United States General Accounting Office

GAO

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

March 1993

NUCLEAR WASTE

Hanford's Well-Drilling Costs Can Be Reduced

GAO/RCED-93-71

GAO

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

Resources, Community, and
Economic Development Division

B-251312

March 4, 1993

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

Dear Mr. Chairman:

As part of the cleanup of radioactive and hazardous wastes at its Hanford Site in southeastern Washington State, the Department of Energy (DOE) will install almost 900 permanent and temporary monitoring wells in fiscal years 1993-97 at a cost of more than $270 million.[1] Over 500 of the planned wells are temporary. About 400 of the 900 wells will reach the groundwater; the remainder are intended only for taking soil samples. These wells and others to be installed after fiscal year 1997 will provide information on the nature and extent of soil and groundwater contamination. Appropriate strategies can then be developed for cleaning up the approximately 1,500 existing waste sites at Hanford.

Given the large number of wells that will be installed at the Hanford Site and the high cost, you asked us to review Hanford's well-drilling program. Specifically, we reviewed (1) what actions DOE and its contractors have taken to reduce well-drilling costs and (2) what opportunities exist for additional cost savings.

Results in Brief

According to two studies completed in late 1990, the cost of installing wells at DOE's Hanford Site could be reduced through the adoption of more efficient drilling methods. One of the studies, performed by a Westinghouse-led team, found that the overall cost for constructing wells at Hanford had increased by over 250 percent since 1988. Following these studies, DOE directed the Hanford Site contractors to jointly study ways to reduce well-drilling costs. The report summarizing the study's findings was issued in April 1991 and updated about a year later. In total, the report contained 144 recommended actions that, if implemented, could potentially reduce Hanford's well-drilling costs by as much as 50 percent.

Although the Hanford Site contractors have implemented many of the report's recommended cost-saving measures, other actions, if implemented, could further reduce well-drilling costs. These actions

[1]Temporary wells, or boreholes, allow samples to be taken and are then filled in.

include (1) adopting, where appropriate, faster and less expensive well-drilling technologies; (2) using the well-drilling program's work force more efficiently; and (3) centralizing the management of the well-drilling program to improve its effectiveness. However, DOE and the Hanford contractors have taken only limited steps to address these opportunities.

Background

The Hanford Site, a 560-square-mile installation managed by DOE's Richland Field Office, has produced nuclear materials for national defense since 1943. As a result of this production, Hanford today contains an estimated 5 billion cubic yards of solid and dilute radioactive, hazardous, and mixed wastes. About 440 billion gallons of liquid wastes have entered the soil, and over 200 square miles of groundwater below Hanford have been contaminated.

In May 1989, DOE, the Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) signed the Hanford Federal Facility Agreement and Consent Order. This document, commonly called the Tri-Party Agreement, established a 30-year plan to bring Hanford into compliance with the Resource Conservation and Recovery Act of 1976, as amended (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA).[2] To monitor the facilities and/or to assess the nature and extent of contamination below the surface, wells are drilled to the groundwater and into the vadose zone (the unsaturated soil layer above the groundwater).

DOE has contracted with the Westinghouse Hanford Company (Westinghouse) to serve as its Hanford Site operations and management contractor with overall programmatic and technical responsibility for programs responding to RCRA and CERCLA requirements. Kaiser Engineers Hanford Company (Kaiser) is DOE's construction and design contractor at Hanford. Kaiser drills the wells in accordance with letters of instruction from Westinghouse, but Kaiser's performance, like Westinghouse's, is overseen and evaluated by DOE.

Several drilling technologies can be used to install a well. A Westinghouse official estimated that over 90 percent of the existing wells at Hanford were installed using the cable-tool method. In cable-tool drilling, a pipe, or

[2]In general, RCRA requires "cradle to grave" management of hazardous waste by all generators, transporters, and owners/operators of treatment, storage, and disposal facilities that handle hazardous wastes. RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984, also requires the cleanup of such facilities. CERCLA, on the other hand, was created by the Congress to provide for the cleanup of contamination at abandoned, or inactive, hazardous waste sites.

casing, is pounded into the ground as the well is being drilled. Methods used at other DOE sites include auger drilling and air or mud rotary drilling. The auger drilling method uses what is essentially a large drill to bore into the ground. In the rotary drilling method, a drill bit attached to a pipe is rotated to drill the hole. The soil, or cuttings, resulting from the drilling are then removed by forcing either compressed air or a mud slurry down the pipe.

