

GAO

Testimony

Before the Subcommittee on Energy and
Water Development and Related Agencies,
Committee on Appropriations, House of
Representatives

For Release on Delivery
Expected at 10:00 a.m. EDT
Thursday, April 6, 2006

HANFORD WASTE TREATMENT PLANT

Contractor and DOE Management Problems Have Led to Higher Costs, Construction Delays, and Safety Concerns

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Highlights of [GAO-06-602T](#), a testimony to the Subcommittee on Energy and Water Development and Related Agencies, Committee on Appropriations, House of Representatives

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Why GAO Did This Study

The Waste Treatment Plant Project at the Department of Energy's (DOE) Hanford site in southeastern Washington state is a massive effort to stabilize and prepare for disposal 55 million gallons of radioactive and hazardous wastes currently held in underground tanks. In 2000, DOE awarded an 11-year, \$4.3 billion contract project to Bechtel National, Inc. (Bechtel) to design and construct the plant. Since then, numerous problems and changes have occurred that will significantly increase the project's final cost and completion date.

This testimony discusses (1) how and why the project's cost and schedule have changed since 2000; (2) the status of DOE and Bechtel efforts to address these problems and improve project management ; and (3) our observations on issues that need to be addressed in going forward. It is based on previous GAO reports and ongoing work.

What GAO Recommends

GAO recommends that DOE (1) consider the feasibility of completing 90 percent of facility design or facility component design before restarting construction; (2) ensure that the revised project baseline fully reflects remaining uncertainties; and (3) improve management controls.

DOE generally agreed, but was concerned about the costs of delaying construction to complete design activities.

www.gao.gov/cgi-bin/getrpt?GAO-06-602T.

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

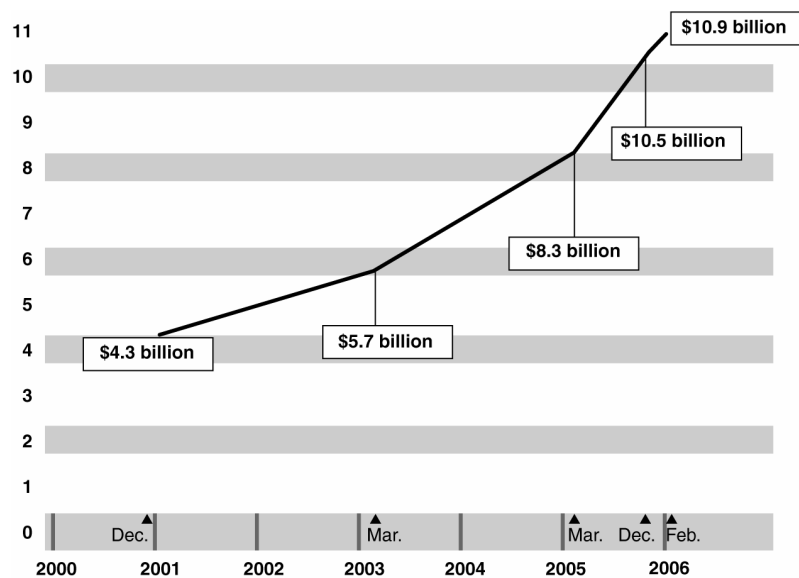
What GAO Found

Since the waste treatment plant construction contract was awarded in 2000, the project's estimated cost has increased more than 150 percent to about \$11 billion, and the completion date has been extended from 2011 to 2017 or later. There are three main causes for the increases in the project's cost and completion date: (1) the contractor's performance shortcomings in developing project estimates and implementing nuclear safety requirements, (2) DOE management problems, including inadequate oversight of the contractor's performance, and (3) technical challenges that have been more difficult than expected to address.

To address the causes of the cost and schedule increases and regain management control of the project, DOE and Bechtel have taken steps to develop a more reliable cost and schedule baseline; slow down or stop construction activities on some of the facilities to allow time to address technical and safety problems and to advance design activities farther ahead of construction activities; and strengthen both project management and project oversight activities.

Despite these actions, we have continuing concerns about the current strategy for going forward on the project. Our main concerns include: (1) the continued use of a fast-track, design-build approach for the remaining work on the construction project, (2) the historical unreliability of cost and schedule estimates, and (3) inadequate incentives and management controls for ensuring effective project management and oversight.

Progression of Cost Estimates on the WTP Project



Source: DOE.

Mr. Chairman and Members of the Subcommittee:

I am pleased to appear before the Subcommittee today to discuss our work on the Department of Energy's (DOE) Waste Treatment Plant Project (WTP) under construction at DOE's Hanford site in southeastern Washington state. The purpose of this massive project is to stabilize and prepare for disposal large quantities of radioactive and hazardous wastes stored in underground tanks. From the 1940s through most of the 1980s, 9 nuclear reactors operated at the Hanford site, producing plutonium and other special nuclear materials primarily for DOE's weapons program. Producing these special nuclear materials generated large volumes of hazardous and radioactive waste. Some of this waste was deposited directly into the ground in trenches, injection wells, or other facilities designed to allow the waste to disperse into the soil; and some was packaged into drums and other containers and buried. The most dangerous waste was stored in 177 large underground storage tanks. DOE has managed this tank waste over the years as high-level waste. The underground tanks currently hold more than 55 million gallons of this waste—enough to fill an area the size of a football field to a depth of over 150 feet. DOE, the Environmental Protection Agency (EPA), and the Washington state Department of Ecology—have determined that stabilizing this waste is one of the most urgent cleanup activities at the Hanford site.

The Hanford site occupies 586 square miles near the cities of Richland, Pasco, and Kennewick, with a combined regional population of over 200,000. The Columbia River—the second largest river in the United States and a source for hydropower production, agricultural irrigation, drinking water, and salmon reproduction—flows through the site for almost 50 miles. Although the underground storage tanks are several miles from the river, tank monitoring data and detection techniques have shown that some of the tanks have leaked in the past. Because the contamination has reached the groundwater under the tanks, officials are concerned that it is now making its way to the Columbia River.

To stabilize the approximately 55 million gallons of waste remaining in the tanks, Hanford's waste treatment project involves (1) designing, constructing, and testing a waste treatment plant¹ (the construction

¹The waste treatment plant consists of a pretreatment facility that separates waste into high-level and low- activity waste, two facilities to treat separated portions of the waste, one analytical laboratory, and a variety of supporting facilities.

project) and (2) operating this plant and others in subsequent years to process and prepare the tank waste for permanent disposal (the operations project). Schedule milestones for stabilizing the tank waste and preparing it for disposal, as well as agreements on the technologies to be used, are set forth in the Hanford Federal Facility Agreement and Consent Order between DOE, Washington state's Department of Ecology, and EPA. This agreement, commonly called the "Tri-Party Agreement," was signed in May 1989.

In 2000, DOE awarded an 11-year, \$4.3 billion contract for the construction project to Bechtel National, Inc. (Bechtel). DOE plans to solicit bids through a competitive process and award a separate contract to operate the WTP once the construction project is completed.

