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GAO

Report to Congressional Requesters

December 2012

HANFORD WASTE TREATMENT PLANT

DOE Needs to Take Action to Resolve Technical and Management Challenges

GAO-13-38

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GAO Accountability * Integrity * Reliability

Highlights

Highlights of GAO-13-38, a report to congressional requesters

Why GAO Did This Study

In December 2000, DOE awarded Bechtel a contract to design and construct the WTP project at DOE's Hanford Site in Washington State. This project—one of the largest nuclear waste cleanup facilities in the world—was originally scheduled for completion in 2011 at an estimated cost of $4.3 billion. Technical challenges and other issues, however, have contributed to cost increases and schedule delays. GAO was asked to examine (1) remaining technical challenges, if any, the WTP faces; (2) the cost and schedule estimates for the WTP; and (3) steps DOE is taking, if any, to improve the management and oversight of the WTP project. GAO reviewed DOE and contractor data and documents, external review reports, and spoke with officials from DOE and the Defense Nuclear Facilities Safety Board and with contractors at the WTP site and test facilities.

What GAO Recommends

GAO recommends that DOE (1) not resume construction on WTP's pretreatment and high-level waste facilities until, among other things, the facilities' design has been completed to the level established by nuclear industry guidelines; (2) ensure the department's contractor performance evaluation process does not prematurely reward contractors for resolving technical issues later found to be unresolved; and (3) take appropriate steps to determine whether any incentive payments were made erroneously and, if so, take actions to recover them. DOE generally agreed with the report and its recommendations.

View GAO-13-38. For more information, contact David C. Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

The Department of Energy (DOE) faces significant technical challenges in successfully constructing and operating the Waste Treatment and Immobilization Plant (WTP) project that is to treat millions of gallons of highly radioactive liquid waste resulting from the production of nuclear weapons. DOE and Bechtel National, Inc. identified hundreds of technical challenges that vary in significance and potential negative impact and have resolved many of them. Remaining challenges include (1) developing a viable technology to keep the waste mixed uniformly in WTP mix tanks to both avoid explosions and so that it can be properly prepared for further processing; (2) ensuring that the erosion and corrosion of components, such as tanks and piping systems, is effectively mitigated; (3) preventing the buildup of flammable hydrogen gas in tanks, vessels, and piping systems; and (4) understanding better the waste that will be processed at the WTP. Until these and other technical challenges are resolved, DOE will continue to be uncertain whether the WTP can be completed on schedule and whether it will operate safely and effectively.

Since its inception in 2000, DOE's estimated cost to construct the WTP has tripled and the scheduled completion date has slipped by nearly a decade to 2019. GAO's analysis shows that, as of May 2012, the project's total estimated cost had increased to $13.4 billion, and significant additional cost increases and schedule delays are likely to occur because DOE has not fully resolved the technical challenges faced by the project. DOE has directed Bechtel to develop a new cost and schedule baseline for the project and to begin a study of alternatives that include potential changes to the WTP's design and operational plans. These alternatives could add billions of dollars to the cost of treating the waste and prolong the overall waste treatment mission.

DOE is taking steps to improve its management and oversight of Bechtel's activities but continues to face challenges to completing the WTP project within budget and on schedule. DOE's Office of Health, Safety, and Security has conducted investigations of Bechtel's activities that have resulted in penalties for design deficiencies and for multiple violations of DOE safety requirements. In January 2012, the office reported that some aspects of the WTP design may not comply with DOE safety standards. As a result, DOE ordered Bechtel to suspend work on several major WTP systems, including the pretreatment facility and parts of the high-level waste facility, until Bechtel can demonstrate that activities align with DOE nuclear safety requirements. While DOE has taken actions to improve performance, the ongoing use of an accelerated approach to design and construction—an approach best suited for well-defined and less-complex projects—continues to result in cost and schedule problems, allowing construction and fabrication of components that may not work and may not meet nuclear safety standards. While guidelines used in the civilian nuclear industry call for designs to be at least 90 percent complete before construction of nuclear facilities, DOE estimates that WTP is more than 55 percent complete though the design is only 80 percent complete. In addition, DOE has experienced continuing problems overseeing its contractor's activities. For example, DOE's incentives and management controls are inadequate for ensuring effective project management, and GAO found instances where DOE prematurely rewarded the contractor for resolving technical issues and completing work.

