of valid cost estimates and efficient use of funds. For one project, it was determined that the contractor's estimate was $270 thousand to $354 thousand (or 2.2 to 3.4 times) higher than private sector estimates.

In each case, DOE is working with the contractor to resolve cost differences. However, as the study by EPA Region X and State of Washington pointed out, such cost differences suggest that DOE is not devoting sufficient resources to routinely reviewing contractors' work. In this regard, the joint study found that one DOE person at Richland had to review contractor cost estimates for 325 projects within a 2-week period of time. Similarly, DOE officials at Idaho Falls told us they did not do an in-depth review of contractor cost estimates last year because of a lack of resources. Such information suggests that DOE may need to increase the resources devoted to overseeing contractors and thereby increase the number of check estimates that are routinely prepared.

Subsequent to our review, the DOE Secretary—as discussed in chapter 1—asked the Department's Office of Procurement, Assistance, and Program Management, in September 1991, to conduct an independent cost evaluation of all project-specific data supporting the 1991 5-year plan. The evaluation determined that EM's estimated fiscal year 1993 funding needs of $6.9 billion for environmental restoration and waste management contained excessive amounts of contractor overhead and contingency and should be reduced to $5.3 billion. The $5.3 billion corresponds to EM's official budget request for the fiscal year. At the end of our review, it was unclear if check estimates would be routinely prepared as a part of the Department's annual budget exercise. DOE officials told us they are considering using check estimates to prepare next year's budget but have not yet made any official decision.

[11]EM also attempted to prepare check estimates at the Oak Ridge National Laboratory and Fernald but were unable to complete those estimates because of the lack of sufficient supporting information.

Developing a Comprehensive Information System Capable of Tracking Cost Growth

DOE has spent more than 3 years and $3.8 million developing a comprehensive information system that, among other things, would track cost growth. This system called the "Waste Information Network" (WIN) is still not fully operational. Although the system contains some cost data, it cannot track the changes in a project's total estimated cost from year to year to determine the extent of cost growth.[12]

According to an early EM draft management plan, WIN was intended as a national information data base[13] for all environmental restoration activities to be used by DOE headquarters, field, and contractor staff.[14] Among the intended features of WIN was a means for documenting the status of environmental restoration activities, including actual and projected costs. However, during our review, we noted that WIN included only partial information on DOE's environmental restoration cleanup projects.[15] The system also did not contain total estimated cost information on those projects that have already been baselined precluding it from reporting on cost growth.

Moreover, because it has taken such a long time for WIN to become fully operational, some DOE field offices have been developing their own tracking and monitoring systems that may not be compatible with WIN. For instance, according to an official of the contractor developing WIN, there is known incompatibility between the type of data stored on WIN and on the information system in place at DOE's Los Alamos National Laboratory, a part of the Albuquerque field office. In addition, we noted that the contractor developing WIN at DOE's Oak Ridge field office also manages the

[12]We found one data base on WIN—the Planning, Budgeting, and Control System—does contain project-specific information supporting DOE's 1990 and 1991 5-year plans. However, acquiring meaningful cost growth information from this system is difficult because the number of projects supporting each 5-year plan has changed and so has the control number used to identify specific projects. For instance, for the Fernald site, the system shows environmental restoration work broken down into 10 projects in the 1990 5-year plan and into 18 projects in the 1991 5-year plan. Using the project's control number as a guide, within this system for Fernald only four projects are traceable from DOE's 1990 to 1991 5-year plan.

[13]The WIN system is currently composed of three data bases—the Planning, Budget, and Control System; the Environmental Restoration Information System; and the Waste Management Information System. Reference throughout this report to the WIN system is referring only to the first two data bases because of their direct support of DOE environmental restoration program activities.

[14]DOE officials indicated that the current management plan drafts are now less-specific on the role of WIN.

[15]An official for the DOE contractor developing WIN said the system, as of October 1991, contained about 50 percent of the release site data (contaminants, location, and media) and about 90 of the project management data (scope, cost, schedule, and status). The official added that WIN contained no monthly data from DOE's Fernald site because officials from that site maintained they were never instructed to provide such data to WIN.

DOE site at Oak Ridge but has not been using WIN because, according to contractor personnel, it has not been ordered to do so. Alternatively, these personnel told us they are looking at possibly purchasing a separate system to satisfy their environmental restoration planning, budgeting, and cost control needs.