This report focuses on three broad categories of wells—those drilled in (1) areas that are not contaminated by hazardous or radioactive materials and do not require chemical sampling during drilling; (2) areas that are not contaminated by hazardous or radioactive materials but do require periodic chemical sampling; and (3) areas that are contaminated by hazardous and/or radioactive materials and also require chemical sampling. Westinghouse reports that the average cost per foot for wells drilled in these categories between May and December 1991 was $782, $1,179, and $2,069 per foot, respectively. During 1991, wells drilled at Hanford ranged from 25 to 472 feet deep.

Cost of Wells Is High Despite Implementation of Some Cost-Saving Measures

Two 1990 studies reported that the cost of installing wells at Hanford could be lowered. In October 1990, EPA and Ecology completed a study of DOE's estimated budgets for meeting the Tri-Party Agreement milestones.[3] Part of the study assessed Hanford's well-drilling activities. After reviewing Hanford's cost estimates, which were based on the use of the cable-tool method, the study concluded that other proven methods may be able to safely drill wells of sufficient quality to meet DOE's requirements at Hanford. The study reported that, even with the same crew sizes, using the faster air rotary drilling method rather than the cable-tool method could lower drilling labor costs by 70 percent.

In November 1990, an independent review of Hanford's groundwater well drilling and installation operations performed by a Westinghouse-led team confirmed that Hanford's well-drilling costs were increasing.[4] The report concluded that the overall costs to construct a well at Hanford had increased by over 250 percent—from an estimated $35,000 in 1988 to $124,000 in 1990. In addition, the report indicated that the estimated cost

[3]Cost Evaluation Project: U.S. Department of Energy -Hanford Site, Washington State Department of Ecology and U.S. Environmental Protection Agency (Seattle, Washington: Oct. 1990).

[4]Suyama, R.M., Independent Review of Ground Water (RCRA/CERCLA) Well Drilling and Installation Operations on the Hanford Site, Westinghouse Hanford Company (Hanford, Washington: Nov. 21, 1990).

to construct a CERCLA well at Hanford was about 3 times the cost of a CERCLA well at the Umatilla Army Depot in Oregon ($32,000 versus $100,000 a well). The study made numerous recommendations on how well-drilling costs at the Hanford Site could be reduced. In addition, the Westinghouse Environmental Engineering and Technology staff reported in July 1991 that Hanford's drilling costs were higher than those at some other DOE and non-DOE sites. The report noted, however, the difficulty of directly comparing well-drilling costs because each of the sites had many different variables, including the type of well and the well-drilling technology used.

In January 1991, recognizing that well-drilling costs were increasing, DOE (1) directed the contractors to study ways to reduce well-drilling costs and (2) set a goal for Kaiser to reduce overall well-drilling costs by 10 percent between March 1, 1991, and August 31, 1991. Following a jointly conducted value engineering study,[5] Westinghouse and Kaiser issued a report on potential cost savings in April 1991.[6] This report resulted in 104 specific recommendations for reducing well-drilling costs or improving efficiency.

In March 1992, DOE estimated that the recommendations implemented in 1991 had saved about $100 per foot for nonhazardous/nonradioactive wells without samples, $230 for nonhazardous/nonradioactive wells with samples, and $550 for hazardous/radioactive wells with samples. However, the savings were partially offset by the use of more expensive contractor geologists because of staff limitations, as well as changes in methods of assigning costs and other accounting differences. Therefore, DOE concluded that Kaiser did not achieve its intended 10-percent cost-reduction goal.

In March 1992, Westinghouse and Kaiser updated the value engineering study, bringing the total number of recommended actions to 144. On the basis of Westinghouse reports, we estimated that implementing these recommended actions could potentially reduce well-drilling costs by about 51 and 33 percent for nonhazardous/nonradioactive with samples and hazardous/radioactive wells with samples, respectively. As of November 1992, the Hanford contractors had evaluated 115 of the 144 recommended actions. Forty-three were rejected and 72 were

[5]Value engineering is a process used to determine the lowest cost of achieving program goals in compliance with performance, reliability, availability, quality, and safety requirements over the life of the program (the life-cycle cost).