Since the contract with Bechtel began in 2000, numerous problems with and changes to the construction project have occurred, which has significantly affected the project's final cost and completion date. My testimony will discuss: (1) how the project's cost and schedule have changed since the contract was awarded to Bechtel in December 2000, and the primary causes for those changes; (2) the status of DOE and Bechtel efforts to address these causes and establish effective management controls over the project; and (3) our observations on issues that need to be addressed in going forward on the project.

My testimony is based on our past reviews of DOE's Environmental Management program and the Hanford project, especially our 2004 report on the project,² and our currently ongoing work for this Subcommittee. Regarding our ongoing work, in order to understand how the project's cost and schedule estimates have changed, the reasons for those changes, and efforts to address any problems, we obtained and analyzed project documents and records developed by DOE and Bechtel as well as evaluations of various aspects of the project conducted by the U.S. Army Corps of Engineers and other independent reviews. We also interviewed

²U.S. General Accounting Office, *Nuclear Waste: Challenges to Achieving Potential Savings in DOE's High-Level Waste Cleanup Program*, [GAO-03-593](#) (Washington, D.C.: June 17, 2003); U.S. General Accounting Office, *Nuclear Waste: Absence of Key Management Reforms on Hanford's Cleanup Project Adds to Challenges of Achieving Cost and Schedule Goals*, [GAO-04-611](#) (Washington, D.C.: June 9, 2004); and U.S. Government Accountability Office, *Nuclear Waste: Better Performance Reporting Needed to Assess DOE's Ability to Achieve the Goals of the Accelerated Cleanup Program*, [GAO-05-764](#) (Washington, D.C.: July 29, 2005).

DOE and Bechtel project and technical managers about the main causes of the cost increases and schedule delays and steps they are taking to address the problems. We also toured the construction site to observe the actual condition of the facilities. A more complete discussion of our scope and methodology is presented in appendix II. We conducted our review from June through September 2005 and from January through April 2006 in accordance with generally accepted government auditing standards. We are continuing our work on this project and plan to issue a final report in October 2006.

In summary, we found the following:

The Hanford waste treatment plant construction project's estimated cost has increased over 150 percent to about \$11 billion since 2000, and the completion schedule has been extended by 6 years to at least 2017. There are three main causes for these results—contractor performance problems, DOE management shortcomings, and difficulties addressing various technical challenges encountered during design and construction.

Regarding the contractor's performance:

- Bechtel has performed poorly on several aspects of the project. For example, Bechtel significantly underestimated the price of steel and how much engineering effort would be needed to complete facility designs. These mistakes, and others like them, have added about \$2 billion to project costs. Bechtel also continues to need increased contingency funding for unexpected problems. Adjusting for additional contingency funding added over \$2 billion to the cost estimate. Importantly, Bechtel failed on several occasions to ensure that nuclear safety requirements were being met, including allowing design changes to be made without following nuclear safety procedures and failing to detect serious construction flaws in tanks that will hold radioactive material in the facilities.

Regarding DOE management:

- DOE has followed an approach to constructing the project known as “fast-track,” design-build — where design, construction, and technology development occur simultaneously. However, this approach is not recommended for designing and constructing one-of-a-kind, complex nuclear facilities because, among other things, it increases the risk of encountering problems that can adversely affect a project's cost and schedule. DOE also did not establish project management requirements

and DOE headquarters staff was not involved in evaluating the project or the contractor's performance.

Regarding technical challenges:

- Bechtel and DOE have encountered many technical problems with facility design and equipment that are taking considerable more time and money than expected to address and correct. These problems include reengineering plant facilities to withstand earthquakes; correcting design and operation problems with waste mixing pumps; and preventing flammable hydrogen gas from building up to unsafe levels in tanks and pipes. Although final cost estimates are not yet available, as of April 2005, these technical challenges have added about \$1.4 billion to project cost estimates.

To address project cost and schedule problems, DOE and Bechtel have focused on three main areas— slowing down construction while addressing technical and safety problems; establishing new project cost and schedule estimates; and strengthening project management and oversight. For example, DOE directed Bechtel to slow down or stop construction activities on the two facilities affected by changing earthquake protection requirements—the pretreatment facility and the high-level waste treatment facility. Slowing the pace of construction will allow more time to address technical and safety problems and make any needed design changes before construction is restarted. DOE also directed Bechtel to develop a new project cost and schedule baseline starting with an analysis of material and labor quantities and costs, and incorporating more contingency funding to address future uncertainties. DOE's project management improvements have included developing a headquarters oversight board that includes several senior DOE executives and funding independent reviews of (1) the new project baseline by the Corps of Engineers and (2) the technical feasibility of the treatment project by a panel of outside experts. These initiatives are ongoing. Bechtel has focused on improving its project performance information, implementing several management and organizational changes, and strengthening safety and quality assurance practices.

Despite the steps DOE and Bechtel have taken to address technical, safety, and other management problems on the construction project, we have continuing concerns about the current strategy for going forward. Our main concerns include: (1) the continued use of a fast-track, design-build approach for the remaining work on the construction project; (2) the reliability of the revised project cost and schedule estimates, and whether

there is enough flexibility in the revised schedule to address remaining project uncertainties during the construction and commissioning phases; and (3) the adequacy of management actions taken to ensure effective project management and oversight. DOE is continuing with the fast-track approach to try and stay as close as possible to milestone dates agreed to in the Tri-Party Agreement and to keep costs down. However, the technical, safety, and management problems on the project make it clear that a fast-track approach is not appropriate. In our view, proceeding with a project construction plan more closely aligned with nuclear industry guidelines, which suggest completing at least 90 percent of the design before restarting construction provides a better chance of successfully completing the project and controlling the cost and completion date. Furthermore, the cost and schedule baseline is being revised before all of the technical issues are understood and the cost and time needed to address them is known. For example, it is not clear whether DOE has allowed sufficient time for testing of all the facilities during the commissioning phase of the project. Also, in our view, the revised cost estimate should contain cost and schedule contingencies that are sufficient to ensure that no further re-baselining of the project will be needed in the future. Finally, regarding overall project management, it is unclear whether the actions taken by DOE and Bechtel are adequate to bring the project under control and create greater overall accountability for results. Specifically, it is unclear how DOE will modify contractor incentives once the cost and schedule baselines are finalized. The current contract incentives are no longer meaningful because the current cost and schedule goals are no longer achievable and are being revised. However, modifying the contract to provide new incentives could be viewed as rewarding Bechtel's past performance. It remains to be seen whether DOE can establish a combination of project incentives and management controls that will lead to the successful completion of the construction project.

We are recommending that the Secretary of Energy take steps to prevent further use of a fast-track, design-build approach to the project; ensure that facility design or facility component design have reached at least 90 percent completion and that technical and safety problems have been satisfactorily addressed before restarting construction; and take other management actions to help ensure that the new project baseline will be reliable and that controls and accountability are such that Bechtel will safely and effectively complete the project.

