United States General Accounting Office

GAO

Report to Congressional Committees

April 2004

NUCLEAR WASTE CLEANUP

DOE Has Made Some Progress in Cleaning Up the Paducah Site, but Challenges Remain

GAO-04-457

April 2004

NUCLEAR WASTE CLEANUP

DOE Has Made Some Progress in Cleaning Up the Paducah Site, but Challenges Remain

GAO Accountability • Integrity • Reliability

Highlights

Highlights of GAO-04-457, a report to congressional committees

Why GAO Did This Study

In 1988, radioactive contamination was found in the drinking water wells of residences near the federal government's uranium enrichment plant in Paducah, Kentucky. In response, the Department of Energy (DOE) began a cleanup program. In 2000, GAO reported that DOE faced significant challenges in cleaning up the site and that it was doubtful that the cleanup would be completed as scheduled by 2010 and within the $1.3 billion cost projection. GAO was asked to determine (1) the amount of money DOE has spent on the site, the purposes for which it was spent, and the estimated total costs for the site; (2) the status of DOE cleanup efforts; and (3) the challenges GAO previously identified that continue to be issues for DOE.

What GAO Recommends

GAO recommends that DOE (1) involve Commonwealth of Kentucky and EPA early in the development of both overall cleanup plans and specific projects to resolve concerns and reach more timely consensus on cleanup decisions and (2) in conjunction with Kentucky and EPA, identify external technical peer review groups with environmental cleanup expertise to facilitate timely resolution of any future differences. In commenting on the report, EPA and Kentucky agreed with the report's two recommendations. DOE provided technical comments, but did not comment on our recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-04-457.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Robin M. Nazzaro at (202) 512-3841 or nazzaror@gao.gov.

What GAO Found

From fiscal year 1988 through 2003, DOE spent $823 million (in 2002 dollars) at the Paducah site. Of this total, DOE spent about $372 million (45 percent) for a host of operations activities, including general maintenance and security; $298 million (36 percent) for actions to clean up contamination and waste; and $153 million (19 percent) for studies to assess the extent of contamination and determine what cleanup actions were needed. DOE currently projects that the cleanup will take until 2019 and cost almost $1.6 billion to complete—9 years and about $300 million more than DOE's earlier projection. The $1.6 billion, however, does not include the cost of other DOE activities required at the site after the plant ceases operations, including final decontamination and decommissioning of the plant and long-term environmental monitoring. DOE estimates these activities will cost almost $5 billion and bring DOE's total costs at the site, including the $823 million already spent, to over $7 billion through 2070 (in 2002 dollars).

DOE has made some progress in cleaning up contamination and waste at Paducah, but much of the work remains to be done. For example, while DOE has removed about 4,500 tons of scrap metal, almost 50,000 tons of contaminated scrap metal remain. Similarly, while DOE's pilot test of a new technology for removing the hazardous chemical trichloroethene (TCE) from groundwater at the site had promising results—removing about 99 percent of the TCE in the test zone—the technology will not be fully implemented for more than a year.

Two of the four challenges GAO identified in 2000—DOE's plans to use untested technology and questionable assumptions that funding for the cleanup would increase—no longer pose the impediment to the cleanup they once did. Two others—uncertainty over the scope of the cleanup and difficulty obtaining timely stakeholder agreement on the cleanup approach—are the principal challenges that remain. First, the actual scope of the cleanup is not yet known. As a result, any additional cleanup actions, the costs of those actions, and the time frame for DOE to implement them are also unknown. Second, DOE and the regulators—the U.S. Environmental Protection Agency (EPA) and Kentucky—have had difficulty agreeing on an overall cleanup approach, as well as on the details of specific projects. Over time, these disagreements have undermined trust and damaged the parties' working relationship. After involving EPA and Kentucky early in the cleanup planning process, as it has done successfully at other sites, DOE officials discontinued this approach early in 2001, due in part to concerns about the growing cleanup scope, associated costs, and that the planned actions were excessive in relation to the risk. The result was an almost 2-year dispute that delayed progress. This poor working relationship has also prevented the parties from quickly reaching agreement on the technical details of specific projects. Unless DOE and the regulators can reach and maintain agreement on key aspects of the cleanup and quickly resolve technical differences, progress at Paducah could continue to be plagued by delays.

Contents

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
DOE	Department of Energy
DMSA	DOE material storage area
EPA	U.S. Environmental Protection Agency
PCB	polychlorinated biphenyl
TCE	trichloroethene
USEC	United States Enrichment Corporation

GAO
Accountability * Integrity * Reliability

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

April 1, 2004

Congressional Committees

The federal government's uranium enrichment plant at Paducah, Kentucky, has a long history of contamination problems. The plant, which enriches uranium for commercial nuclear power plants, is located on about 3,500 acres in western Kentucky and continues to operate under a lease to a private company, the United States Enrichment Corporation (USEC). Plant operations have contaminated the site over time with radioactive and hazardous substances, including technetium-99 (a radioactive fission product), polychlorinated biphenyls (PCBs), uranium, and volatile organic compounds such as trichloroethene (TCE). In 1988, after contaminated groundwater was found in nearby residents' wells, a sitewide review identified contaminated surface water and soils within and outside the site. As a result, the Department of Energy (DOE) began a cleanup program to identify and remove these hazards. DOE's Office of Environmental Management has overall responsibility for the site cleanup being performed by its contractor, Bechtel Jacobs. Other stakeholders include the U.S. Environmental Protection Agency (EPA) and the Commonwealth of Kentucky (Kentucky), both of which have regulatory responsibilities and participate in cleanup decisions.

In April 2000, prompted by continuing congressional concerns, we reported that DOE faced significant challenges in cleaning up the Paducah site.[1] These challenges included (1) the planned use of unproven technologies to treat TCE contamination; (2) assumptions that annual federal funding for the cleanup would increase; (3) uncertainties about the nature, extent, and sources of the contamination to be cleaned up; and (4) optimistic assumptions about reaching timely agreement with both EPA and state regulators on issues such as cleanup levels, strategies, and priorities that could affect DOE's ability to meet its milestones. Given these challenges, we stated that it was uncertain that the cleanup could be completed as scheduled by 2010 and within the $1.3 billion cost projection, which excluded other DOE activities such as the final decommissioning and decontamination of the uranium enrichment plant.

[1]U.S. General Accounting Office, *Nuclear Waste Cleanup: DOE's Paducah Plan Faces Uncertainties and Excludes Costly Cleanup Activities*, GAO/RCED-00-96 (Washington, D.C.: Apr. 28, 2000).

As directed by the conference report for DOE's 2003 appropriations,[2] and because of the Committees' ongoing concerns regarding the limited progress in cleaning up the site, this report discusses (1) the amount of money DOE has spent on the Paducah site, the purposes for which the money has been spent, and the estimated total costs for the site; (2) the status of DOE efforts to clean up the contamination at the site; and (3) those challenges we previously identified that continue to be issues for DOE. We provided preliminary observations on these issues during our testimony at a hearing held in Paducah, Kentucky, on December 6, 2003.[3]

In conducting our work, we met with DOE and contractor officials; reviewed agency documents involving expenditures, cleanup schedules and scope, and cleanup challenges; and visited the Paducah site. We also met with and collected information from officials from EPA and Kentucky. We conducted our review from April 2003 through March 2004 in accordance with generally accepted government auditing standards. Our scope and methodology for this review are presented at the end of this report.

Results in Brief

From fiscal year 1988 through fiscal year 2003, DOE has spent $823 million, in 2002 dollars, on the Paducah site. Of this total, DOE spent about $372 million (45 percent) to pay for operations at the site, including construction, security, general maintenance, and legal costs; $298 million (36 percent) on actions to clean up contamination and remove waste; and $153 million (19 percent) for studies to assess the extent of the contamination and determine what cleanup actions were necessary. Furthermore, although DOE estimated in January 2000 that the cleanup would be complete by 2010 and cost about $1.3 billion, DOE now estimates that the cleanup will take at least until 2019 and cost almost $1.6 billion, due in part to an expanded cleanup scope. That estimate, however, does not include the cost of other DOE activities at the site, including building and operating a facility to convert more than 38,000 cylinders of depleted uranium hexafluoride stored at the site to a more stable form, final decontamination and decommissioning of the uranium enrichment plant

[2]H.R. Conf. Rep. No. 108-10, at 895 (2003).

[3]U.S. General Accounting Office, *Nuclear Waste Cleanup: Preliminary Observations on DOE's Cleanup of the Paducah Uranium Enrichment Plant*, GAO-04-278T (Washington, D.C.: Dec. 6, 2003).

and associated infrastructure after the plant ceases operations, and long-term environmental monitoring at the site. According to DOE estimates, completing these activities will cost almost $5 billion in 2002 dollars. This will bring the total cost of DOE activities at the site, including the $823 million already spent, to over $7 billion in 2002 dollars through 2070.