[6]Ground Water Monitoring Wells, Value Engineering Study Report, Kaiser Engineers Hanford, GEP008.91 (Richland, Washington: Apr. 2, 1991).

implemented, resulting in estimated cost savings of about $250 per foot for nonhazardous/nonradioactive wells and over $300 per foot for hazardous/radioactive wells. Some of the most cost-effective actions implemented were

- providing optimum safety and health coverage at well sites, combining site safety meetings, streamlining site safety plans, requiring staff responsible for monitoring for radioactive materials (health physics technicians) to report directly to well sites, allowing site entry without health physics technicians present at the beginning of the day, and using roving site safety officers to oversee drilling at nonhazardous wells instead of requiring full coverage and
- reducing labor, support, and equipment needed at the drill sites by developing special trailers for RCRA and CERCLA sites.

DOE reported that these cost-cutting efforts have reduced drilling costs. In addition, Westinghouse reported that for 20 wells completed between June and September 1992, total costs were about 5 percent below Westinghouse's baseline cost.

Opportunities Exist for Additional Cost Reductions

The Hanford Site contractors have not implemented several cost-saving measures recommended in the value engineering study that could significantly reduce drilling costs for all types of wells. Specifically, costs could be reduced by adopting, where appropriate, faster and less expensive well-drilling technologies and using the drilling work force more efficiently. In addition, centralizing management control of all aspects of well drilling could result in a more effective and efficient drilling program.

Faster, Less Expensive Drilling Methods Can Be Used

Although Westinghouse and Kaiser officials agree that a faster drilling method could be used in many areas of Hanford, contractors used the relatively slow cable-tool method to install over 90 percent of the wells in 1991 and 1992. However, compared with other methods, cable-tool drilling is slow. For example, a 293-foot well that was installed at Hanford in about 5 days using the ODEX (an air rotary drilling system) drilling method would have taken about 30 days using the cable-tool method. According to DOE officials, because total staffing at the drill site does not vary significantly with the drilling method used, slower drilling methods result in proportionately higher costs.

DOE officials said that the cable-tool method has been chosen as the preferred method of drilling in known or suspected contaminated areas. The major advantages of the cable-tool method, according to DOE, are that it protects the health and safety of workers, provides unaltered geologic samples, minimizes cuttings, does not require that anything be added to the cuttings to remove them from the well, and controls the spread of hazardous and/or radioactive contamination. Although cable-tool drilling may be an appropriate technology for drilling wells in contaminated areas, other technologies are available that are faster, less expensive, and meet applicable safety standards. While Hanford uses cable-tool technology on over 90 percent of its wells, other DOE sites we surveyed make more extensive use of faster drilling methods. According to DOE and contractor representatives, these sites have used auger and rotary drilling methods even in hazardous/radioactive areas. In addition, many of the wells to be drilled at Hanford are not in contaminated areas, offering additional opportunities for using other drilling methods. According to information provided by Westinghouse, 377 of the 886 wells to be installed through fiscal year 1997 will be in uncontaminated areas.

The April 1991 Westinghouse and Kaiser value engineering study recommended evaluating seven specific drilling methods that could possibly drill wells faster than the cable-tool method. Of the seven methods recommended, Westinghouse has rejected three—the mud rotary, cable-tool with casing hammer, and remote-operated sonic drilling methods.[7] According to Westinghouse's Manager of Groundwater Well Services, these methods were rejected because they introduced unwanted materials into the soil, were unproven, or were costly. DOE, however, is preparing to implement another type of sonic drilling and also plans to award a contract to use the ODEX drilling method for 15 wells in 1993. As of November 1992, no date had been set for evaluating two remaining recommended methods—the reverse air rotary and large auger methods—although some limited testing of the large auger was conducted in the summer of 1992.

As directed by DOE in January 1991, Westinghouse began field testing a sonic drill rig at Hanford in September 1991. Westinghouse compared the resulting wells with cable-tool wells. The sonic rig drilled at a rate almost double that of the cable-tool rig. Westinghouse determined that, because of the high equipment rental rate, the sonic drilling method cost about 6 percent more overall than the cable-tool method. However, after adjusting for the high rental rate, Westinghouse estimated that the sonic

[7]In the sonic drilling method, vibration and rotary power are used to force the pipe into the ground.

drilling method could reduce the cost of installing shallow (less than 150 feet) groundwater wells by about 33 percent. On the basis of these test results, DOE issued a request for proposal to purchase the sonic drilling system. However, DOE decided that the scope of the contract would not meet their needs and that the cost proposed in the only response to this request was too high. As of December 1992, DOE was discussing a contract with a private vendor to provide sonic drilling services for Hanford. Therefore, the sonic drilling method will not be used until April or May 1993 at the earliest.