On April 4, we met with DOE officials, including the Assistant Secretary for Environmental Management, to obtain oral comments on this

testimony. DOE generally agreed with the testimony findings and conclusions and two of the three recommendations. DOE agreed with our recommendations to ensure that the new project baseline fully reflects all remaining uncertainties on the project and to strengthen management controls over the project. However, regarding our recommendation that DOE not restart construction until facility design has reached 90 percent and the project's major technical and safety problems have been satisfactorily addressed, DOE only partially agreed. DOE said that it would discontinue using a fast-track, design-build approach to completing the project and acknowledged that use of this approach has led to increased costs and schedule delays on the project. DOE's Assistant Secretary for Environmental Management said that DOE has already taken some initial steps to discontinue the fast-track approach by widening the gap between facility design and construction to at least one year or longer. However, the Assistant Secretary expressed concern about delaying construction of WTP facilities until the facility design has reached at least 90 percent completion and the project's major technical and safety problems have been satisfactorily addressed. He said that DOE has not studied the extent to which such a delay in restarting construction could potentially increase the overall cost of the project. Accordingly, we modified our recommendation to ensure that DOE evaluates the feasibility of completing at least 90 percent of the facility design or facility component design, and that major technical and safety issues have been satisfactorily addressed before restarting construction.

Background

DOE carries out its high-level waste cleanup program at Hanford under the auspices of the Assistant Secretary for Environmental Management and in consultation with a variety of stakeholders. The EPA and the Washington State Department of Ecology provide regulatory oversight of cleanup activities at the site. The Defense Nuclear Facilities Safety Board (Safety Board) also oversees DOE's operations. The Safety Board was created by the Congress in 1988 to provide an independent assessment of safety conditions and operations at defense nuclear facilities, including DOE's Hanford site. Other stakeholders involved in the Hanford cleanup project include county and local governmental agencies, citizen groups, advisory groups, and Native American tribes. These stakeholders advocate their views through various processes, including site-specific advisory boards. DOE manages the tank waste at Hanford through its Office of River Protection, which Congress directed DOE to establish in 1998. The office

has a staff of about 110 DOE employees and a fiscal year 2006 budget of about \$1 billion. It manages Hanford's tank waste through two main contracts: a tank farm operations contract with CH2M Hill Hanford Group³ to maintain safe storage of the waste and to prepare it for retrieval, and a construction contract with Bechtel to design, construct, and commission the operation of a waste treatment plant. For additional information on Hanford's tank wastes, see appendix I.

The Hanford waste treatment construction project includes the construction of three primary processing facilities, a large analytical laboratory, and 23 supporting buildings on a 65 acre site. The three primary processing facilities are:

- the pretreatment facility, which receives the waste from the tank farms and separates it into its low-activity and high-level waste components;
- the high-level waste facility that immobilizes high-level waste for offsite disposal through a process known as vitrification, which mixes nuclear waste with molten glass;⁴ and
- the low-activity waste facility, which vitrifies the low-activity waste for onsite disposal.

The waste treatment plant facilities are large and complex. For example, Bechtel estimates that the completed project will contain almost 270,000 cubic yards of concrete and nearly a million linear feet of piping. The largest building, the pretreatment facility, has a foundation the size of four football fields and is expected to be 12-stories tall.

³CH2M Hill Group is a limited liability corporation of the CH2MHill Company.

⁴DOE currently is evaluating the suitability of Yucca Mountain in Nevada as the site of the repository for the high-level waste canisters.

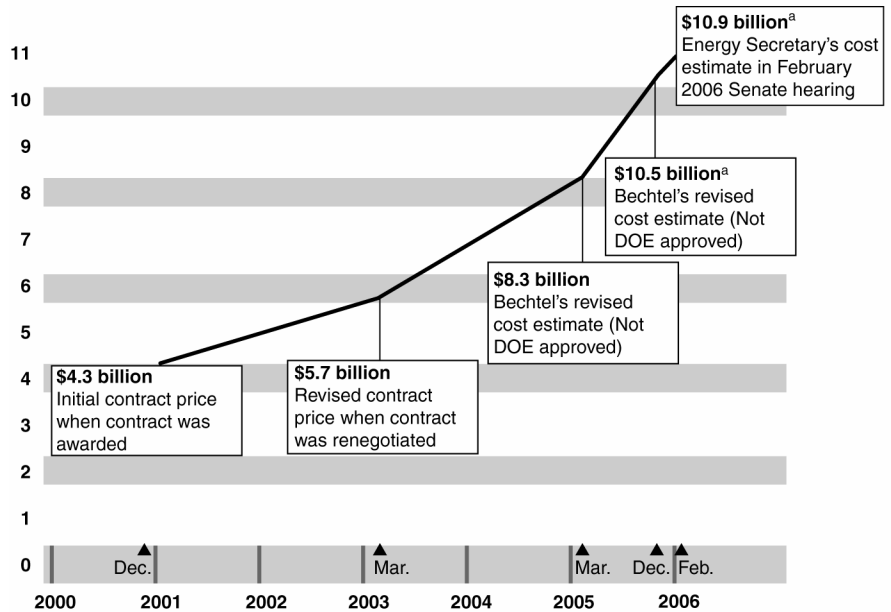
**Contractor
Performance
Problems, DOE
Management
Shortcomings, and
Technical Challenges
Have Resulted in
Significantly Higher
Cost Estimates and
Longer Completion
Dates for the
Construction Project**

In just over 5 years, the estimated cost of the project has increased more than 150 percent to about \$11 billion and the schedule has been extended from an 11-year project to a 17-year project. Three main factors were responsible for the cost and schedule increases: (1) poor contractor performance in developing project estimates and implementing nuclear safety and other requirements, (2) management weaknesses in DOE's approach to and oversight of the project, and (3) technical challenges that have been more difficult than expected to address.

**Project Cost and Schedule
Have Increased
Significantly**

Since DOE awarded the contract to Bechtel in 2000, both the contract price and the completion date have increased significantly. In 2000, the contract price was \$4.3 billion, including contractor fee and project contingencies. In 2003, Bechtel revised the estimate to \$5.7 billion, based on changes DOE wanted to make in plant capacity and to correct for estimating errors and other problems that were already occurring on the project. Since then, the cost estimate has continued to climb. For example, Bechtel's December 2005 estimate of the cost to complete the project, an estimate that DOE has not yet approved, totals about \$10.5 billion plus contractor fee, a significant increase from the initial estimate in 2000. Bechtel is still revising its estimate of the project costs, and the final estimate will very likely be higher. For example, in a February 2006 hearing before the Senate Armed Services Committee, the Secretary of Energy said that the final cost for the project could be nearly \$11 billion. Figure 1 shows this progression of cost estimates for the construction project.

Figure 1: Progression of Cost Estimates for WTP Construction Project.



Source: DOE.

^aThese cost estimates do not include contractor performance fees.

Note: This comparison is based on dollar values that were not adjusted for inflation which was about 15 percent over this time period.