DOE has moved forward in cleaning up contamination at Paducah since 2000, but progress has been slow for several reasons, including lack of agreement on the cleanup scope and approach, disagreements on technical details of specific cleanup projects, and difficulty resolving regulatory violations. As a result, much of the work identified to date remains to be done. For example, although DOE has tested a new technology for removing the hazardous chemical TCE from groundwater at the site with promising results—removing about 99 percent of the TCE in the test zone—the technology will not be fully implemented for over a year. Similarly, DOE has removed about 4,500 tons of scrap metal, but almost 50,000 tons of contaminated scrap metal remain. DOE also plans to conduct a number of assessments to determine if other cleanup actions, in addition to those already planned, are necessary. For example, DOE will test the groundwater near several areas where waste is buried to determine if contamination from the waste poses a risk above acceptable levels and, if so, what corrective action will be needed.

Two of the four challenges we identified in 2000—DOE's plans to use untested technology and obtaining adequate funding for the cleanup—no longer pose the impediment to the cleanup effort they once did because of actions taken to mitigate their impact. The remaining two challenges—uncertainty over the scope of the cleanup and obtaining timely stakeholder agreement on the cleanup approach—are the principal challenges that remain for DOE to resolve in completing the cleanup at Paducah.

- *Uncertainty about the scope of the cleanup.* The entire scope of and time frames for the cleanup at the Paducah site are not yet known. Although DOE has established completion dates for the cleanup actions already identified, additional cleanup actions may be identified as a result of both studies that DOE plans to conduct and a comprehensive sitewide assessment after the plant ceases operations. However, DOE has not yet decided when these additional efforts will begin. As a result, any additional needed actions, the costs of those actions, and the time frame for DOE to implement them are not yet known. For example, DOE plans to initially cover waste currently buried at 12 separate sites with soil caps as a waste-management measure. As part of the

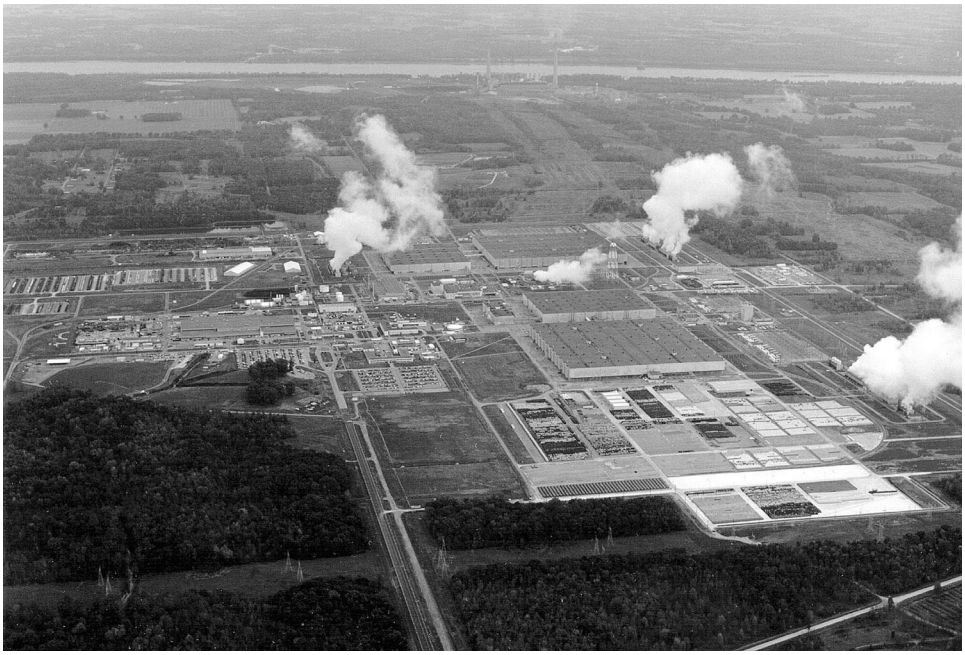
comprehensive sitewide assessment, DOE plans to examine the caps to assess their effectiveness in containing the waste. If DOE finds that contamination poses a risk above acceptable levels, they may need to be excavated, at a cost of about $110 million each. Thus, planning a cleanup project whose future costs and scope are unknown poses a considerable challenge to DOE.

- *Lack of agreement on cleanup approach.* DOE and the regulators have had difficulty in agreeing on an overall cleanup approach, as well as on the details of specific projects. Over time, these disagreements have undermined trust and damaged the three parties' working relationship. After involving EPA and Kentucky early in the cleanup planning process—an approach that has been key to DOE's success at other sites, such as at Rocky Flats in Colorado—DOE officials discontinued this approach early in 2001 and limited the regulators' role to one of reviewing DOE's proposals. This collaborative approach was discontinued, due in part to DOE's concerns about the growing cleanup scope, the associated increase in costs, and that the planned cleanup actions were excessive in relation to the risk to human health and the environment. This resulted in an almost 2-year dispute—from June 2001 to April 2003—among DOE, EPA, and Kentucky that delayed progress. The poor working relationship between DOE and the regulators has also prevented them from quickly reaching agreement on the technical details of specific projects. For example, it took DOE and Kentucky 5 months to agree on the amount and type of data required to confirm that contaminated soil from a key drainage ditch could be disposed of on-site. Unless DOE and the regulators can reach and maintain agreement on key aspects of the cleanup, progress at Paducah could continue to be plagued by delays. To facilitate timely agreement on the cleanup approach and speedy resolution of differences on technical issues to help prevent future delays, this report recommends that DOE involve the regulators early in the cleanup planning process, and that the three parties identify and retain external technical peer review groups with environmental cleanup expertise.

Background

The Paducah uranium enrichment plant, shown in figure 1, is located in western Kentucky, just south of the Ohio River and about 10 miles west of the city of Paducah. The plant—formerly operated by DOE and now operated by USEC—enriches uranium for commercial nuclear power reactors. Since it began operations in 1952, the Paducah plant has processed, or enriched, more than a million tons of uranium.

Figure 1: Aerial View of the Paducah, Kentucky, Uranium Enrichment Plant



Source: DOE.

Plant operations over time have introduced to the site radioactive and hazardous chemical wastes, including technetium-99, PCBs, uranium, and volatile organic compounds such as TCE. In past years, a cleaning solvent containing TCE—much like that previously used by dry cleaners—was used to degrease parts and equipment. In the plant's more than half a century of operations, these various waste materials have contaminated the area's groundwater, surface water, soils, and air.

The Paducah site cleanup is funded primarily through the Uranium Enrichment Decontamination and Decommissioning Fund, which was established by the Energy Policy Act of 1992.[4] The fund receives money from both annual federal appropriations and assessments on commercial utilities. Through fiscal year 2003, the Paducah site had received from the fund annual cleanup amounts ranging from $35.9 million to $97.2 million.

[4]Prior to the Energy Policy Act of 1992, cleanup activities were funded through the normal DOE budget process.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), governs the cleanup of sites placed on the National Priorities List—EPA's list of contaminated sites designated as highest priority for cleanup. Paducah was placed on the list in 1994. CERCLA provides broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. It stresses the importance of permanent cleanup remedies and innovative treatment technologies, and it encourages citizen participation in deciding on how sites should be cleaned up. The Resource Conservation and Recovery Act of 1976, as amended, also comes into play in governing the Paducah cleanup. While CERCLA generally deals with cleaning up inactive and abandoned hazardous waste sites, this act generally governs the safe management and disposal of the huge amounts of hazardous or other solid wastes that are generated nationwide and are currently destined for disposal or recycling. The act permits states, rather than EPA, to assume primary responsibility for implementing its requirements.

At Paducah, the key documents governing the cleanup are a federal facility agreement, the site management plan, and the life cycle baseline. The federal facility agreement—among DOE, EPA, and Kentucky—coordinates the requirements of both CERCLA and the Resource Conservation and Recovery Act for cleanup activities at Paducah and governs the cleanup. Under this agreement, the parties developed a site management plan that lays out DOE's approach for the cleanup and includes near- and long-term milestones and projected activities for the site. This plan is updated annually by DOE and approved by EPA and Kentucky. DOE also uses a life cycle baseline to manage the cleanup. The life cycle baseline contains detailed information on cleanup projects, cost estimates, and time frames for completion and is updated frequently by DOE's contractor to reflect the evolving nature of the cleanup process. For this report, we examined the May 2003 and November 2003 versions of the site management plan and the September 2002 version of the life cycle baseline.

DOE's Office of Environmental Management is responsible for the cleanup at Paducah, including characterizing, treating, and disposing of waste and contamination identified during site cleanup. Prior to January 2001, the Office of Nuclear Energy acted as the "landlord" at the site with responsibilities for maintaining roads, grounds, facilities not leased to USEC, and DOE material storage areas (DMSAs), which have since been transferred to the Office of Environmental Management. Currently, the

role of the Office of Nuclear Energy is limited to administering USEC's lease.

DOE's cleanup strategy for the Paducah site divides the cleanup into seven major categories as follows:

- Groundwater—About 10 billion gallons of groundwater are contaminated with radioactive and hazardous materials.

- Surface water—Contaminated sediments have been discovered in ditches and creeks leaving the site. One of the main sources of this contamination is rain runoff from thousands of tons of contaminated scrap metal stored at the site.

- Surface soils—Soils and sediments at the site have been contaminated by water runoff, spills, and buried waste.