The ODEX drilling method, for which testing was completed in 1992, is an improved version of an ODEX that DOE originally tested and rejected in the mid-1980s. As of November 1992, this method had been used at Hanford to drill 12 wells to depths of between 150 and 460 feet. We watched a crew using the ODEX drill in 8 minutes the equivalent of what they could have drilled in an average day with the cable-tool rig. In addition, according to the test report, the improved ODEX generated less waste than the cable tool (3 barrels instead of 17) and satisfied all health and safety requirements. According to Westinghouse estimates, this technology could result in a cost reduction of about 40 percent.

Although DOE is testing some of these drilling technologies at Hanford, the DOE cost-reduction coordinator said that DOE did not have an overall plan for using the results of the testing. Even though opportunities exist to use less costly technologies at the almost 400 wells projected to be installed in noncontaminated areas in fiscal years 1993-97, DOE has not developed a plan for determining which technology should be used or where. According to Westinghouse and Kaiser staff, a major impediment to changing the drilling method is the fragmented management of Hanford's well-drilling program. Westinghouse's Manager of Environmental Projects said that no one has been tasked with identifying the most effective technology to use on each well. Instead of allowing Kaiser to identify the most cost-effective technique to use, Kaiser's Manager of Well Drilling said that Westinghouse usually instructs Kaiser to use available, government-owned, cable-tool rigs for drilling wells.

Well-Drilling Staff Efficiency Could Be Increased

According to studies by DOE and contractors, the high cost of Hanford wells can also be attributed, in part, to inefficient use of the well-drilling staff. For instance, according to their job descriptions, the field team leader (from Westinghouse) and the drilling superintendent (from Kaiser) are each responsible for job safety and for ensuring that necessary

equipment and personnel are in place. However, the Westinghouse cost-reduction coordinator said that Kaiser rejected a proposal to combine the positions because the contractors could not agree on who should take the leadership role. DOE officials said that they believed it was best to let the contractors work out their own interrelationships.

To increase drill-site efficiency and promote a team approach to work, a June 1991 study by a DOE consultant recommended that cross-training be provided to both union and nonunion personnel to increase productivity.[8] For instance, the study commented that productivity could be increased by cross-training health physics technicians to perform industrial hygiene measurements, thereby providing real-time monitoring of both radiological and hazardous chemical contaminants. At present, separate staff measure the two types of hazards. Additional proposals to reduce labor costs were made in the studies by DOE and the contractors. These proposals included the following:

- Combine operators, teamsters, and laborers into working teams with cross-functional jurisdictional duties.
- Implement a 4-day, 10-hour-per-day work schedule. According to Kaiser's well-drilling manager, a 30-percent increase in drilling time was achieved in the summer of 1991 using a 5-day, 10-hour-per-day workweek and overtime.
- Have either the site safety officer or the health physics technician perform the morning and afternoon checks at nonhazardous wells; these checks are currently performed by both.

Generally, any changes in the composition and duties of the work crew would require renegotiating labor agreements, reassessing organizational charters, and cross-training personnel. According to Kaiser officials, Kaiser has negotiated with the individual unions to establish the specific task responsibilities, such as who is responsible for equipment decontamination or setting up the drill rig. However, neither Kaiser nor Westinghouse officials have tried to negotiate work-rule changes with union representatives to increase the efficiency of staffing at well-drilling sites. The Westinghouse coordinator of the value engineering study told us that such negotiations would be "too difficult." The DOE cost-reduction coordinator said that the sensitive labor relations associated with changing the site's mission from weapons production to environmental restoration has probably affected DOE's ability to make the necessary

[8]Evaluation of the Hanford RI/FS Cost Projections, Environmental Management Operations (Richland, Washington: June 1991).

cost-efficiency changes in a timely manner.[9] Union officials we interviewed said that no efforts have been made to revise the well-drilling responsibilities.

Management Effectiveness Can Be Improved

Although Hanford's well-drilling activities will require multimillion-dollar appropriations over many years, only that portion related to drilling RCRA wells has ever been managed as a project. As a result, the administrative responsibilities for DOE's well-drilling program at Hanford are dispersed among four DOE organizations, two Westinghouse organizations, and Kaiser. Within DOE,

- the Assistant Manager for Operations, Waste Management Division, is responsible for the RCRA-related well program;
- the Environmental Restoration Division, under the Assistant Manager for Environmental Management, is responsible for the CERCLA-related well program;
- the Project Management Division, under the Assistant Manager for Projects, is responsible for capital funding of projects (this represents about half of the total funding for RCRA-related wells) and is generally responsible for Kaiser's activities at Hanford; and
- the Office of Environmental Assurance, Permits, and Policy is responsible for overseeing efforts to reduce well-drilling costs.