The estimated completion date has also been extended. In 2000, the estimated date to complete the construction of the waste treatment project was 2011. This date corresponded to the work schedule agreed to by DOE in the Tri-Party Agreement under which DOE was to begin operating the waste treatment facilities by 2011. However, Bechtel's latest estimate, not yet approved by DOE, is that the construction project will be completed by 2017 or later, at least a 6-year extension and a 50 percent increase in the project's schedule.

Furthermore, the revised cost and schedule estimates Bechtel developed in December 2005 are not final and will likely increase further. At least through the rest of 2006, DOE and Bechtel will continue to address identified technical and safety issues and incorporate additional design changes into its estimates. For example, Bechtel is currently reviewing several technical issues recently raised by a panel of experts DOE invited

to study the project.⁵ Bechtel plans to incorporate changes resulting from the review into a new cost estimate. This revised estimate is expected to be complete in late May 2006. Once that estimate is available and DOE has completed its review of the estimate, DOE and Bechtel will need to agree on a revised contract price that incorporates any changes made to the project, including any changes to the fee that Bechtel can potentially earn. DOE officials do not expect to have these activities completed until late 2006.

Bechtel and DOE Share Responsibility for the Main Causes of the Cost Increases and Schedule Delays

In our view, Bechtel and DOE both share in the responsibility for the problems with the Hanford waste treatment plant.⁶

Contractor performance. Poor contractor performance in the areas of developing and revising cost estimates and adhering to nuclear safety and other requirements contributed to cost and schedule increases.

Bechtel made a number of miscalculations on a broad range of activities when developing and revising its cost estimates for the project. Specifically, we found that Bechtel:

- underestimated by more than 50 percent the engineering hours needed to design the facilities (a small portion of this increase was due to changes in seismic design criteria). The current estimate for design hours is now over 14 million hours.

⁵*“Comprehensive Review of the Hanford Waste Treatment Plant Estimate at Completion—Preliminary Draft,”* Assessment Conducted by an Independent Team of External Experts, at the direction of the U.S. Department of Energy, Office of Environmental Management (Washington, D.C.: Mar. 20, 2006).

⁶Between 2000 and 2003, cost increases estimated at \$1.2 billion occurred because of engineering problems, estimating errors, and contingency funding increases. Cost increases occurring between 2003 and May 2005, based on Bechtel’s April 2005 estimate and the Corps of Engineers’ May 2005 review of Bechtel’s estimate, show that Bechtel underestimated costs by an additional \$845 million, ongoing technical problems added an additional \$1.15 billion to costs, and an additional \$1.45 billion was added to the project’s estimated contingency. These estimates were based on a revised contract price of \$9.3 billion. These analyses have not yet been updated to document the current cost increases based on the latest estimated contract price estimate of nearly \$11 billion. DOE expects Bechtel to complete its current cost and schedule estimate in late May 2006.

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- underestimated the cost of key commodities like steel. Steel prices climbed sharply once project construction started.
 - incorrectly assumed that it could obtain an exception to the fire code and avoid applying a protective coating on some of the structural steel used in the facilities and instead use a less expensive sprinkler system. In April 2005, Bechtel estimated that the estimating errors collectively added about \$845 million to the estimated contract price.

Additionally, Bechtel also incorrectly estimated the amount of contingency funds that would be needed to account for project uncertainties. In 2000, Bechtel estimated that \$500 million in contingency was needed. However, in its December 2005 estimate, Bechtel proposed that a total of \$2.8 billion in contingency be allocated to the project. The \$2.8 billion in contingency funds included \$1.76 billion to address technical and programmatic risks outside the current scope of the project and an additional reserve of about \$1 billion for potential future problems not yet identified.

Finally, Bechtel was ineffective at ensuring that the completed facilities would meet nuclear safety requirements. In March 2006, DOE's Office of Enforcement issued a report documenting a number of different safety problems with the construction project, including a failure to (1) include safety requirements in design documents, (2) identify and use the correct design codes and safety standards, and (3) track design changes to ensure purchased materials and supplies were consistent with those changes.⁷ These failures led to significant problems. For example, Bechtel ordered approximately 70 tanks with incorrect structural specifications to ensure the quality of their welds. These tanks, that will be located in inaccessible areas of the waste treatment plant, were in various stages of fabrication. Had this problem not been identified, the quality of welds for all of these tanks could have been flawed. One tank had already been installed using these incorrect specifications before the problem was discovered. The tank was installed because neither the supplier nor Bechtel had performed the required weld inspection. Furthermore, when the welds were first repaired the subcontractor used incorrect welding rods, requiring more rework to repair the repairs.

⁷No estimate is available for how problems in meeting nuclear safety requirements specifically affected project cost estimates.

In addition, in September 2005, Bechtel discovered errors that had been made in structural steel calculations for the laboratory facility. These potentially serious errors included design specifications that were incorrect and discrepancies between engineering calculations and design drawing specifications, which led to replacing steel already purchased and correcting hundreds of engineering drawings. Of significant concern, a 2005 DOE-sponsored survey found that some construction and engineering employees were reluctant to raise safety concerns to Bechtel management, fearing reprisal. Bechtel is now developing a strategy for cultivating a more rigorous culture of safety among its workforce that it expects to complete by June 2006.

DOE management. In our view, DOE's management of the project has been flawed, as evidenced by (1) adopting a fast-track approach to design and construction activities that both created and exacerbated problems and (2) failing to exercise adequate and effective oversight of contractor activities, both of which contributed to cost and schedule increases.

DOE's decision to pursue a fast-track, design-build approach under which technology development, facility design, and construction activities were carried out concurrently has proven to be regrettable. DOE adopted the fast-track approach because of commitments made under the Tri-Party Agreement to have facilities operating by 2011, and to treat all of the tank waste by 2028. However, using a fast-track approach for nuclear facilities is considered "high risk," and is not recommended for designing and constructing one-of-a-kind, or first-of-a-kind complex nuclear facilities. DOE's own project management guidance cautions against using this approach for complex facilities. For example, DOE Order 413.3 cautions that a design-build approach should only be used in limited situations, such as when work scope requirements are well defined, projects are not complex, and technical risks are limited.

Furthermore, the project approach included optimistic assumptions that virtually every major safety, technology, regulatory, and nuclear material acquisition uncertainty could be resolved while facilities were being constructed at an unusually fast pace for the largest, most complex, first-

of-a-kind, nuclear waste treatment plant in the United States.⁸ Less than one year after construction began, DOE was already experiencing problems with construction activities outpacing design, technology problems that were affecting the critical path of the construction project, contractor safety control inadequacies, and outdated facility seismic criteria. Despite these problems, DOE insisted on continuing its fast-track design-build approach under its accelerated cleanup plan until early 2005. At that point, the effect of these and other unresolved issues, contractor performance problems, and signs of significant cost growth and schedule delays caused DOE to direct Bechtel to significantly slow construction, rework the design, and reevaluate safety, seismic, and regulatory requirements.