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Abbreviations

DOE	Department of Energy
EPA	Environmental Protection Agency
ORP	DOE's Office of River Protection
PNNL	Pacific Northwest National Laboratory
WTP	Waste Treatment and Immobilization Plant

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United States Government Accountability Office
Washington, DC 20548

December 19, 2012

The Honorable Fred Upton
Chairman
The Honorable Henry A. Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Cliff Stearns
Chairman
The Honorable Diana DeGette
Ranking Member
Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

The Honorable Edward J. Markey
House of Representatives

The Department of Energy (DOE) is responsible for one of the world's largest environmental cleanup projects: the treatment and disposal of millions of gallons of radioactive and hazardous waste at its 586-square-mile Hanford Site in southeastern Washington State. A total of nine nuclear reactors—including the world's first operating large-scale reactor, developed as part of the Manhattan Project during World War II—were built at Hanford and operated until the late 1980s. The primary mission of these reactors was to produce plutonium and other special nuclear materials for DOE's nuclear weapons program. Some of the large volumes of hazardous and radioactive waste that resulted from nuclear materials production 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. The underground tanks currently hold more than 56 million gallons of this waste—enough to fill an area the size of a football field to a depth of over 150 feet.

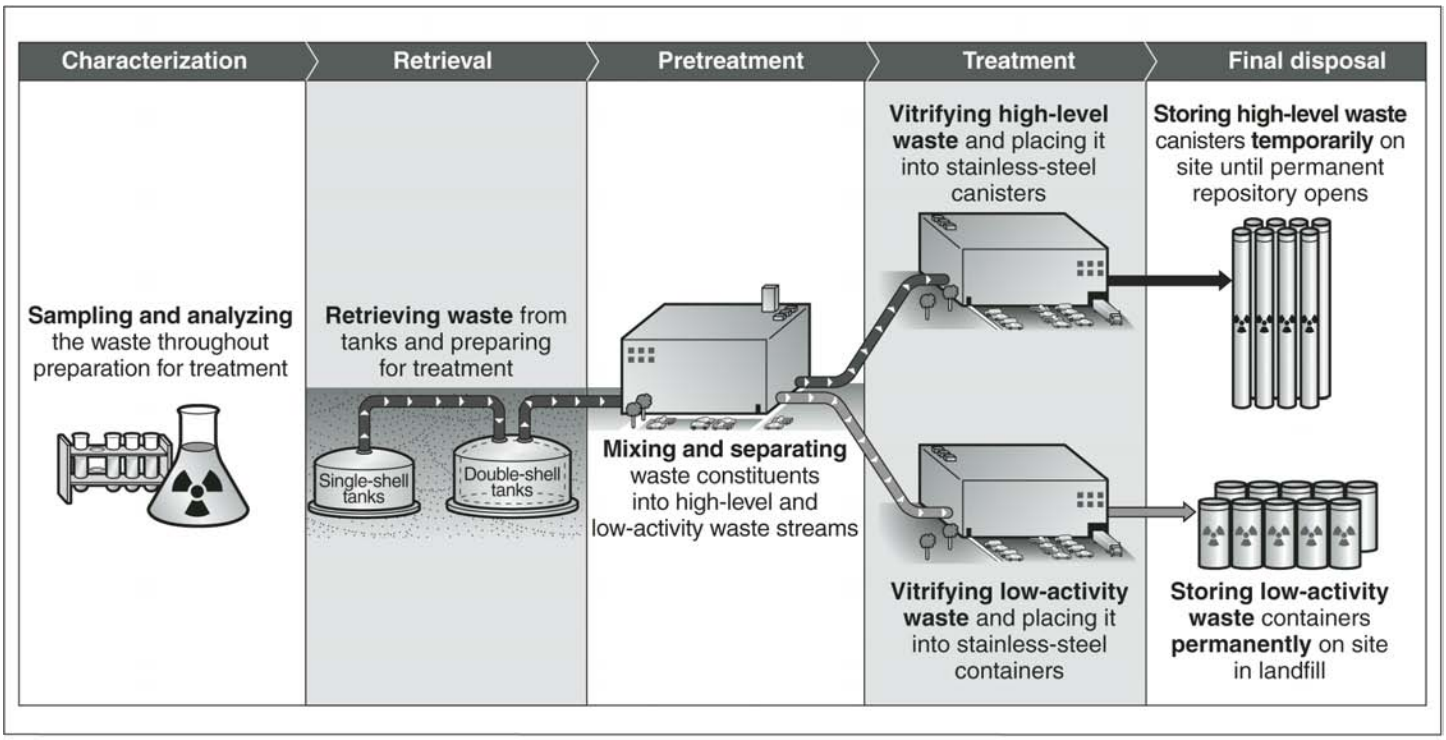
The oldest 149 tanks, some of which date back to the 1940s, have single-layer walls, or shells; were built with a 20-year design life; and will be almost 100 years old by the estimated end of waste treatment. DOE has reported that 67 of these tanks are assumed or are known to have leaked