In March 1989, DOE assigned Westinghouse programmatic and technical responsibility for drilling wells in response to RCRA and CERCLA requirements and assigned Kaiser all drilling tasks in the field. Westinghouse has assigned the RCRA well-drilling program to the Environmental Projects Group within its Environmental Surveillance and Monitoring Program and the CERCLA program to the Environmental Field Services staff within its Environmental Restoration Program. This separation, however, is not clear-cut because certain functions remain the sole responsibility of only one of these organizations. For example, Environmental Field Services is in charge of storing drill cuttings for all wells, and the Environmental Projects Group provides logistics support and obtains permits for all CERCLA and RCRA groundwater wells.

As noted, DOE assigned Kaiser full responsibility for drilling wells in March 1989; in September 1990, DOE also assigned Kaiser responsibility for

[9]For more information on labor relations, see DOE Management: Impediments to Environmental Restoration Management Contracting (GAO/RCED-92-244, Aug. 14, 1992).

providing site safety. Unlike Westinghouse, Kaiser has centralized its well-drilling responsibilities under one manager.

According to Westinghouse and Kaiser officials, splitting the responsibilities between the two contractors has made coordination of activities and resolution of issues difficult for well drilling under both RCRA and CERCLA requirements. For example:

- In June 1990, Kaiser halted all drilling activities for 4 months pending a determination by DOE that Kaiser, not Westinghouse, was responsible for health and safety at the drill sites. According to Westinghouse officials, this delay cost about $1 million.
- A Kaiser official said that lack of adequate planning by Westinghouse has resulted in wide variation in the work load. For example, 27 drill rigs were operating in September 1991, 18 in January 1992, 8 in June 1992, 11 in September 1992, and 7 in October 1992. In 1993, plans call for as many as 20 rigs to be in operation in any given month.
- In March 1992, the drilling of RCRA-related wells was stopped for about 3 weeks pending a review of a request by Kaiser for additional funds beyond its original estimates for the drilling. While staff were assigned to other drilling-related activities, overhead charges continued to accumulate.
- Westinghouse ordered a crew to drill a well in mid-October 1992 but did not start drilling until mid-November. Kaiser standby time cost over $50,000.

The November 1990 Westinghouse study of Hanford's well-drilling program concluded that Hanford's cost-control efforts were weakened by the "lack of true ownership by any one individual or organization for the well drilling and installation process." The study found that the complex organization may have added restrictions or additional requirements that increased well-drilling costs and suggested that one organization within Westinghouse be assigned to manage the entire process. Similarly, the joint value engineering study proposed assigning responsibility for well drilling to one DOE office and integrating the Kaiser and Westinghouse drilling teams. These recommendations are consistent with the principles outlined in DOE Order 4700.1, Project Management System. This order states that costly, complex, and long-running multimillion-dollar efforts should be managed as a project. The objectives of the order, in part, are to

- ensure the application of sound management principles to provide a disciplined, systematic, and coordinated approach to project management,

- provide a basis for determining priorities and relate these priorities to various levels of resource availability,
- promote project execution that achieves technical, schedule, and cost objectives, and
- centralize authority for project approval and allocation of resources and decentralize authority for project execution.

DOE, Westinghouse, and Kaiser officials recognize that the current management structure has increased Hanford's well-drilling costs, but their respective organizations have not taken action to correct the situation. DOE rejected the value engineering study's recommendation to reduce the number of its offices with well-drilling roles. DOE's cost-reduction coordinator said that all of Hanford's well drilling could not be managed as a single project because the funds come from separate sources. However, we found that at DOE's Rocky Flats Office in Colorado, all well drilling, regardless of the funding source, was managed by the Environmental Restoration Division. DOE's Director of the Project Management Division at Hanford also said that a project can be established for programs with more than one funding source.

Conclusions

Drilling wells to determine the extent of contamination at the Hanford Site will be expensive—DOE estimates that well-drilling costs will exceed $270 million through fiscal year 1997. Studies by DOE's contractors have shown that Hanford's well-drilling costs had been increasing and that numerous cost-reduction opportunities exist.