To track environmental restoration information including cost, DOE field offices are using a variety of information systems. Two separate DOE contractors, which operate at several different DOE sites, have apparently opted to install a different type of environmental restoration tracking system at each site. For instance, for one contractor, Control/Microframe is the system of choice at Idaho Falls, Macintosh/Excel is the system of choice at Richland, and Timeline/Tracer is the system of choice at Savannah River. For the other contractor, Microplanner Expert is the system of choice at Idaho Falls, Artimus is the system of choice at Rocky Flats, and Timeline/Tracer is the system of choice at Mound.

The use, across the DOE complex, of various information systems that may not be compatible with WIN can be traced, we believe, to two causes. First, DOE has not identified the specific data required to be stored on WIN and disseminated those data requirements to the field. Second, no DOE office has been checking on these systems to determine their data compatibility with WIN. Regarding the latter, according to an official of the contractor developing WIN, checking on the data compatibility of different information systems used across the DOE complex with WIN should be the contractor's responsibility, but no one in DOE has asked their company to do so.

There are many reasons why it has taken DOE so long to make WIN operational. According to DOE officials, they needed time to assess the system and to determine if WIN could be an effective tool for EM. Furthermore, they told us that key personnel required to oversee the development of WIN were not on board. We believe, however, there were other contributing factors. These factors include not appointing a full-time EM project manager for WIN and not issuing an order to the field offices declaring WIN the official repository for DOE environmental restoration information. These latter factors were cited as being necessary to ensure the successful implementation of WIN in a March 1990 DOE study of that system.

At the end of our review, DOE was taking actions to evaluate and address WIN. Because of WIN's problems, EM, in late 1991, developed and instituted a new progress tracking system that will not monitor cost growth but will

monitor the expenditure of environmental restoration funds. If WIN becomes fully operational, an EM official advised us, this separate system may become a component of WIN.

Furthermore, the EM information resource manager told us the Department has recently awarded work for a contractor to independently evaluate the problems, status, and future of WIN. We observed, however, that the scope of work for this contract is explicitly directed toward only an evaluation of WIN. With the advent of headquarters' and field office WIN-related information systems, it is not clear that WIN is DOE's best and only choice for departmentwide environmental restoration information. Even if WIN is operational soon and works well, it will provide some useful information but may still not report cost growth.

DOE officials, in commenting on our observations, said formal policies and procedures are being finalized to reflect information systems development activities in EM. Field office systems as well as headquarters systems are and will be reviewed prior to their being implemented. In addition, a plan is being developed for an integrated information system for EM. Furthermore, data requirements, when identified, will be implemented and will address the data requirements of each EM office.

Sharing the Lessons Learned About Environmental Restoration

It is DOE's policy that information gained, or lessons learned, about environmental restorations should be generated and shared to let managers know what is working well and what is not. In practice, however, we found that DOE contractors performing environmental restoration work have been sharing this information—including both "bad" and "good" experiences—only to a limited degree. Absent an exchange of lessons-learned information, the possibility is increased that environmental restoration mistakes can be made or repeated at other DOE sites performing similar work. In our review of DOE's efforts to clean up solar ponds across the DOE complex, we noted two instances in which lessons-learned information was not generated and shared, thereby increasing the problems encountered and the costs incurred at one DOE site.

DOE has many vehicles for sharing lessons-learned experiences. One of DOE's principal means is through the Department's unusual occurrence reporting system. Because the system is implicitly designed for reporting problems that develop, it is not intended to document good experiences or situations that go well. However, if an event (1) seriously affects the

standard purpose of DOE facilities, (2) affects the health and safety of the public, or (3) has a noticeable adverse effect on the environment, a short-term notification followed by an unusual occurrence report should be prepared alerting upper level DOE management to the event including the lessons that were learned.

We have found historically, however, that such reports have not been consistently prepared. In a 1989 report,[16] we noted that a total of only 39 percent of the events occurring between 1982 and 1987 at DOE's Savannah River Plant that were identified by the contractor as having "significant consequence or hazard potential" were reported to DOE as unusual occurrences. This underreporting problem, that report concluded, was primarily due to inadequate contractor oversight by DOE personnel.