waste into the soil. Because some of this contamination has reached the groundwater under the tanks, DOE officials are concerned that the contamination is now making its way to the Columbia River, which borders the Hanford Site for almost 50 miles. The Columbia River is the second largest river in the United States and a source for hydropower production, agricultural irrigation, drinking water, and salmon reproduction. The site is also near the cities of Richland, Pasco, and Kennewick, with a combined regional population of over 200,000. DOE, the Environmental Protection Agency (EPA), and the Washington State Department of Ecology have determined that containing, stabilizing, and preparing this highly radioactive liquid waste for final disposal is one of the highest priority cleanup activities at the Hanford site. It is also one of the most complex cleanup activities and, as of August 2012, none of the waste in the tanks had been treated for disposal because no treatment facility was yet available.

In 2000, DOE awarded a contract to Bechtel National, Inc. to design, construct, and commission a Waste Treatment and Immobilization Plant (WTP) to stabilize large quantities of this waste and prepare it for disposal at a permanent national geologic repository that is yet to be identified. The WTP is to consist of a pretreatment facility that separates waste into high-level and low-activity radioactivity waste streams; two facilities to treat these separated streams using a process called vitrification, where waste is mixed with melted glass and poured into steel canisters where it cools and hardens, to prepare it for final disposal; an analytical laboratory; and a variety of supporting facilities.[1] See figure 1 for a description of the process that is to be used to treat and stabilize waste at the WTP and prepare it for disposal.

[1]As designed, the WTP Low Activity Waste Facility will only be capable of treating less than half of the expected quantity of Hanford's low-activity waste. DOE has indicated that a second plant or alternative approach that is not part of the current project will be necessary to treat the rest of the low-activity waste and is still exploring a supplemental technology outside the scope of the WTP to treat this waste. See GAO, *Nuclear Waste: DOE Should Reassess Whether the Bulk Vitrification Demonstration Project at Its Hanford Site Is Still Needed to Treat Radioactive Waste,* GAO-07-762 (Washington, D.C.: June 12, 2007).

Figure 1: WTP Waste Treatment Process



Sources: GAO and DOE.