- Legacy waste—Low-level radioactive or hazardous waste generated at the site before 2001 from DOE cleanup or site maintenance activities remains stored at the site.

- DOE material storage areas—160 indoor and outdoor storage areas contain a variety of radioactive, hazardous, and other materials. These areas have been added to the cleanup scope since our 2000 report.

- Burial grounds—Twelve burial grounds contain a variety of waste, including barrels of materials with low levels of radioactivity and hazardous chemicals.

- Decontamination and decommissioning of 17 unused buildings and other structures—These facilities were contaminated during earlier operations; 15 have been added to the cleanup scope since our 2000 report.

DOE's draft fiscal year 2004 site management plan, submitted to the regulators for approval in November of 2003, would commit DOE, EPA, and Kentucky to an accelerated cleanup of the site. Specifically, the plan establishes a two-phased cleanup approach for five of the seven categories—DMSAs and legacy waste are not included but are covered under DOE's life cycle baseline and an October 2003 settlement between

DOE and Kentucky.[5] The two-phase approach consists of a series of early cleanup actions and studies while the uranium enrichment plant is in operation and a second series of actions to be implemented after the plant ceases operations. The primary objectives of the first phase are to prevent on- and off-site human exposure—including exposure of plant workers—to unacceptable risks, and to complete cleanup actions that provide the greatest opportunity for reducing risks. The second phase will include final decontamination and decommissioning of the plant and associated infrastructure,[6] and an evaluation of the entire site to (1) determine the effectiveness of cleanup actions taken in phase I; (2) assess residual risks; and (3) determine what, if any, additional cleanup actions are needed.

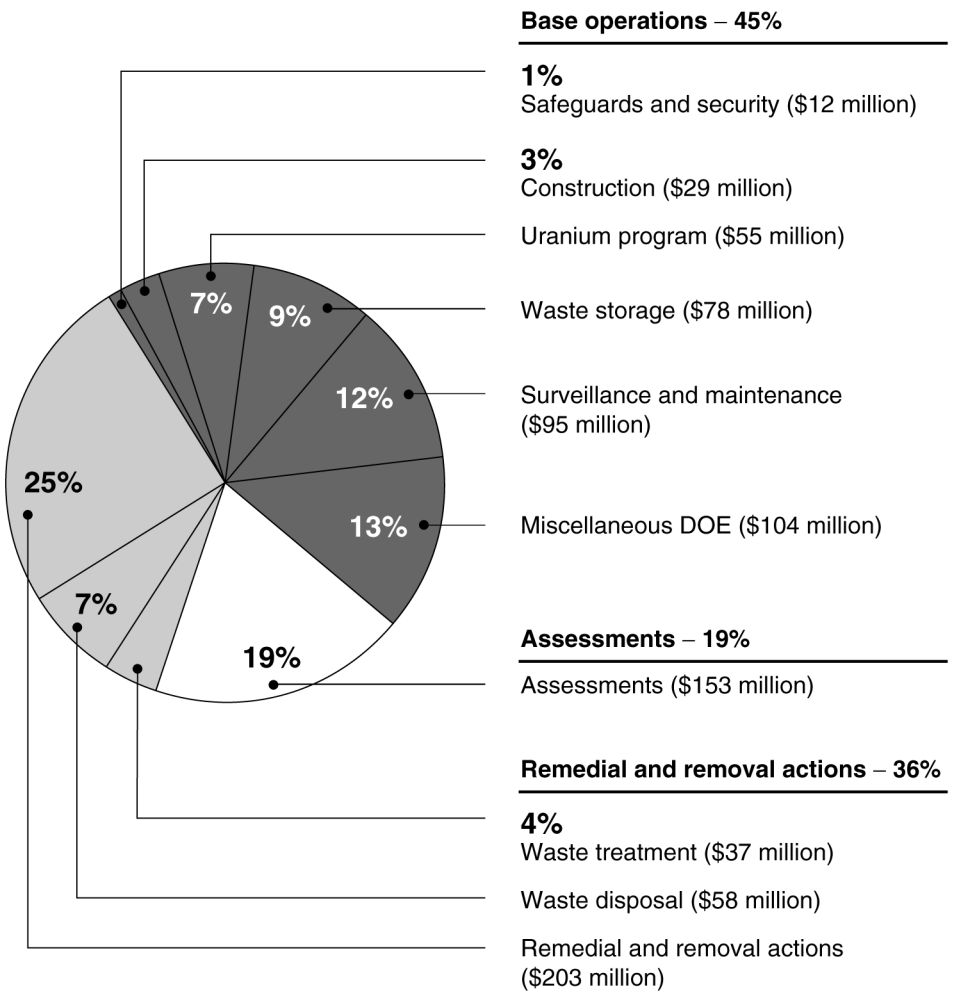
DOE Has Spent $823 Million at the Paducah Site; However, Billions of Dollars Will Be Required to Complete DOE Activities at the Site

From fiscal year 1988 through fiscal year 2003, DOE has spent $823 million (in 2002 dollars) for cleanup and related activities at Paducah. DOE's expenditures fall into three major categories: (1) base operations—including activities to maintain the site, such as security, waste storage, and environmental monitoring, and some administrative and legal costs; (2) removal and remedial actions—activities such as treatment and disposal of waste, and projects to clean up contamination at the site; and (3) assessments—studies done to investigate and characterize, or determine the qualities of, contamination and waste so that DOE's contractor can determine what remedial or removal actions are necessary. As figure 2 shows, 45 percent was spent on base operations, 36 percent on actions taken to clean up contamination and remove waste, and 19 percent on assessments.

[5]According to the DOE site manager for Paducah, DMSAs and legacy waste are not included in the draft 2004 site management plan in order to provide the department flexibility in deciding how best to conduct the overall cleanup.

[6]Final decontamination and decommissioning could begin shortly after the plant ceases operations in approximately 2010 or be deferred to a later date.

Figure 2: Expenditures at Paducah by Category, Fiscal Years 1988-2003



Source: GAO analysis of DOE data.

Note: Total cleanup expenditures for fiscal years 1988-2003, adjusted to fiscal year 2002 dollars, were $823 million. The individual dollar figures noted above do not total $823 million because of rounding.

However, for the past three fiscal years, the percentage of expenditures on remedial and removal actions has increased to about half of all funds expended. This increase can be attributed to increased overall funding for the cleanup and a smaller percentage of funds being spent on assessments. Nevertheless, the percentages spent on cleanup and related activities at Paducah through fiscal year 2003 are similar to those DOE's Office of Environmental Management found for all of its cleanup programs: only

about one-third of the environmental management program budget goes toward actual cleanup and risk reduction work, with the remainder going to maintenance, fixed costs, and miscellaneous activities, contributing to a lack of risk reduction and raising costs for DOE's cleanups.[7] As a result, DOE has since begun to implement accelerated cleanup plans at Paducah and other sites.

DOE's current estimate for completing the cleanup at Paducah is almost $1.6 billion—a $300 million increase over its 2000 estimate—and the completion date has moved from 2010 to 2019.[8] The cost increase is due in part to an expanded project scope since 2000—for example, the inclusion of DMSAs not previously considered part of the cleanup—as well as millions of dollars for site operations for each of the nine additional years of cleanup. However, according to DOE's site manager, DOE has not yet revised its life cycle baseline to reflect the scope changes under the proposed accelerated cleanup approach and DOE may be able to reduce the cost of the cleanup.[9] For example, DOE's life cycle baseline currently includes the cost of excavating five burial grounds at a cost of about $550 million, but DOE's draft site management plan calls only for capping the burial grounds unless further study indicates that the contamination from the burial grounds poses a risk above acceptable levels.

However, the $1.6 billion cleanup estimate does not represent DOE's total responsibilities at the site. In addition to cleaning up the contamination from past activities at the site, DOE will (1) build and operate a facility to convert more than 38,000 cylinders of depleted uranium hexafluoride stored at the site to a more stable form;[10] (2) carry out final decontamination and decommissioning of the uranium enrichment plant and associated infrastructure once USEC ceases plant operations; and (3) perform long-term environmental monitoring at the site, which includes

[7]Department of Energy, *A Review of the Environmental Management Program* (Washington, D.C.: Feb. 4, 2002).

[8]The 2019 completion date represents completion of phase I of DOE's proposed cleanup plan.

[9]The proposed cleanup approach is outlined in DOE's draft fiscal year 2004 site management plan.

[10]Depleted uranium hexafluoride is typically stored in large steel cylinders. Although there are different sized cylinders in use, most of the cylinders contain 14 tons (12 metric tons) of uranium hexafluoride.

activities such as monitoring groundwater and surface water for residual contamination. According to DOE estimates, completing these activities will cost almost $5 billion in 2002 dollars. This will bring the total cost of DOE activities at the site, including remaining cleanup costs and the $823 million already spent, to over $7 billion, in 2002 dollars.[11] Table 1 shows DOE's past expenditures and estimated costs and time frames for future activities at the site.