The impact of many of these problems could have been lessened if facility design had been more complete before construction began. Under nuclear industry guidance, which recommends that facility design be essentially complete before construction begins, major environmental, technological, and regulatory issues can be resolved in advance of construction.⁹ The benefit of this process is that most uncertainties are resolved before major capital is at risk, and the potential for project delay is significantly reduced. On this project, under the fast track approach, actual schedule delays of more than two years have occurred, contributing to more than 1,000 workers being laid off, and work on the two largest waste treatment facilities coming to a halt.

GAO, the Safety Board, and others have criticized DOE in the past for using the fast-track approach for large, complex first-of-a-kind nuclear cleanup facilities. We issued reports in 1993, and again in 1998, that were critical of DOE for using an approach that differs so significantly from

⁸The Corps of Engineers reported in May 2004 that DOE did not properly account for cost increases that should have been expected from the overall complexity of nearly every aspect of the project—including the variety of tank wastes; the required technology integration; the design, construction, and commissioning of the plant; and the regulatory climate. See U.S. Army Corps of Engineers, *Independent Cost and Schedule Baseline Review Summary Report*, (Walla Walla, Washington, May 28, 2004).

⁹10 CFR 52.47(b)(1) for certification of a nuclear power plant design, calls for facility design to be “essentially complete” to resolve safety issues before starting construction. According to the director of new plant deployment at the Nuclear Energy Institute, for a first-of-a-kind plant, the commercial nuclear power industry’s goal is to achieve 90 percent completion of final detailed design before construction begins. In addition, DOE’s own Order 413.3 states that facility design should be “essentially complete” and all environmental and safety criteria met when the project is ready to begin construction.

nuclear industry guidelines for constructing complex nuclear facilities. The Safety Board cautioned in June 2002, and again in March 2004, that a fast-track, design-build approach could lead to expensive plant modifications or to the acceptance of increased public health and safety risks. In June 2004, we recommended that DOE avoid using a fast-track approach to designing and constructing its complex nuclear facilities. The department accepted this recommendation, but apparently believes that it does not apply to this project. At the time of our 2004 report, the department could not identify a single instance where it had successfully used the approach to construct a large, complex nuclear cleanup facility. Despite the fact that DOE has never been successful with this approach on any complex nuclear cleanup project, Bechtel reported in its most recent cost and schedule estimate that a “fast-track engineering, procurement, and construction” approach is a standard commercial approach for large projects and the best approach for a schedule-driven project.

DOE’s lack of oversight of Bechtel’s activities has also been unfortunate. DOE did not ensure adherence to normal project reporting requirements and, as a result, status reports provided an overly optimistic assessment of progress on the project. For example, in January 2005, DOE’s project status report indicated that costs and scheduled work to date were proceeding as planned. However, Bechtel was not providing accurate information. The project almost always appeared to be on schedule because Bechtel adjusted the project baseline schedule to match actual project results. In addition, DOE headquarters oversight officials were generally unaware of the full extent of the problems with the project.

Finally, DOE has not prevented significant safety problems from occurring on the project. DOE is responsible for ensuring that its activities follow nuclear safety requirements and generally receives no outside regulatory oversight of nuclear safety. However, the department was not fully effective in ensuring that nuclear safety requirements were being met. Contributing to the problem, DOE’s internal safety oversight had been significantly reduced since 2000. Furthermore, key responsibilities to ensure quality control of contractors were placed under the responsibility of the DOE project manager who also had primary responsibility for meeting project cost and schedule targets. In late 2003, DOE began recognizing some of the nuclear safety problems on the project but many of these problems dated back to 2002, or earlier. Finally, in 2005 and 2006, according to the WTP project manager, DOE withheld a total of \$800,000 in performance fee from Bechtel for industrial and nuclear safety problems, but problems continued. In 2006, DOE assessed a civil penalty

of \$198,000 for a number of nuclear safety violations. DOE also recently increased the number of staff assigned to oversee safety activities.

Technical challenges. Constructing the waste treatment plant at the Hanford site is a massive, highly complex and technically challenging project. Problems in addressing these technical challenges have contributed to cost and schedule increases.

A number of technical problems have continued to plague the project, including:

- changing seismic standards that resulted in substantial re-engineering of the facility design;
- problems with “pulse jet mixers” needed to keep waste constituents uniformly mixed while in various tanks in the facilities;
- the potential buildup of flammable hydrogen gas in the waste treatment plant tanks and pipes; and
- problems with radioactive and hazardous wastes plugging treatment plant piping systems during operations.

Bechtel estimated, in December 2005, that collectively these technical problems could add nearly \$1.4 billion to the project’s estimated cost.

In 2002, the Safety Board began expressing concerns that the seismic standards used to design the facilities were not based on the most current ground motion studies and computer models, and were not based on geologic conditions present directly under the construction site. After more than 2 years of analysis and discussion, DOE contracted for a new seismic analysis that confirmed the Safety Board’s concerns that the seismic criteria were not “sufficiently conservative” for the two largest treatment facilities—the high-level waste facility and the pretreatment facility. Revising the seismic criteria caused Bechtel to recalculate thousands of engineering estimates and to rework thousands of design drawings to ensure that tanks, piping, cables, and other equipment in these facilities were adequately anchored. Bechtel determined that the portions of the building structures already constructed were sufficiently robust to meet the new seismic requirements. By December 2005, however, Bechtel estimated that engineering rework and other changes to tanks and other equipment resulting from the more conservative seismic requirement

would increase project costs by about \$750 million to \$900 million and result in a 26 month schedule delay.

In 2003, potential problems with the pulse jet mixers caused project construction delays. Bechtel initially planned to rely on computer modeling to confirm that the mixer would successfully keep the tank waste uniformly mixed. However, because these mixers were designed to be placed in “black cells” in the pretreatment facility where they could not be repaired or modified after operations began because of the high levels of radiation in the cells, mixer failure was considered high risk. Given this risk, in April 2003, just 9 months before the design configuration for the mixers was to be completed, Bechtel decided to conduct laboratory tests of the mixers to ensure that they would successfully mix the tank waste. Based on laboratory performance testing, Bechtel found that the mixers did not adequately work. Consequently, the mixers had to be re-designed. The tanks that were to house the mixers also had to be redesigned with greater structural support to accommodate more forceful mixing pumps and other modifications. DOE spent about two years addressing problems with the pulse jet mixers. According to DOE’s project manager, Bechtel has completed the testing and design modifications for the mixers. As of May 2005, this problem had contributed more than \$300 million to the project’s cost growth.

In June 2004, we reported on the possibility of hydrogen gas building up in the plant’s tanks, vessels, and piping systems, and noted that the buildup of flammable gas in excess of safety limits could cause significant safety and operational problems. Although DOE and Bechtel have been aware of this problem since 2002, the problem has not been fully resolved. As of March 2006, Bechtel continued to assess how to resolve this technical problem but has not identified final solutions. In April 2005, Bechtel estimated that this problem contributed about \$90 million to the project’s cost growth.