DOE's Richland Field Office has taken some actions to reduce costs; however, major cost-reduction opportunities remain unaddressed. Evaluations by DOE's contractors indicate that significant savings can be realized by replacing or supplementing the slow cable-tool method with increased use of faster, more modern approaches. In addition, information from contractors indicates that faster, less expensive methods that meet applicable safety standards can be used at a large number of drill sites. Staff efficiency could also be improved by reducing duplication and promoting an environment in which cross-training and teamwork are allowed.

Achieving these savings depends on improving the management of the program, particularly at DOE. Cost-control efforts have been weakened by the lack of responsibility for well drilling by any one organization within DOE or its contractors. If responsibility remains as fragmented as it

currently is, we believe that it will be difficult to direct the implementation of the cost-savings opportunities that have been identified. Without changes in project management, current inefficient practices will likely continue.

Recommendations

GAO recommends that the Secretary of Energy direct the Manager of the Richland Field Office to

- expedite the evaluation of alternative well-drilling technologies and, in the interim, require its contractors to select the most cost-effective technology, consistent with safety standards, for use at each well being drilled at Hanford;
- direct its contractors to negotiate with representatives of the Hanford work force to allow more effective use of well-drilling staff; and
- simplify the organizational structure, put a single DOE official in charge of well-drilling decisions, and assign project status to well drilling. In addition, the DOE project manager should have the necessary authority to centralize contractor's management to ensure efficient operation of the project.

Agency Comments

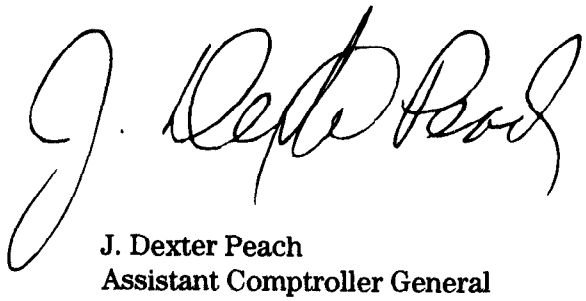
We discussed the facts in this report with the Deputy Manager of DOE's Richland Field Office, Richland staff responsible for RCRA and CERCLA programs, a DOE headquarters representative, and Westinghouse and Kaiser officials responsible for installing Hanford's wells. These officials generally agreed that the report was balanced and accurate. As you requested, we did not obtain written agency comments on a draft of this report.

We performed our work between January and November 1992 in accordance with generally accepted government auditing standards. To assess Hanford's well-drilling programs, we reviewed various studies and cost reports, interviewed responsible officials, and surveyed other DOE sites. (See app. I for a more detailed discussion of our objectives, scope, and methodology.)

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 the Secretary of Energy. We will also make copies available to others upon request. This

report was prepared under the direction of Victor S. Rezendes, who can be reached at (202) 512-1441. Other major contributors to this report are listed in appendix II.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

Objectives, Scope, and Methodology

The Chairman, Senate Committee on Governmental Affairs, requested that we review the Department of Energy's (DOE) well-drilling program at its Hanford Washington Site. Specifically, we reviewed (1) what actions DOE and its contractors have taken to reduce well drilling costs and (2) what opportunities exist for additional cost savings.

To determine the cost of drilling wells at Hanford and DOE's efforts to control these costs, we reviewed DOE and Westinghouse reports and files located in Richland, Washington, and at various facilities at the Hanford Site. We also observed various well-drilling activities at Hanford.

To assess actions DOE has taken to control drilling costs, we interviewed officials at DOE's headquarters and Richland Field Office who were responsible for the oversight of the well-drilling programs. We also interviewed current and past staff from Westinghouse and Kaiser to determine how the well-drilling operations were performed, funded, and managed. In addition, we interviewed representatives of unions involved in well drilling.

To compare Hanford's well-drilling operations with operations at other facilities, we conducted a structured interview with DOE and contractor employees at six DOE sites: the Nevada Test Site, Oak Ridge Operations Office, Rocky Flats Plant, Savannah River Operations Office, Idaho National Engineering Laboratory, and Fernald (Ohio) Plant. We interviewed DOE and contractor staff from the six sites to collect comparative technical, organizational, cost, and operational information about their well-drilling programs. We selected these sites on the basis of discussions with Westinghouse's Manager of Groundwater Well Services. To validate our interviews, we visited the Idaho National Engineering Laboratory and the Rocky Flats Plant. To provide an additional comparison, we also interviewed representatives of an environmental contractor that was performing monitoring work at a private facility at Hanford. We also reviewed studies prepared by the Washington State Department of Ecology and the Environmental Protection Agency and by others.

Major Contributors to This Report

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