Table 1: Past Expenditures and Future Estimated Costs and Time Frames for DOE Activities at the Paducah Site

Dollars in millions

Category	Time frame (fiscal years)	Expenditures and estimated costs (2002 dollars)
Cleanup and related activities	1988-2003	$823
Phase I cleanup	2004-2019	1,583
Subtotal cleanup costs		**$2,406**
Decontamination and decommissioning[a]	undetermined	1,612
Construction and operation of depleted uranium hexafluoride conversion facility[b]	2004-2031	878
Long-term environmental monitoring	2019-2070	2,399
Subtotal (other costs)		**$4,889**
Total		**$7,295**

Sources: DOE and GAO.

Note: For years prior to 2003, we used the actual gross domestic product price index from the Bureau of Economic Analysis, Department of Commerce, to convert the estimated costs to 2002 dollars. Otherwise, we used DOE's escalation cost of 2.5 percent as the inflation rate to convert the estimated cost from current dollars to 2003 dollars and subsequently converted the resulting cost in 2003 dollars to an amount in 2002 dollars using the bureau's actual gross domestic product price index.

[a]DOE's estimate of decontamination and decommissioning costs, which was issued in October 2000, assumed that uranium production activities at Paducah would terminate in fiscal year 2007, and final decontamination and decommissioning would occur from fiscal year 2010 to fiscal year 2021. However, DOE has not yet established a schedule for final decontamination and decommissioning at Paducah. DOE's estimate includes a 20 percent contingency. In addition to the costs in DOE's 2000 estimate, this figure includes the cost of constructing an on-site waste disposal cell and remediation of underlying soil and foundations. It does not include decontamination and decommissioning of 2 structures included in the 2000 estimate because these are now included in phase I of the cleanup.

[b]Construction of the conversion facility is scheduled to begin during fiscal year 2004.

[11]Our earlier testimony stated that these costs, in addition to the money already spent on the Paducah cleanup, would total over $13 billion. These preliminary results were represented in actual dollars. Since then we have converted the estimated future costs to fiscal year 2002 constant dollars.

While DOE Has Achieved Some Progress, Much Remains to Be Done

Since 2000, DOE has made some progress in cleaning up the contamination and waste at Paducah, but much of the cleanup work remains to be done. Cleanup progress has been slowed by several factors, including several disagreements over the scope and approach of the cleanup and technical details of specific cleanup projects, and difficulty resolving regulatory violations at the site. For example, an on-site landfill was unavailable for almost a year—from November 2002 to October 2003—as a result of a violation notice that Kentucky issued to DOE for improper waste disposal at the landfill. Until DOE and Kentucky resolved the violation, 25 cleanup projects involving 19,056 tons of various types of waste were delayed.[12] A discussion of the cleanup categories, including DOE's major accomplishments since our 2000 report (as of the end of fiscal year 2003) and the work remaining, follows.[13]

Groundwater

After hazardous and radioactive contamination was found in the drinking water wells of residences near the Paducah plant in 1988, DOE discovered that plumes of groundwater contaminated with TCE and technetium-99 were moving toward the Ohio River.[14] The largest identified source of the contamination is below the plant's C-400 building, where TCE had been used for years to degrease parts and equipment. DOE's strategy for addressing the groundwater contamination is to focus its resources on this and other large concentrations of accumulated TCE at the Paducah site.

To address the source contamination, DOE conducted a pilot test of technology to remove TCE sources from the ground. According to DOE officials, the test results were promising. During the pilot test, about 1,500 gallons of TCE were removed from the largest source—about 99 percent of the TCE in the area treated. However, this represents only about 1 percent of the estimated 180,000 gallons of TCE that had leaked into the ground at

[12]DOE and Kentucky resolved this and other disputed violations in an October 2003 settlement agreement. As part of the settlement, DOE agreed to pay Kentucky $1 million.

[13]In its comment on this report, DOE provided updated information on actions taken for the surface water and DMSA categories which we have included in the report.

[14]A plume is defined as the area occupied by a groundwater contaminant after it has begun to spread, through diffusion or other forces, away from its point of origin.

the site.[15] DOE contractor officials told us that full implementation of this technology at C-400 will not occur until 2006, after the regulators have approved DOE's proposal and DOE has completed the system design. In spring 2004, DOE will conduct a study to investigate the second largest TCE source at the site and determine what additional actions are necessary. In addition to its actions to address major TCE sources, DOE has pumped from the ground and treated about 710 million gallons of groundwater from the contaminated groundwater plumes since our 2000 report to remove TCE and technetium-99 and prevent off-site contamination. About 1.3 billion gallons have been treated this way since the program began. DOE's estimated completion date for currently planned groundwater cleanup activities is 2010. While this end date takes into account construction and implementation of a system to remove contamination, treatment actions could extend well beyond that date.

Surface Water

DOE discovered surface water contamination in creeks, ditches, and sludge lagoons—artificial ponds for the storage of wastewater. Historically, storm water runoff and wastewater from plant operations have been discharged into two streams flanking the plant—Bayou Creek and Little Bayou Creek—through a series of ditches. Each discharge point is monitored to ensure that the waste material entering the stream is within the parameters of the discharge permit issued by Kentucky. Contaminants of concern are technetium-99, solid uranium tetraflouride, uranium-contaminated silts and sediments, radionuclides, metals, and PCBs.

To prevent contaminated runoff, DOE has removed about 4,500 tons of scrap metal from the site since 2000—primarily crushed drums that previously had contained uranium, and aluminum ingots. An estimated almost 50,000 tons of contaminated scrap metal remains to be removed from the site. At the north-south diversion ditch, a key wastewater conduit from the plant, surface water discharges and runoff have been rerouted and piped to bypass contaminated areas, and DOE has begun excavation work to remove contaminated soil. According to DOE officials, DOE has excavated section 2 of the ditch and plans to complete excavation of section 1 by summer 2004—a year ahead of schedule. DOE will also

[15]According to DOE, this estimate is based on the assumptions that TCE was used at the site from 1953 to 1993 and that a fixed amount was released to the ground each day. A high degree of uncertainty surrounds this estimate, and the actual amount of TCE released cannot be verified.

conduct additional investigations and risk assessments to determine what additional actions are required to address contamination associated with internal ditches; outfalls—outlets through which water leaves the site; sections 3, 4, and 5 of the north-south diversion ditch; and the storm sewer system, and whether additional sediment controls are needed. The estimated completion date for all currently planned surface water cleanup activities is 2017.

Surface Soils

Because soil contamination represents a lower risk for exposure and migration than, for example, groundwater contamination, and because other work, such as removal of scrap metal, must be performed before some soils can be reached for assessment and removal, surface soils have been a lower priority than other cleanup categories. However, DOE has performed a preliminary assessment of all accessible surface soils at the site to identify radioactive contamination and protect plant workers and has removed 2,500 cubic yards of contaminated soils—enough to cover a football field 17 inches deep. DOE estimates that it will need to remove and dispose of an additional 87,500 cubic yards of soils by 2015. In addition, other contaminated areas that are not currently accessible because they are still in use by USEC, as well as the soil under the 17 buildings and other structures being decontaminated and decommissioned during phase I of the cleanup, will be addressed after the plant ceases operations during phase II.

Legacy Waste

We reported in 2000 that the equivalent of 52,000 55-gallon barrels of waste was stored in various locations on the Paducah site. Most of this waste is materials that have a low level of radioactivity. All of this waste has undergone an initial characterization to determine proper on-site storage and may require additional characterization to determine proper treatment, if necessary, and disposal. Since 2000, DOE has disposed of the equivalent of over 7,000 barrels off-site and has repackaged another 6,000 barrels' worth of waste that is ready for disposal. DOE plans to remove the 6,000 barrels ready for disposal and characterize and dispose of the remaining legacy waste—the equivalent of over 38,000 barrels—by 2011. In addition to the legacy waste, new waste generated during the course of the cleanup must be disposed of within a year of its generation.

DOE Material Storage Areas

In 2000, we reported that DMSAs were not included in the scope of the Office of Environmental Management's cleanup plan. These storage areas were created in 1996 when DOE accepted responsibility for large amounts of material stored in USEC-leased buildings and outdoor areas to expedite the process USEC used to obtain an operating certificate. The materials in the 160 DMSAs include thousands of barrels of low-level radioactive waste and PCB wastes, barrels labeled as asbestos waste, contaminated uranium processing equipment, various items and containers whose contents are unknown, and scrap metal.