In March 2006, an external technology review identified another technological problem called “line plugging,” involving the potential that solid and liquid radioactive and hazardous wastes could plug waste treatment facility piping systems during treatment operations.¹⁰ Described

¹⁰ *Comprehensive Review of the Hanford Waste Treatment Plant Flowsheet and Throughput—Prepublication*,” Assessment conducted by an Independent Team of External Experts, at the direction of the U.S. Department of Energy, Office of Environmental Management (Washington, D.C.: Mar. 17, 2006).

as the most serious problem the external group identified, the report emphasized that unless corrected, this flaw could prevent the plant from operating successfully. The review concluded that the treatment plant's piping systems could begin plugging within days to a few weeks of operational start up. The external review did not estimate the potential cost and schedule impact of correcting this problem, but concluded that DOE identify and consider the corrective actions needed to resolve the problem. Bechtel plans to address these actions in its final cost and schedule estimate due in late May 2006.

DOE and Bechtel Have Taken Several Steps to Strengthen Management and Oversight of the Project

To address underlying causes contributing to cost and schedule growth on the construction project, DOE and Bechtel have undertaken three main initiatives: (1) slowing construction to allow time to address technical and safety problems and to advance design activities further ahead of construction activities, (2) developing a more credible cost and schedule baseline, and (3) improving project management and oversight.

Slowing construction to address technical problems and advance the design work

Because of the scope of the technical problems on the project, especially the need to apply more conservative seismic standards to the pretreatment and high-level waste facilities, in December 2004, DOE directed Bechtel to slow construction on these facilities. This allowed Bechtel to focus on addressing the technical problems and to advance plant design further ahead of construction activities. According to the DOE project manager, as of March 2006, the design for the waste treatment plant was about 60 percent complete. DOE's project manager told us that once construction starts again, he expects to have a gap of about one year between completing the design of specific building components and beginning construction of those components. Slowing the construction of project facilities has also allowed DOE and Bechtel to resolve some of the technical issues that contributed to cost and schedule growth. For example, according to DOE's WTP project manager, seismic criteria have been revised and are being incorporated into facility design. The Corps is reviewing Bechtel's design rework to ensure that it meets the revised criteria. These criteria are scheduled to be confirmed by the Corps in early 2007. Similarly, DOE's WTP project manager said that problems with tank waste mixing pumps have apparently been resolved and changes are being incorporated into the revised design. However, issues involving the potential for hydrogen gas to build up in the waste treatment plant tanks

and piping systems have not yet been resolved, according to DOE's project manager.

Developing a more reliable project baseline

Bechtel and DOE have taken steps to develop estimates they believe will better reflect the project's true cost. Bechtel has been conducting a more detailed review of cost and schedule elements than occurred in developing previous baselines. In the past, Bechtel relied more on estimating techniques to develop the baseline because the design was not sufficiently mature to more accurately estimate material and labor costs. Bechtel's December 2005 baseline estimate of \$10.5 billion was based on using detailed design drawings and a better understanding of the actual material and labor costs. According to Bechtel's deputy project manager, the new estimate better defines risk on the project and assigns a more realistic contingency value to that risk. Bechtel also brought in outside experts and conducted two major corporate reviews of the estimates in April and December 2005. Bechtel is expected to submit a final revised cost and schedule estimate by the end of May 2006.

In addition to Bechtel's efforts, DOE has hired two external teams to review the revised estimates. First, DOE contracted with the Corps of Engineers to review the reasonableness of various aspects of Bechtel's estimate. DOE expects the Corps of Engineers to validate such things as the revised ground motion criteria and other geophysical data, whether the ground motion criteria has been adequately incorporated into the plant design, and the reasonableness of material and labor cost estimates, including the amount of contingency funds needed for the project. DOE expects the Corps of Engineers to complete its review by July 2006. Second, DOE directed Bechtel to hire an independent review team of experts from industry and academia to review the technical, cost, and schedule aspects of the project. The team's preliminary report concluded that the project's cost estimate should be increased to \$11.3 billion, plus contractor fee.¹¹

In our view, while these reviews are a step in the right direction, given the Department's past history in developing a credible project baseline, it is

¹¹*Comprehensive Review of the Hanford Waste Treatment Plant Estimate at Completion—Preliminary Draft*, Assessment Conducted by an Independent Team of External Experts, at the direction of the U.S. Department of Energy, Office of Environmental Management (Washington, D.C.: Mar. 20, 2006).

too soon to tell whether these reviews will assist DOE and Bechtel in providing reliable cost and schedule estimates.

Taking other steps to improve management and oversight

Both Bechtel and DOE have undertaken several other actions to improve management and oversight of the project. Bechtel's actions include (1) improving its cost and schedule performance tracking system, (2) making management and organizational changes, and (3) taking steps to improve quality and safety on the project. Regarding the cost and schedule performance tracking system—referred to as an earned value system—DOE requires that a contractor's system be certified to comply with industry standards. However, DOE had not certified Bechtel's earned value system. Bechtel is now working to have its earned value management system certified by September 2006. In addition, to improve its management of the project, Bechtel has reorganized to provide greater control and oversight of facilities engineering work and greater standardization in purchasing material and supplies. According to Bechtel's deputy project manager, the new organizational structure, along with selected personnel changes will strengthen oversight of this work. Finally, following a March 2006 nuclear safety enforcement action by DOE, Bechtel is in the process of developing a nuclear safety and quality culture change initiative. This includes holding meetings to emphasize quality and safety, implementing new training requirements, and conducting employee focus groups to promote greater awareness of safety requirements.

DOE has also taken steps to strengthen its management and oversight. To address organizational and staffing oversight issues, DOE formed a special headquarters task force, in late 2005, to study various aspects of the Hanford project and to advise the Secretary and the DOE project manager as the project goes forward. In addition, the Assistant Secretary for Environmental Management directed the DOE site manager to hire at least eight additional contracting staff to help administer the project, including a director of procurement, a procurement attorney, two senior contracting officers, two senior contract specialists, and two contract specialists. DOE expects to fill these positions by spring 2006. DOE also established a new headquarters office—the Office of Project Recovery—to focus greater attention on projects, such as the waste treatment plant project, that have performance problems. This office, which reports directly to the Assistant Secretary for Environmental Management, is intended to work with field officials to help get projects in trouble back on track.

To address project management and reporting concerns, DOE is improving the use of its earned value information—data DOE uses to

monitor cost and schedule performance on its projects. DOE is also requiring Bechtel to comply with DOE's project management requirements, as defined in DOE Order 413.3. In our June 2004 report on the Hanford waste treatment project,¹² we found that DOE awarded the original contract in December 2000, without putting in place these key project management requirements. We noted that this approach added significantly to project risk. Additionally, the Assistant Secretary for Environmental Management directed DOE's Office of Engineering and Construction Management to provide more frequent assessments of the waste treatment project and, if necessary, initiate more external reviews of the project.

To address continuing problems in nuclear safety and quality, DOE recently initiated an enforcement action, including a civil penalty of \$198,000, against Bechtel for the continuing recurrence of quality and safety violations. In its March 16, 2006 Preliminary Notice of Violation letter, DOE listed several areas where Bechtel had violated nuclear safety requirements, including non-adherence to procedures, inadequate training for staff, and emphasizing meeting cost and schedule requirements over quality and safety. In its March 16 letter, DOE noted that past actions by Bechtel to correct these long-standing problems had not been effective. DOE plans to meet with Bechtel in June 2006 to discuss the contractor's progress in improving nuclear safety on the project and determine what additional steps will be necessary to ensure safety and quality on the project.