During this review, we also noted that DOE did not prepare an usual occurrence report on one of the three projects we examined in detail.[17] As discussed in chapter 2, problems have been encountered cleaning up solar ponds at Oak Ridge, Tennessee. Once the problems were detected, a compliance investigation was undertaken and documented but an unusual occurrence report was not prepared. Thus, anyone querying the Department's unusual occurrence reporting system would not have discovered the problems that occurred.[18]

According to DOE officials, there are three other means in addition to unusual occurrence reporting by which lessons-learned information is shared. Technical demonstration projects are held at various DOE sites with participation from personnel across the DOE complex to share technology. In addition, a waste management conference is held each year in which technical papers on environmental restoration topics are presented. Furthermore, commencing in mid-1990, one DOE contractor began holding meetings for company officials who provide environmental restoration services at various DOE sites.[19]

We determined, however, that while each means is helpful, none represents a systematic way of sharing information. For instance, the

[16]Nuclear Health and Safety: Savannah River's Unusual Occurrence Reporting Program Has Been Ineffective (GAO/RCED-90-53, Dec. 20, 1989).

[17]We noted, on the other hand, DOE did prepare unusual occurrence reports on the other two projects.

[18]Though a lessons-learned memorandum was generated as a result of the investigation undertaken, we found it was not included in the lessons-learned information system maintained by the DOE contractor operating the Oak Ridge, Tennessee, site.

[19]DOE also sponsors numerous technical conferences and seminars.

technical demonstration projects, we noted, are an attempt to integrate new and evolving technologies into the environmental restoration program but not technologies already proven to be successful at a particular DOE site. In addition, the annual waste management conference, we observed, is a symposium for presenting technical papers only on selected cleanup experiences and other topics. Furthermore, the contractor's meetings, we found, did not include participation from other DOE contractors, and none of the other contractors we contacted had commenced similar meetings within their organizations.

According to a senior official in DOE's Office of Technology Development, the Department has a long way to go in sharing lessons-learned technical information. In this DOE official's view, respective DOE field offices and contractors have been entrenched for decades in protecting their own data with a tendency that mistakes are repeated DOE-wide. What is needed to better exchange technical information, this official believed, is an infrastructure that emphasizes communication through electronic mailings and workshops.

Absent some type of communication infrastructure, we identified—during our review—two instances in which we believe lessons-learned information was not shared. First, because of not generating and sharing lessons-learned information from the Rocky Flats, Colorado, solar pond cleanup project, mistakes that were made in this project have been repeated at a similar project at Oak Ridge, Tennessee. Basically, the mistakes made at both facilities included (1) poor project management; (2) the absence of quality assurance; and (3) improper training of the operators involved in mixing the pond sediment with cement, resulting in poorly solidified waste. Just where the responsibility lies for the lack of communication and for mistakes being repeated in this one instance is unclear. DOE/Oak Ridge officials said they could have avoided making certain mistakes if Rocky Flats had conducted a detailed investigation of the problems encountered, as Oak Ridge had done, and generated lessons-learned information.[20] Conversely, an official at Rocky Flats said Oak Ridge should have been more attentive to what was occurring across the DOE complex.

In a second instance, we also believe it was a mistake, or benefits lost in not sharing a "good" experience, for personnel at Oak Ridge, Tennessee, to attempt to place the pond sediment in unlined steel drums when the 2

[20]DOE officials at Rocky Flats did prepare an unusual occurrence report on the solar pond cleanup project but that report only indicated, on a lessons-learned basis, that Rocky Flats had not developed and installed an adequate solidification process.

years before, personnel at Richland, Washington, determined it was best to place their pond sediment in lined steel drums. In reflection, the compliance investigation at Oak Ridge confirmed this was a mistake and determined—as discussed in chapter 2—that the unlined steel drums used to contain the sediment were incompatible with the waste leading to numerous corroded and leaking drums. According to the DOE/Oak Ridge project manager for the pond solidification project, personnel involved with the cleanup there have no excuses. They simply did not check on what else was being done across the DOE complex and what was working.