Since our 2000 report, DOE has transferred responsibility for DMSAs from the Office of Nuclear Energy to the Office of Environmental Management so that they can be addressed as part of the comprehensive sitewide cleanup scope. DOE has also ranked the 160 DMSAs at the Paducah site on the basis of their potential to contain hazardous materials or contaminate the environment: 34 are high-priority, 11 are medium-priority, and 115 are low-priority. Of the 160 DMSAs, DOE has completely characterized materials from 28 high- and 10 low-priority DMSAs and has initiated characterization of an additional 41 DMSAs. As a result, two-thirds of the total volume of materials in all 160 DMSAs has been characterized as of March 2004. According to DOE officials, only 0.01 percent of the materials characterized to date have been determined to be hazardous waste. In addition to the progress made in characterizing DMSAs, all materials from 9 high-priority DMSAs—about 15 percent of all materials to be removed during phase I of the cleanup—have been removed and either shipped off-site or placed in an on-site landfill for final disposal. DOE plans to complete its characterization of the DMSAs by the end of fiscal year 2009 and dispose of all free-standing materials from the remaining DMSAs by 2010. Fixed equipment in the DMSAs, such as piping and equipment attached to buildings and facilities, will be disposed of during final decommissioning and decontamination of the site after the uranium enrichment plant ceases operations.[16]

Burial Grounds

The 12 burial grounds at the site contain a variety of waste, including barrels of materials with low levels of radioactivity and/or hazardous chemicals, and pyrophoric uranium, which has a tendency to

[16]DOE estimates that about 810,000 cubic feet of material and equipment are stored in the 160 DMSAs at Paducah. About 180,000 cubic feet of this volume is fixed equipment.

spontaneously combust in the presence of oxygen. To date, DOE's activities at the 12 burial grounds have consisted of studies and environmental monitoring and maintenance, and DOE continues to conduct these studies. Currently, DOE's planning assumption is that they will cap—cover with a layer of soil—the burial grounds and monitor nearby groundwater for contamination to evaluate the effectiveness of the caps. If contamination from the burial grounds is found to pose a risk above acceptable levels, some burial grounds may need to be excavated during phase II of the cleanup at the site, which is not scheduled to start until after the plant ceases operations. Groundwater monitoring will be ongoing through the end of phase I of the cleanup in 2019.

Decontamination and Decommissioning of 17 Unused Buildings and Other Structures

Seventeen buildings and other structures that were originally used as part of the uranium enrichment process, including two 250,000-gallon water storage tanks, a nitrogen generation plant, and an incinerator previously used for disposing of contaminated items are no longer in use and await decontamination and removal. In 2000, we reported that only 2 of 18 unused buildings and structures awaiting decontamination and decommissioning at the site were included in the scope of the Office of Environmental Management's cleanup plan. Since then, 1 of the 18 buildings has been transferred to USEC for use in operations at the Paducah Gaseous Diffusion Plant, according to DOE contractor officials; the remaining 17 are now included in the scope of the Office of Environmental Management's cleanup. DOE has completed its preliminary assessment of the contamination at the 17 buildings and other structures and has begun removing the infrastructure of one of the buildings. In addition, DOE continues to perform surveillance and maintenance on all 17 inactive facilities to prevent significant deterioration of the buildings and other structures until decommissioning and decontamination is complete. DOE's plan proposes to demolish all of these inactive facilities by 2017; the underlying foundations and soil will be addressed during phase II of the cleanup.

While Two Previously Identified Challenges Have Been Mitigated, Uncertainty about the Cleanup Scope and Reaching Stakeholder Agreement on Cleanup Approach Remain the Current Principal Challenges

Two of the four challenges we identified in 2000—DOE's plans to use untested technology and obtaining adequate funding for the cleanup—no longer pose the impediment to the cleanup effort they once did because of actions taken to mitigate their impact. The remaining two challenges—uncertainty over the scope of the cleanup and obtaining stakeholder agreement on the cleanup approach—are the principal challenges that remain for DOE to resolve to successfully complete the cleanup at Paducah.

DOE Has Mitigated the Impact of Two Previously Identified Challenges

In 2000, we reported some of the cleanup technologies contemplated, while not new, were untested for the specific environment in which they were to be applied. Since then, several technologies have been evaluated for treating groundwater for TCE contamination at Paducah, including permeable treatment barriers and six-phase heating.[17] According to DOE officials, removing TCE is the most difficult cleanup task at Paducah.[18] Specifically, TCE is difficult to treat when it has mixed with groundwater and soil—it migrates to the bottom of the aquifer making it difficult to access, and because it dissolves slowly in water, it can contaminate large quantities of groundwater for long periods of time. Permeable treatment barriers, which DOE assumed in 2000 would be the primary treatment strategy for addressing contaminated groundwater, could not be effectively installed at Paducah, according to DOE officials, because of unfavorable soil conditions and potential high costs to maintain the technology.

[17]Using permeable treatment barriers involves injecting a gelatinous, gummy substance called guar gel into the aquifer (an underground geological formation or group of formations that contain water and a source of groundwater for wells and springs) to treat groundwater as it flows through the treated area.

[18]According to DOE officials, Paducah currently has the largest TCE contamination source in the United States. They speculate that if the estimated 180,000 gallons of TCE contaminating the groundwater and associated soil were left untreated, it could take 7,000 years for the contamination to completely dissipate (attenuate) into the environment. However, DOE contractor officials told us that if the TCE is treated aggressively, complete attenuation could occur in roughly 700 years.

Furthermore, such technologies only deal with the contaminated groundwater plume, not the source of the contamination. However, DOE has made progress in testing six-phase heating for removing TCE from the groundwater and soil at Paducah. In the six-phase heating process, electricity is applied to steel rods that have been drilled into the ground to heat the soil. When the soil is hot enough that the TCE and groundwater begin to boil, the resulting vapor is collected and condensed and then filtered to remove the TCE. DOE officials told us the results of the test exceeded their expectations, and their preliminary review of the test results concluded that the technology should be considered for full-scale implementation. DOE officials state that they have submitted a proposed plan to the regulators for approval and plan to begin full-scale implementation in 2006. The officials added that unless problems are encountered when the process is fully implemented, DOE should be able to remove the majority of the TCE source.

In 2000, we also reported that assumptions about future increases in federal funding for the Paducah cleanup could affect DOE's ability to meet cleanup milestones and that, if the planned increases did not occur, the cleanup could be delayed and costs could increase. DOE had estimated that, as the cleanup progressed, its funding would increase from $78 million in fiscal year 2001 to $307 million in fiscal year 2008. We now believe these assumptions were unrealistic considering that funding levels for the cleanup during the seven fiscal years prior to 2001 averaged only $43 million annually. Since 2000, DOE has revised its annual funding assumptions to reflect more consistent and appropriate funding levels. Currently, DOE estimates its annual funding needs at about $100 million.[19] DOE's contractor official for finance stated that annual funding of $100 million is sufficient to complete the cleanup given the scope of work and the 2019 end date proposed in its fiscal year 2004 draft site management plan. In addition, actual annual funding for the Paducah cleanup has increased significantly in recent years. In fact, in fiscal year 2003, Congress appropriated more than DOE's $100 million request. However, if cleanup cost estimates increase, or appropriations for the cleanup are not maintained at their current level, funding could resurface as a challenge.

[19]DOE expects to request a 2.5 percent increase for inflation annually.

Uncertainty Regarding the Scope of DOE's Cleanup Remains a Challenge

In 2000, we also reported that uncertainties about the contamination yet to be cleaned up could result in increased cleanup costs. These uncertainties remain a challenge, in part, for DOE because its fiscal year 2004 draft site management plan does not clearly define the entire scope and time frame for completing the cleanup. For phase I of the cleanup, DOE has identified a series of early actions for five of the seven cleanup categories. Some of these actions are currently under way, and DOE plans to have them all completed by 2019. DOE plans to study the effectiveness of phase I actions as they are completed. Phase II of the cleanup will include the final decontamination and decommissioning of the USEC plant and a comprehensive sitewide assessment that will evaluate the effectiveness of all cleanup actions conducted in phase I and assess the need for additional cleanup actions. For example, DOE's planning assumption is to cover the 12 burial grounds with soil caps during phase I as a waste management measure and then monitor the burial grounds to assess the effectiveness of the caps in containing the waste. If DOE finds that contamination from these sites poses an unacceptable risk, DOE may need to excavate some of the burial grounds, at a cost of about $110 million each, during phase II. Additionally, since DOE does not plan to remove the foundations and soil underlying the 17 unused buildings and other structures to be decontaminated and decommissioned during phase I, additional cleanup actions may be necessary during phase II if the soil is found to be contaminated.

DOE has also not yet determined when phase II will begin. DOE's draft site management plan calls for phase II to begin once the USEC plant ceases operations. USEC has recently announced that the plant will operate until about 2010.[20] However, DOE's site manager stated that several options exist. For example, rather than begin phase II in 2010, DOE could decide to postpone the comprehensive sitewide assessment and some phase II cleanup actions until DOE has completed all of phase I. Alternatively, DOE could decide to start final decontamination and decommissioning shortly after the plant ceases operations in approximately 2010 and conduct phase II activities concurrently with phase I cleanup actions. If DOE selects this option, increases in annual funding would be needed to conduct both phases of the cleanup simultaneously. Until DOE decides when phase II

[20]According to USEC's director of communications, for planning purposes USEC assumes that the plant will be in operation until about 2010.

will begin, any additional necessary actions, the costs of those actions, and the time frame for DOE to implement them are not known.

DOE, Kentucky, and EPA Have Continued to Have Great Difficulty Agreeing on a Cleanup Approach

In our 2000 report, we stated that DOE's assumptions about the timely achievement of regulatory and stakeholder agreement on cleanup levels, strategies, and priorities were optimistic because the regulators had already disagreed with some of DOE's proposed approaches and had not reached agreement on several contentious issues. Since then, DOE and the regulators have continued to have difficulty agreeing on an overall cleanup approach and individual projects. As table 2 shows, the draft fiscal year 2004 site management plan is only the latest of several cleanup plans proposed for the site since 1999, all of which have differed significantly in terms of costs, scope, and time frames for cleanup and were intended as solutions to problems at the site. According to DOE's site manager, DOE has revised its plans for Paducah to incorporate additional scope and ensure that the requirements of the two statutes that govern the cleanup were met. On the other hand, EPA and Kentucky officials told us that these frequent changes have frustrated them and undermined their confidence that DOE would adhere to an agreed-to plan and achieve progress in cleaning up the site. As a result, their working relationship has deteriorated, slowing cleanup progress.