Observations About Selected Issues DOE Will Need to Address in Going Forward on the Project

Despite the actions taken by DOE and Bechtel to address technical, safety, and other management problems on the project, we have continuing concerns about the current strategy for going forward. Our main concerns include:

- the continued use of a fast-track, design-build approach to the remaining work on the construction project,
- the reliability of the project baseline and whether it will fully account for remaining uncertainties, and

¹²U.S. General Accounting Office, *Nuclear Waste: Absence of Key Management Reforms on Hanford's Cleanup Project Adds to Challenges of Achieving Cost and Schedule Goals*, [GAO-04-611](#) (Washington, D.C.: June 9, 2004).

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- the adequacy of project incentives and management controls for ensuring effective project management and oversight.
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The use of a fast-track, design-build approach to the project

It is unclear whether DOE plans to go forward with the fast-track approach and allow Bechtel to work concurrently on technology, design, and construction activities. Although design and construction activities will be less “close-coupled” than before, the work schedule will still not fully comply with nuclear industry guidelines to complete at least 90 percent of the design before constructing the facilities. DOE is continuing with this fast-track, design-build approach to try and stay as close as possible to milestone dates agreed to in the Tri-Party Agreement, and because DOE believes that doing so will help to control costs on the project. However, the myriad of technical, safety, and management problems that have already occurred on the project make it clear that a more systematic approach to the project is needed. Indeed, many of those problems have not yet been fully resolved. Continuing with a fast-track, design-build approach under these conditions increases the risk that the completed facilities may require major rework to operate safely and effectively, which could further increase costs. In our view, proceeding with a project construction plan more closely aligned with nuclear industry guidelines for complex nuclear facilities will provide the best chance of successfully completing the project and controlling the final cost and completion date.

The reliability of the revised project estimates

None of the estimates Bechtel has developed so far have been reliable. Estimates of material and labor costs have been inadequate and Bechtel has not included sufficient contingencies in the project baseline to account for the high risk, technical complexities, and managerial challenges it has faced. As DOE’s project management guidance states, the key is to develop a project baseline estimate that is fully achievable. Re-baselining the project is a time-consuming and costly effort. Bechtel’s December 2005 baseline proposal is contained in a roughly 44,000 page document that according to Bechtel’s deputy project manager required the efforts of about 200 staff over a 6-month period and cost about \$10 million to develop. Furthermore, outside reviews and baseline validations have cost DOE an additional \$20 million since 2003.

Bechtel has indicated that the project’s revised cost and schedule estimates will be comprehensive enough to account for known uncertainties, such as what it might take to address the problem of hydrogen gas building up in facility pipes as well as any less predictable

unknowns that might occur, such as a shortage of a key commodity. While we are encouraged that Bechtel is taking a more systematic approach to developing the project estimates, we have some remaining concerns. In particular, the project estimate must not only account for constructing the facilities but also commissioning—when DOE and Bechtel will demonstrate that the facilities are safe and ready to operate. In the past, to try and achieve milestone dates agreed to for beginning facility operations, DOE and Bechtel reduced the amount of time in the baseline schedule allocated to facility commissioning and testing activities from about 58 months to 42 months. In our June 2004 report, we expressed a concern that shortening the commissioning schedule may affect the reliability of the completed facilities. We also contacted former DOE and contractor officials and industry technology development managers who told us that the commissioning approach in the 2003 baseline could result in significant problems being overlooked.

Under Bechtel's most recent proposal, the timeframe for commissioning and testing activities has been increased to about 46 months, including about 21 months of component testing before commissioning with simulated and actual waste begins. However, Bechtel does not yet have a detailed plan for the commissioning activities that demonstrates a 46 month period is adequate. Furthermore, one independent review has concluded that the commissioning phase will be the most difficult aspect of the entire construction project.¹³ Given the nuclear safety problems Bechtel has encountered so far on the project, and the complexity and size of the waste treatment plant, the commissioning phase portion of the schedule will need to be long enough to allow full testing of the facilities and sufficient time to identify and address any remaining problems before operations begin.

The adequacy of project management and oversight

One of the remaining management uncertainties is how DOE will modify contract incentives once the new baseline is finalized. Due to cost increases and schedule delays that have occurred, the incentive fees in the current contract are no longer meaningful. Those incentives included more than \$300 million for meeting cost and schedule goals or construction milestones, and about \$111 million for building a plant that

¹³LMI Government Consulting, *Hanford Waste Treatment and Immobilization Plant Project: After-Action Fact Finding Review*, January 2006.

operates effectively. This greater focus on cost and schedule milestones may help explain why DOE has found a less than adequate concern for nuclear safety on the project. Another issue, however, is that modifying the contract to provide new incentives could be viewed as rewarding Bechtel's past performance. Overall, it remains to be seen whether DOE can finally put in place a combination of performance incentives and management controls that will support the successful treatment of the Hanford tank wastes over the next few decades.

Conclusions

By just about any measure, the Hanford waste treatment project is in disarray, as evidenced by ever-increasing cost estimates, construction delays, and more recently, safety concerns. In our view, what is happening is uncharacteristic of a well-planned and well-managed construction project. Project costs are increasing rapidly and we do not know what the facilities will ultimately cost or when they will be operational. Of great concern to us is the fact that many nuclear safety and other technical problems have occurred on the project. We believe that it is imperative that Bechtel and DOE discover any and all safety problems and immediately address them. In going forward, it is unclear whether DOE plans to continue using a fast-track approach that we have found is inappropriate for this unique, complex nuclear facility. We believe that DOE needs to follow nuclear industry construction guidelines and take a more conservative approach to design and construction activities that avoids carrying out these activities concurrently. Furthermore, the revised baseline must be robust enough to adequately address remaining uncertainties and allow sufficient time for testing the facilities during the commissioning phase. Unless the revised baseline fully reflects all remaining uncertainties, especially problems that may occur during facility commissioning, DOE will be unable to ensure that no further re-baselining of the project will be necessary. Furthermore, it is unclear how DOE will modify contract incentives or carry out its revised plan for overseeing the project. We believe that DOE needs to develop contract incentives that better balance cost and schedule incentives and incentives to ensure that the facilities operate safely and effectively as well as improve the department's management and oversight of contractor activities. In our view, if DOE takes these actions the project will have a better chance of being successfully completed.

Recommendations

We recommend that the Secretary of Energy take the following three actions:

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1. Discontinue using a fast-track, design-build approach to completing the project and consider the feasibility of completing at least 90 percent of the facility design or facility component design before restarting construction, and ensure that the project's major technical and safety problems have been addressed before restarting construction.
 2. Develop a revised project baseline that fully reflects the remaining uncertainties, including potential problems that may be encountered during the commissioning phase, before presenting it as a reliable estimate of the project's cost and schedule.
 3. Establish improved management controls, including revising contract incentives and strengthening accountability for performing oversight activities.