In September 1991 EM officials told us that they recognized that the Department could do a much better job of sharing lessons-learned environmental restoration information. Consequently, they said the Department had recently contracted for the development of a system containing such information with the system scheduled to be operational by spring 1992.[21] Once this system is developed, it is unclear how DOE will avoid the underreporting problems that have plagued the Department's unusual occurrence reporting system. There has been a tendency within DOE to not admit that mistakes have been made or to be unwilling to share those mistakes with the world. Therefore, DOE may need to ensure that "bad" as well as "good" experiences are entered into the system and that mistakes are not repeated because the system is not used.

Conclusions

To be able to control cost growth, DOE needs to utilize certain basic management tools. These basic management tools, however, are not a panacea and will not in themselves reduce the substantial cost growth the environmental restoration program has experienced. However, at a minimum, they should put DOE in a better position to identify and understand abnormal cost growth and deal with it.

First, DOE needs to estimate, or baseline, the total costs, schedule, and technical progress necessary to complete the projects comprising the entire environmental restoration program. Doing so would put DOE in accordance with OMB and departmental guidance and would give DOE the performance information it needs to more fully understand cost growth. Once baselines are established, any significant changes, such as a dramatic cost growth, to these baselines must adhere to DOE's policy. This policy requires that significant changes to any baselines receive senior DOE

[21]DOE officials maintained that the communications literature demonstrates that informal mechanisms for disseminating scientific and technical information are much more effective than formal systematic approaches but that the Department also needed a lessons-learned information system.

management's attention and consent. DOE is currently developing baselines for the entire environmental restoration program.

Second, DOE needs to have a consistent process for estimating environmental restoration costs. Because DOE lacks such a process, inconsistent cost estimating apparently has occurred. To ensure greater cost estimating consistency, DOE must develop a uniform method of estimating costs and must prepare, on a regular basis, cost estimates to check on the quality of the estimates generated by its contractors. Only a limited number of check estimates have been prepared, and those checks suggest that DOE contractors may be overestimating project costs. Both OMB and DOE have recently recognized the need for check estimates and have been carrying out studies whereby check estimates for the fiscal year 1993 budget have been prepared. It is unclear, at this time, the extent DOE will use check estimates in the future. We believe all future environmental restoration projects that experience a higher degree of cost growth would benefit from check estimates.

Third, DOE needs an information system that can identify and analyze the projects that are experiencing a higher degree of cost growth. During this review, DOE was generally unable to provide us with project-specific cost growth information. Although DOE has spent more than 3 years and $3.8 million developing a system originally intended to monitor environmental restoration cost growth, we found this system—called WIN—was still not fully operational. Furthermore, because WIN has taken such a long time to become operational, some DOE field offices are developing their own tracking and monitoring systems which, at least in one instance, is not compatible with WIN.

Finally, DOE needs to develop a lesson-learned information system. In visiting five separate DOE field offices, it became clear that lessons-learned information is shared only to a limited degree. We believe sharing such information is particularly important given the large number of DOE environmental restoration projects to be undertaken, many of which are similar and could benefit from previously gained information. To the Department's credit, DOE officials said they recognize that the Department could do a much better job of sharing lessons-learned information. Consequently, the Department has recently contracted for the development of a system containing such information. We believe, however, that if certain steps are not taken, underreporting, which has plagued the Department's unusual occurrence reporting system, could also befall this lessons-learned information system too.

Recommendations

To improve the management of the environmental restoration program and better control cost growth, we recommend that the Secretary of Energy

- complete baselining of the environmental restoration program as soon as possible and monitor this baseline to ensure that changes made are in accordance with departmental guidance;
- develop guidance specifying a consistent cost estimating process to be used throughout DOE and assess annually which environmental restoration projects should receive check estimates;
- establish a reliable management information system that will monitor the degree of and the reasons for environmental restoration cost growth and resolve any incompatibility between this system and individual information systems being developed by DOE field offices; and
- once the lessons-learned environmental restoration information system is developed, monitor its use to ensure that "bad" as well as "good" experiences are entered into the system and that mistakes are not repeated because the system is not used.

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.	James E. Wells, Jr., Associate Director William F. Fenzel, Assistant Director Robert J. Baney, Evaluator-in-Charge

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use $300

First-Class Mail
Postage & Fees Paid
GAO
Permit No. G100

Ordering Information

The first copy of each GAO report is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20877

Orders may also be placed by calling (202) 275-6241.