Table 2: DOE Estimates of Paducah Plant Cleanup Costs and Completion Schedule for Several Cleanup Plans Proposed from 1999–2004

Dollars in billions

Date and source of DOE estimate	Estimated cleanup cost	Estimated completion date
Plan presented at October 1999 appropriations hearing	$0.7	2012
January 2000 life cycle baseline	1.3	2010
Amended fiscal year 2003 site management plan	2.5	2030
Draft fiscal year 2004 site management plan	1.6	2019

Sources: GAO and DOE.

The most significant example of the parties' inability to reach and maintain agreement has been a dispute over the fiscal year 2001 site management plan that lasted from June 2001 to April 2003 and slowed overall cleanup

progress. The dispute began when DOE headquarters decided they could no longer support the site management plan assumptions. According to Kentucky officials, this site management plan was developed collaboratively by high-level officials from DOE, EPA, and Kentucky who agreed on an overall cleanup approach. In addition, a midlevel working group was developed, called the Core Team, with representatives from DOE, EPA, and Kentucky who examined the technical requirements to plan individual projects. These two groups identified a number of cleanup actions for implementation, and the parties successfully agreed on the fiscal year 2001 site management plan. However, as a result of the increased cleanup scope identified by the Core Team, the resulting increase in costs, and DOE's Top-to-Bottom Review,[21] DOE headquarters questioned whether the planned cleanup actions were excessive in relation to the risk to human health and the environment and requested additional time from the regulators to further review the site management plan. The regulators denied the request. Because of its continuing concerns that the planned cleanup actions were excessive, DOE subsequently discontinued this collaborative approach, removed decision-making authority from the Core Team, and reduced the regulators' role to reviewing DOE's proposals. According to Kentucky officials, DOE also limited communication between DOE technical staff and the regulators.

While DOE and Kentucky have made some progress in addressing near-term cleanup impediments, the three parties continue to have difficulty in reaching agreement on the overall approach. DOE and Kentucky signed a letter of intent in August 2003, followed in October 2003 by an agreed order that resolved all outstanding Kentucky environmental compliance violations pending against the department. The letter of intent also commits the two parties to promote an accelerated cleanup of the site, which is reflected in the draft fiscal year 2004 site management plan. Nevertheless, according to DOE's site manager, DOE and the regulators are still negotiating the fiscal year 2004 site management plan, submitted by DOE on November 15, 2003. In February 2004, DOE received and responded to formal comments from EPA and Kentucky, and submitted a second draft of the site management plan to the regulators for review. It is uncertain when the 2004 site management plan, which was to be implemented during fiscal year 2004, will be finalized. Furthermore, as discussed earlier, many more decisions about the cleanup's scope and

[21]Department of Energy, *A Review of the Environmental Management Program* (Washington, D.C.: Feb. 4, 2002).

DOE's approach will require agreement by the three parties throughout the life of DOE's cleanup efforts. Early involvement by all three parties could be helpful in avoiding similar lengthy and unproductive cycles of negotiations over the annual site management plans in the future.

Involving the regulators early in planning the overall cleanup approach and specific projects has been a key element of DOE's good working relationship with regulators at other DOE sites. For example, at Rocky Flats in Colorado, DOE involves the regulators when updating the site management plan and developing individual projects. This allows concerns to be communicated and addressed early in the process. According to officials at Colorado's Department of Public Health and Environment, this has reduced the amount of time needed for regulatory reviews, since the number of "comment and revise, comment and revise" cycles has been reduced. Colorado state officials also told us that a successful working relationship requires up front and continual communication beyond just reviewing already developed documents and proposals. Additionally, they stated that a consultative process is an evolving process and must be worked through in good faith by all parties.

Both EPA and Kentucky officials believe that their early involvement would aid cleanup progress at Paducah, such as early involvement in developing the annually submitted site management plan. EPA and Kentucky officials told us that they have been frustrated by their exclusion from the planning process for both the overall cleanup approach and specific projects and feel that the current process is more time-consuming than if they were involved early in the process. Not being involved in the planning process reduces their role to reviewing DOE's project proposals and making comments on those proposals. Comments on proposals often necessitate more than one revision cycle. Multiple revisions can cause schedule changes and delays because DOE's schedule for each project assumes only one revision to respond to regulators' comments. At a December 6, 2003, hearing before the Senate Committee on Energy and Natural Resources in Paducah, the Secretary of Kentucky's Natural Resources and Environmental Protection agency encouraged all parties to revisit the Core Team approach. He urged that a collaborative team be created and empowered to work effectively toward meaningful action. However, DOE's site manager cautioned that such an approach would not necessarily hasten decision making, but agreed that early discussion of technical details could possibly help improve formal submission of DOE cleanup proposals to the regulators.

The poor working relationship between DOE and the regulators has also prevented them from quickly reaching agreement on technical details of specific projects. According to Kentucky officials, DOE proposed using existing data about the north-south diversion ditch—a major wastewater conduit from the plant—to determine whether soil from the ditch could be disposed of in an on-site landfill. However, Kentucky's response to DOE's proposal was that these data were not sufficient because the samples were not representative of all the areas where waste entered the ditch. It took DOE and Kentucky 5 months to agree on a sampling plan. Similarly, DOE and Kentucky disagreed over whether available data demonstrated that the risk reduction to be obtained by installing sedimentation basins was significant enough to warrant their installation. In 2000, DOE planned to install two sedimentation basins at a cost of $4 million each, but the state wanted four basins. Currently, DOE's position is that it does not believe that available data indicates any sedimentation basins are needed, but has agreed to collect additional data and install basins if new information warrants it. DOE and Kentucky are still negotiating the amount and type of data required to determine whether the basins are needed.

As the cleanup progresses and individual projects are designed and implemented, DOE and the regulators will continue to have to reach agreement on the specifics of these projects. Given the past technical disagreements and the vast scope of work remaining at Paducah, additional technical issues such as those experienced with the north-south diversion ditch and the sedimentation basins are likely to arise in the future. However, DOE and the regulators do not currently use any mechanisms such as external technical peer reviews to assist them in resolving technical disputes in a timely manner. A 1997 National Academy of Sciences report on the use of peer review by DOE's Office of Science and Technology cited several benefits of using such reviews to help resolve technical disagreements that could apply to Paducah.[22] According to the report, peer reviews

- provide an effective way to increase the technical quality of projects, thereby enhancing the credibility of project decisions;

- add confidence that those decisions are based on the best scientific and technical information available; and

[22]National Research Council, *Peer Review in the Department of Energy—Office of Science and Technology: Interim Report* (Washington, D.C.: National Academy Press, 1997).

- introduce independent experts to a project who can recognize previously unrecognized technical strengths and weaknesses, challenge the status quo, and identify ways to improve the project that may have been overlooked.

DOE and EPA officials told us that they believe the use of peer reviews could help resolve technical disagreements at the site. Kentucky officials told us that while they believe such reviews have value, they would not want the results of a review to usurp the state's regulatory decision-making authority.

Conclusions

While some progress has been made in cleaning up the site and addressing previously identified challenges, DOE still faces significant challenges in completing the cleanup at Paducah. For example, DOE, EPA, and Kentucky have been unable to agree on an overall cleanup approach and technical aspects of individual projects. Even now, DOE and the regulators are still negotiating the draft fiscal year 2004 site management plan, submitted by DOE in early November 2003, and it is uncertain when it will be finalized. Moreover, despite past difficulties, which have slowed cleanup progress, and the many decisions that must be made in the future regarding scope and time frames, the parties have no mechanisms in place, such as early stakeholder involvement or technical peer review, to help resolve disagreements between the three parties in a timely manner. Unless DOE and the regulators can reach and maintain agreement on key aspects of the cleanup and quickly resolve technical disagreements, progress at Paducah could continue to be hampered by delays.

Recommendations for Executive Action

To help improve the likelihood that DOE and the regulators will reach timely agreement on the cleanup approach, we recommend that the Secretary of Energy direct the Assistant Secretary of the Office of Environmental Management to

- involve the Commonwealth of Kentucky and EPA early in the development of the annual site management plan and specific projects—before submitting formal cleanup proposals for regulatory approval—so that the parties can identify and resolve their concerns and reach consensus on cleanup decisions in a more timely manner, and

- in conjunction with Kentucky and EPA, identify and retain external technical peer review groups with environmental cleanup expertise to facilitate timely resolution of any future differences between DOE and the regulators.