Thank you, Mr. Chairman and Members of the Subcommittee. That concludes my testimony. I would be pleased to respond to any questions that you may have.

Contacts and Acknowledgments

For further information on this testimony, please contact Mr. Gene Aloise at (202) 512-3841. Individuals making key contributions to this testimony included Chris Abraham, John Delicath, Nancy Kintner-Meyer, Jeff Larson, Tom Perry, and Bill Swick.

Appendix I: Additional Information on Hanford's Tank Wastes

DOE has a vast complex of sites across the nation dedicated to the nuclear weapons program, but the high-level waste stemming from reprocessing spent nuclear fuel to produce weapons material such as plutonium and uranium has been limited mainly to three sites—the Savannah River site, South Carolina; the Idaho National Laboratory near Idaho Falls, Idaho; and the Hanford site near Richland, Washington.¹ The underground storage tanks that store the high-level waste at the Hanford site consist of 149 single shell steel tanks and 28 double shell tanks encased in concrete. Most of these tanks have already exceeded their design life. DOE has concluded, based on tank monitoring data and other techniques used to detect contamination in soil under the tanks, that 67 of the single shell tanks have leaked about 1 million gallons of high-level waste into the soil. DOE does not believe that the double shell tanks have leaked any waste.

The waste in these tanks contains radioactive components that emit dangerously intense radiation. Because of the intense radiation emitted from high-level waste, the waste must be isolated and handled remotely behind heavy shielding such as a layer of concrete in order to protect humans and the environment. In addition to intense radioactivity, some radioactive components are highly mobile in the environment and can quickly migrate to contaminate the soil and groundwater if not immobilized. In addition to radioactive components, DOE's high-level waste also generally contains hazardous components added during the process of dissolving used nuclear fuel to remove plutonium and other nuclear materials or to stabilize the waste for storage. These hazardous components include solvents, acids, caustic sodas, and toxic heavy metals such as chromium and lead. Radioactive waste components, when combined with hazardous components, are referred to as "mixed wastes."

High-level waste generally exists in a variety of physical forms and layers inside the underground tanks, depending on the physical and chemical properties of the waste components. The waste in the tanks takes three main forms:

- **Sludge:** The denser, water insoluble components generally settle to the bottom of the tank to form a thick layer known as sludge, which has the consistency of peanut butter.

¹DOE also agreed to clean up high-level waste at another site—the West Valley Demonstration Project at West Valley, New York—where the state sponsored reprocessing of both commercial and DOE spent nuclear fuel. DOE completed treatment and preparation of this waste for disposal in September 2002.

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- **Saltcake:** Above the sludge may be water-soluble components such as sodium salts that crystallize or solidify out of the waste solution to form a moist sand-like material called saltcake.
 - **Liquid:** Above or between the denser layers may be liquids comprised of water and dissolved salts called supernate.

The treatment and disposal of high-level waste produced at DOE facilities is governed by a number of federal laws, including laws that define the roles of DOE and the Nuclear Regulatory Commission (NRC) in waste management. The Atomic Energy Act of 1954 (AEA) and the Energy Reorganization Act of 1974 established responsibility for the regulatory control of radioactive materials including DOE's high-level wastes. Under amendments the Federal Facility Compliance Act of 1992 made to the Resource Conservation and Recovery Act of 1976 (RCRA), DOE generally must develop waste treatment plans for its sites that contain mixed wastes.² These plans are approved by states, including the state of Washington, that EPA has authorized to administer RCRA or by EPA in those states that have not been so authorized.

²42 U.S.C. 6939c(b).

Appendix II: Scope and Methodology

To determine how costs and schedule for DOE's waste treatment plant located at the Hanford site near Richland, Washington have changed, and the primary causes for those changes since the contract was awarded in 2000, we reviewed previous GAO reports on the project from 1993 to 2005. In addition we reviewed several internal and external reports addressing cost, schedule, technology, and other issues on the project, including two studies by the Army Corps of Engineers, and a study conducted for DOE by LMI Government Consulting—a private engineering consulting firm. We also reviewed both the April and December 2005 Estimates at Completion prepared by Bechtel and two March 2006 reports prepared by external review teams to assess the impact of a variety of technical issues on the project and Bechtel's estimated cost estimate for completing the project. Both of these reports were prepared under the direction of the department's Office of Environmental Management. While we did not independently verify the accuracy of the data presented in these reports, based on our review of much of the supporting documentation cited in the reports, we determined the data to be of sufficient reliability use in our report. To assist in evaluating these reports and other technical issues on the project, we obtained assistance from our technical consultant, Dr. George Hinman, who has a Ph. D. in physics and serves as Professor Emeritus at Washington State University. Dr. Hinman has extensive nuclear energy experience in industry, government, and academia.

We also discussed the problems and underlying causes of cost and schedule growth with DOE and contractor officials at the site as well as DOE officials in its Office of Environmental Management, Office of Engineering and Construction Management, and Office of Budget. We discussed the project's cost and schedule changes with outside experts, including officials from the Defense Nuclear Facilities Safety Board. To document the primary causes for changes in the cost and schedule estimates, we relied on these documents as well as interviews with key project and program officials. We quantified the cost impact of each of the main causes for cost growth and schedule increases from information provided in Bechtel's April 2005 estimate and the Corps of Engineers' May 2005 report. These estimates were based on an estimated contract price of \$9.3 billion. However, even though Bechtel updated its cost and schedule estimates to reflect a potential contract price of nearly \$11 billion as of December 2005, it does not plan to finalize its estimate until late May 2006. As a result, we were not able to quantify the impact of each of the main causes we cited for cost and schedule changes to reflect the most recent cost estimate.

To determine the steps DOE and Bechtel are taking to improve management and oversight of the project, we reviewed several documents, including a letter by the Assistant Secretary for Environmental Management directing that a number of management improvements be made. We reviewed DOE policy and procedure documents, and discussed DOE's strategy to manage the project with DOE headquarters officials in its Office of Environmental Management. We also discussed management improvement initiatives with senior Bechtel officials. In reviewing the role of fast track on the project, we obtained information from the nuclear industry to update current guidance on designing, licensing, and building nuclear facilities that may be equivalent in size, scope, and complexity to the Hanford waste treatment plant.

To develop information on nuclear safety issues at the waste treatment plant and DOE's enforcement action, we obtained numerous documents from DOE and Bechtel describing safety problems that had been identified over the years, analyses of the causes, and proposed actions to correct the problems. We discussed nuclear safety issues with DOE's Director of Environmental Safety and Quality at Hanford as well as Bechtel's Quality Assurance Manager and Price-Anderson Amendments Act Coordinator. To understand the significance of safety violations raised in DOE's March 17, 2006 enforcement action, we discussed the Proposed Notice of Violation with the Director of the Office of Enforcement in DOE's Office of Environmental Safety and Health. We also discussed safety concerns with officials from the Defense Nuclear Facilities Safety Board and with state regulators.

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