Agency Comments and Our Evaluation

We provided DOE, EPA, and Kentucky with draft copies of this report for their review and comment. DOE's written comments on our report did not address our recommendations, but DOE agreed that it still faces many challenges in accomplishing a safe, cost-effective cleanup at the Paducah site. However, DOE disagreed with our characterization of the department's decision to discontinue the Core Team process and stated that we did not fully acknowledge DOE's improving working relationship with the regulators. DOE also asserted that our report did not provide a balanced presentation of all three parties' responsibilities for the past poor working relationship and delayed progress. Finally, DOE stated that our report did not adequately represent recent progress at the site and that we should not include post-closure environmental monitoring costs in comparison of past cleanup costs or estimates.

We disagree with DOE's view that we did not accurately characterize their decision to discontinue the Core Team approach. Our report clearly cites DOE's rationale for discontinuing its participation. We also disagree that we did not fully acknowledge the progress DOE and Kentucky have made in improving their working relationship. For example, our report does reflect the progress they have made in addressing near-term clean up impediments, such as the signing of the agreed order that resolved outstanding regulatory violations. However, the inability of the three parties to agree to and sign the fiscal year 2004 Site Management Plan, issued in draft in November 2003, indicates that the parties' working relationship continues to be a challenge. We also disagree with DOE's statement that our report does not provide a balanced presentation of all three parties' responsibilities for the past poor working relationship and delayed progress. We cite throughout our report examples of disagreements between DOE and the regulators, providing each side's position on these issues. For example, we describe the disagreement over a sampling plan for soil excavation at the north-south diversion ditch, and present DOE and Kentucky's rationales for including different numbers of sedimentation basins at the site. We have added to the report information on the recent progress made on the north-south diversion ditch, but we disagree with DOE's assertion that we included post-closure costs in our comparison of past cleanup costs and schedules. We have, however,

included post-closure costs as part of our discussion of DOE's total financial responsibilities at Paducah. Nevertheless, we have revised the report to more clearly indicate that post-closure environmental monitoring costs are a separate activity from cleanup activities and related costs.

In their written comments, EPA commended GAO for a fair and balanced analysis of the challenges that the three parties face in the environmental cleanup at the site. Kentucky stated that the report was a fair and accurate assessment of both the progress at the site and the working relationship among the three parties since 2000. Both EPA and Kentucky agreed with the report's two recommendations.

DOE and Kentucky also provided technical comments, which we incorporated into the report as appropriate. DOE's, EPA's, and Kentucky's written comments are presented in appendixes I, II, and III, respectively. Appendix I also includes our responses to DOE's comments.

Scope and Methodology

To determine the amount of money DOE has spent on cleanup-related activities, the purposes for which the money has been spent, and the estimated total for the site, we interviewed officials from DOE's Oak Ridge Operations Office, which is responsible for managing costs for the Paducah site, and reviewed budget documents including appropriation data related to the cleanup. During two visits to the Paducah site, we interviewed the representative from Bechtel Jacobs responsible for finance, reviewed expenditure and project data from 1988 through 2003, and estimated out-year expenditures. Specifically, we obtained and analyzed historic and estimated expenditures for the major expenditure categories of the cleanup—remedial and removal actions, environmental risk assessments, base operations, and their subcomponents—as well as cost estimates for other activities required to close the site, including final decontamination and decommissioning of the uranium enrichment process plant, and long-term environmental monitoring at the site. We reported all 1998-2003 expenditures in 2002 dollars. To assess the reliability of the DOE cost information, we interviewed Bechtel Jacobs staff responsible for the databases containing the data that were provided. We obtained and reviewed descriptions of the databases, how data are entered into the databases, quality control checks on the data, and testing conducted on the data. We also reviewed in detail a year's coding of the data into the categories of interest to us. After taking these steps, we determined that the data provided to us were sufficiently reliable for the purposes of this report.

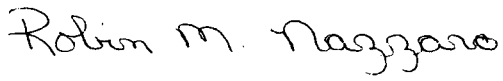
To assess the status of DOE efforts to clean up the contamination at the site, we had Bechtel Jacobs representatives provide a written status of what actions have been taken to address waste and contamination for each cleanup category: groundwater, surface water, surface soils, legacy waste stored at the site, DOE material storage areas, waste burial areas, and contaminated unused building and structures. We also reviewed various documents, such as an evaluation of a new technology for removing TCE from groundwater, to further document actions taken in the various categories. In addition, during two visits to the Paducah site, we interviewed representatives from Bechtel Jacobs responsible for finance and planning, as well as other activities regarding the status of DOE's cleanup. We also interviewed DOE's Office of Environmental Management site officials regarding progress achieved. During the two visits to Paducah, we toured the site to get a further understanding of how these cleanup actions were undertaken and implemented. We also interviewed officials from DOE's Office of Environmental Management in Washington, D.C.

To determine which of the challenges we previously identified continue to be issues for DOE at Paducah, we interviewed the Assistant Secretary and other headquarters officials from DOE's Office of Environmental Management to obtain a high-level perspective on these challenges. We also interviewed DOE's Office of Environmental Management site officials regarding progress achieved under each category. During our two visits to Paducah, we toured the site to develop a firsthand understanding of the cleanup challenges. Furthermore, on each visit we interviewed representatives from Bechtel Jacobs responsible for the cleanup, finance, and planning regarding the status of the challenges and actions taken to address them, and reviewed site-specific documents, including the September 2002 life cycle baseline, the federal facility agreement, and the May 2003 and November 2003 site management plans. To obtain a complete perspective on the four previously identified challenges, we interviewed officials from EPA Region IV, the Commonwealth of Kentucky's Department for Environmental Protection, and the Governor of Kentucky, and reviewed related studies and correspondence. We also interviewed the Chairman of the Paducah Site Specific Advisory Board, attended one of the board's monthly meetings, interviewed the Chairman of the Greater Paducah Economic Development Council and the Chairwoman of the Paducah Chamber of Commerce, and consulted with GAO's Chief Technologist on these challenges. We reviewed studies of various cleanup technologies, site-specific progress reports, DOE's Top-to-Bottom report, and testimony from congressional hearings.

To identify potential solutions to the challenge of a lack of stakeholder agreement on the cleanup approach, we interviewed officials from DOE's Office of the Inspector General and reviewed relevant reports, interviewed DOE and state officials at other cleanup sites where DOE has worked successfully with regulators to implement an accelerated plan such as Rocky Flats, Colorado, and reviewed National Academy of Science reports regarding the benefits of technical peer review.

We are sending copies of this report to the Secretary of Energy, the Administrator of the Environmental Protection Agency, and the Secretary of the Kentucky Natural Resource and Environmental Protection Cabinet. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff have any questions on this report, please call me at (202) 512-3841. Other staff contributing to this report are listed in appendix IV.



Robin M. Nazzaro
Director, Natural Resources and Environment

List of Congressional Committees

The Honorable Ted Stevens, Chairman
The Honorable Robert C. Byrd, Ranking Minority Member
Committee on Appropriations
United States Senate

The Honorable Pete V. Domenici, Chairman
The Honorable Jeff Bingaman, Ranking Minority Member
Committee on Energy and Natural Resources
United States Senate

The Honorable C.W. Bill Young, Chairman
The Honorable David R. Obey, Ranking Minority Member
Committee on Appropriations
House of Representatives

The Honorable Joe Barton, Chairman
The Honorable John D. Dingell, Ranking Minority Member
Committee on Energy and Commerce
House of Representatives

Comments from the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

Department of Energy
Washington, DC 20585
March 12, 2004

Ms. Robin M. Nazzaro
Director, Natural Resources and Environment
United States General Accounting Office
Washington, D.C. 20548

Dear Ms. Nazzaro:

We appreciate the opportunity to review and comment on the General Accounting Office (GAO) draft report entitled *NUCLEAR WASTE CLEANUP: DOE Has Made Some Progress in Cleaning Up the Paducah Site, but Challenges Remain.* We have reviewed the draft report twice and are disappointed that this second version neither fully reflects the extent of the comments and concerns we previously shared with the GAO staff, nor does it fully acknowledge recent significant progress at the site.

See comment 1.

We disagree with the GAO's findings regarding our decision to stop participating in the Core Team process. The report characterizes DOE's decision as cutting off a "collaborative" process with the regulators, which is not accurate. The Core Team was collaborative in concept, but in practice, resulted in staff making decisions without senior management policy input. DOE discontinued its participation on the Core Team to ensure that decisions for the site were made based on risk and regulatory requirements, and that actions were being taken consistent with policy set forth by senior management. Although the Core Team was disbanded, DOE continued to collaborate with the regulators, albeit at the senior management level. Staff was encouraged to continue collaborating and exchanging information as appropriate. DOE and the regulators have made significant progress and working relationships have improved since the signing of the Agreed Order with Kentucky in October 2003. This fact is not properly reflected in the report.

See comment 2.

DOE is concerned that, while the draft report states that the GAO's review covers a time period from April 2003 to March 2004, most of the strides taken in the past six months at the site are not adequately represented. For example, DOE has successfully accelerated its cleanup on two of the five sections of the north-south diversion ditch. Excavation and construction to remove contaminated soils from Section 2 is complete, and Section 1 excavation is projected to be completed this fiscal year, a year ahead of schedule. Your report fails to indicate completion of the Section 2 work and states that DOE is planning to complete the work by 2005.

See comment 3.

In other areas of concern, the report continues to include post-closure environmental monitoring with cleanup costs. Post-closure costs should not be

See comment 4.

Printed with soy ink on recycled paper

See comment 5.

included in comparisons of past cleanup estimates or schedules. Also, although we accept our share of the responsibility, the report does not balance the responsibility for damaged relationships and delayed progress on all parties.

Enclosed are our specific comments addressing our concerns. We agree that DOE still faces many challenges to accomplishing a safe, cost-effective cleanup at the Paducah site. DOE remains committed to meeting our responsibilities and complying with the terms of its agreements with the regulators.

If you have any further questions, please call me on (202) 586-7709, or Mr. William Murphie, Manager Portsmouth/Paducah Project Office, on (859) 219-4001.

Sincerely,

Jessie Hill Roberson
Assistant Secretary for
Environmental Management

Enclosure

The following are GAO's comments on the Department of Energy's letter dated March 12, 2004.

GAO Comments

1. We disagree. We believe that the report accurately describes DOE's decision to discontinue the Core Team process. This approach, established as a result of congressional hearings held in 1999, was designed as a collaborate process to advance progress at the site. Furthermore, EPA and Kentucky viewed this effort as a collaborative process. As we state in the report, DOE became concerned about the growing scope of the cleanup and the associated increase in costs, and believed that the Core Team's recommended actions were excessive. While discussion of the cleanup did continue at the senior management level, according to Kentucky officials and DOE site staff and contractor officials, DOE staff at the Paducah site were instructed by DOE headquarters not to continue discussing the cleanup with regulatory officials.

2. Our report does reflect the progress DOE and Kentucky have made in addressing near-term cleanup impediments, such as the signing of the agreed order that resolved outstanding regulatory violations. However, the long history of mistrust and lack of shared vision on the cleanup approach at Paducah, and the inability of the three parties to agree to and sign the fiscal year 2004 Site Management Plan, issued in draft in November 2003, indicate that the parties' relationship remains a challenge.

3. We have modified the final report to reflect DOE's recent progress on the excavation of the north-south diversion ditch.

4. We disagree with DOE's statement that we included post-closure costs in our comparison of past cleanup costs and schedules. For example, post-closure costs are not included in the comparison of current and past cleanup estimates and schedules presented in table 2. However, because we believe that it is important to provide a complete picture of DOE's financial responsibilities at the Paducah site, we did include post-closure costs as part of our discussion of DOE's total financial responsibilities at Paducah. We have also revised our report to more clearly indicate that post-closure environmental monitoring costs are a separate activity from cleanup activities and related costs.

5. We disagree with DOE's statement that our report does not provide a balanced presentation of all three parties' responsibilities for the past poor working relationship and delayed progress. We cite throughout our report examples of disagreements between DOE and the regulators, providing each side's position on these issues. For instance, we describe the disagreement over a sampling plan for soil excavation at the north-south diversion ditch. We also present DOE and Kentucky's positions over whether available data was adequate to warrant the installation of sedimentation basins at the site.

Comments from the Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

MAR 11 2004

Ms. Robin M. Nazzaro
Director, Natural Resources and Environment
U. S. General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Ms. Nazzaro:

Thank you for the opportunity to review a draft of the forthcoming General Accounting Office (GAO) report entitled *Nuclear Waste Cleanup: DOE Has Made Some Progress in Cleaning Up the Paducah Site, but Challenges Remain* (GAO-04-457). I would like to commend the GAO for a fair and balanced analysis of the challenges the Department of Energy (DOE), Environmental Protection Agency (EPA) and the Commonwealth of Kentucky (KY) face in the environmental cleanup at the Paducah Gaseous Diffusion Plant (PGDP) . I would also like to note that the report is based on a November, 2003, draft DOE Site Management Plan (SMP) about which EPA had serious concerns. The current version of the SMP, delivered as a final draft on February 27, 2004, addresses many of our concerns, and indicates that DOE, EPA and KY may be close to agreement on the overall plan for environmental assessment and cleanup at the PGDP. Reaching consensus on this plan would provide important stimulus to progress of cleanup at this site.

Another significant issue addressed in your report concerns cost and schedule uncertainty in the cleanup of the PGDP. **EPA believes that if DOE plans and implements site studies, whereby actual data will replace estimates and assumptions about the scope of cleanup, uncertainty in cost and schedules can be reduced.** The recommendations in the report that DOE involve the regulators earlier and establish an external peer review group would also expedite the implementation of site studies and cleanup activities.

Again, I would like to thank you for the opportunity to comment.

Sincerely,

J. I. Palmer, Jr.
Regional Administrator

Comments from the Commonwealth of Kentucky

ERNIE FLETCHER
GOVERNOR

LAJUANA S. WILCHER
SECRETARY

COMMONWEALTH OF KENTUCKY
ENVIRONMENTAL AND PUBLIC PROTECTION CABINET
OFFICE OF THE SECRETARY
CAPITAL PLAZA TOWER
FRANKFORT KENTUCKY 40601
TELEPHONE: (502) 564-3350

March 11, 2004

Ms. Robin M. Nazarro, Director
Natural Resources and Environment
United States General Accounting Office
441 G. Street NW, Room 2J27
Washington, DC 20548

Dear Ms. Nazarro:

The Commonwealth of Kentucky's Environmental and Public Protection Cabinet (Cabinet) has received your draft report to Congressional committees regarding the progress of environmental clean up at the Paducah Gaseous Diffusion Plant. I appreciate the opportunity for review and input that GAO has afforded the Cabinet in the formulation of this document.

The Cabinet finds the draft report to be a fair and accurate assessment of both the progress at the site and the working relationship among DOE, USEPA and the Cabinet since 2000. The taxpayers of the United States and the stakeholders of the Paducah Gaseous Diffusion Plant deserve much better than the disputes and cleanup delays chronicled in your report. Please know that a priority of this Cabinet is to work effectively with DOE and USEPA to improve the working relationship described in the draft report.

The Cabinet is encouraged by and agrees with GAO's recommendation that DOE involve Kentucky and USEPA early in the development of both overall cleanup plans and specific projects in order to resolve concerns and reach timely consensus on cleanup decisions. The Cabinet also recognizes the merit of GAO's recommendation that DOE, in conjunction with Kentucky and USEPA, identify external technical peer review groups with environmental cleanup expertise who can facilitate timely resolution of any future differences. To that end, I will direct my staff to explore this recommendation with DOE and USEPA. Lastly in this regard, the Cabinet believes that any peer review group so engaged should be free of any contractual agreements with the agencies, beyond the agreement necessary to conduct the peer review.

Attached please find specific comments on the draft report provided by the Cabinet's Division of Waste Management. These comments are primarily offered to clarify factual information in the draft report.

PRINTED ON RECYCLED PAPER
AN EQUAL OPPORTUNITY EMPLOYER M/F/D

However, there are some comments, particularly pertaining to the burial grounds at the PGDP that speak more broadly to the Cabinet's position with regards to those areas.

I hope you will find this correspondence and the attached comments to be helpful, and again I thank you for the opportunity to review and provide input on this important document.

Sincerely,

LaJuana S. Wilcher,
Secretary

LSW/arh
c: Jessie Roberson, Assistant Secretary, DOE
Allen Barnes, USEPA Region IV
Anthony R. Hatton, KDWM
Mike Welch, KDWM

GAO Contact and Staff Acknowledgments

GAO Contact

Robin M. Nazzaro (202) 512-3841
Sherry L. McDonald (202) 512-8302

Staff Acknowledgments

In addition to the individual named above, Nancy Crothers, Chris Ferencik, Kerry Dugan Hawranek, and Kurt Kershow also made key contributions to this report.

GAO's Mission

The General Accounting Office, the audit, evaluation and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through the Internet. GAO's Web site (www.gao.gov) contains abstracts and full-text files of current reports and testimony and an expanding archive of older products. The Web site features a search engine to help you locate documents using key words and phrases. You can print these documents in their entirety, including charts and other graphics.

Each day, GAO issues a list of newly released reports, testimony, and correspondence. GAO posts this list, known as "Today's Reports," on its Web site daily. The list contains links to the full-text document files. To have GAO e-mail this list to you every afternoon, go to www.gao.gov and select "Subscribe to e-mail alerts" under the "Order GAO Products" heading.

Order by Mail or Phone

The first copy of each printed report is free. Additional copies are $2 each. A check or money order should be made out to the Superintendent of Documents. GAO also accepts VISA and Mastercard. Orders for 100 or more copies mailed to a single address are discounted 25 percent. Orders should be sent to:

U.S. General Accounting Office
441 G Street NW, Room LM
Washington, D.C. 20548

To order by Phone:	Voice:	(202) 512-6000
	TDD:	(202) 512-2537
	Fax:	(202) 512-6061

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm
E-mail: fraudnet@gao.gov
Automated answering system: (800) 424-5454 or (202) 512-7470

Public Affairs

Jeff Nelligan, Managing Director, NelliganJ@gao.gov (202) 512-4800
U.S. General Accounting Office, 441 G Street NW, Room 7149
Washington, D.C. 20548

United States
General Accounting Office
Washington, D.C. 20548-0001

Official Business
Penalty for Private Use $300

Address Service Requested

Presorted Standard
Postage & Fees Paid
GAO
Permit No. GI00