To construct the facility, DOE and Bechtel adopted a fast-track, design-build approach. Using the unconventional design-build approach, technology development activities, plant design, and construction occur simultaneously. In a conventional construction approach, these activities occur sequentially. As required by DOE's project management directives, approval to begin construction is granted when technology development and design of the facility is essentially complete and after the establishment and approval of a project's performance baseline, which represents DOE's commitment to complete a project with a specific scope at a certain cost and by a specific date. We and others have raised concerns about DOE's use of the design-build approach for the WTP because some sections of this facility are constructed before designs are complete and before technology issues are fully resolved, which has

led to significant cost increases and schedule delays.[2] Specifically, when the contract was awarded in 2000 for the WTP, the contract for constructing the WTP specified that the project would cost $4.3 billion and would be completed in 2011. As a result of numerous problems with the design and construction of WTP facilities, in 2006, DOE significantly modified the project's baseline. Despite the problems throughout the construction process, however, DOE has continued with the design-build approach. In the last 2 years, several WTP project engineers and managers and the Defense Nuclear Facility Safety Board (Safety Board)—an independent oversight agency created by Congress to assess safety conditions and operations at defense nuclear facilities at DOE's sites—publicly criticized DOE and Bechtel for ignoring technical and safety concerns that threaten the plant's ability to operate safely once constructed. In 2011, DOE reported that unresolved technical risks would cause the cost and schedule estimates to slip further unless additional funding was provided.

In this context, you asked us to evaluate DOE's management of the WTP project. Our objectives were to examine: (1) remaining technical challenges, if any, the WTP faces; (2) cost and schedule estimates for the WTP; and (3) steps DOE is taking, if any, to improve the management and oversight of the WTP project.

To accomplish our objectives, we conducted our work at the Hanford Site, including the WTP construction site; DOE's Office of River Protection (ORP)—which is responsible for DOE management of the construction of the WTP; Bechtel's WTP project office in Richland, Washington; and test facilities at Mid Columbia Engineering. We interviewed, among others, current and past DOE WTP project directors and officials from WTP project support divisions, including the WTP Engineering Division, ORP Engineering and Nuclear Safety Division, and ORP Environmental Safety and Quality Division.

[2]GAO, *Hanford Waste Treatment Plant: Contractor and DOE Management Problems Have Led to Higher Costs, Construction Delays, and Safety Concerns,* GAO-06-602T (Washington, D.C.: Apr. 6, 2006); GAO, *Department of Energy: Major Construction Projects Need a Consistent Approach for Assessing Technology Readiness to Help Avoid Cost Increases and Delays,* GAO-07-336 (Washington, D.C.: Mar. 27, 2007); GAO-07-762.

To identify any remaining technical challenges that the WTP is facing, we reviewed DOE and Bechtel documents that provide a summary and current status of technical issues, including criteria for addressing these issues and a timeline for their resolution. We also examined independent reviews on technical and safety issues and interviewed officials from DOE's Office of Engineering and Construction Management and Office of Health, Safety, and Security; the Pacific Northwest National Laboratory (PNNL); the Safety Board; and the Consortium for Risk Evaluation with Stakeholder Participation—a group of engineering, scientific, and policy experts from seven universities that advises DOE in its environmental management activities.[3] We also interviewed officials from the Washington State Department of Ecology and EPA.

To examine the current cost and schedule estimates for the WTP, we reviewed the most current estimates for the project that DOE prepared in 2006, DOE and Bechtel progress reports on the project's adherence to these cost and schedule estimates, and project risk management plans. We also interviewed DOE officials to obtain information on recent efforts to revise the project's cost and schedule estimates.

To determine any steps DOE is taking to improve the management and oversight of the WTP project, we reviewed DOE policies on project management, examined regulatory requirements, and reviewed agreements between DOE, EPA, and the state of Washington. We also reviewed DOE WTP management documents, risk analysis reports, and contractor project plans.

We conducted this performance audit from September 2011 to December 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[3]DOE's Office of Engineering and Construction Management is now called the Office of Project Management and is within DOE's Office of Acquisition and Project Management.

Background

Established in 1943, Hanford produced plutonium for the world's first nuclear device. At the time, little attention was given to the resulting by-products—massive amounts of radioactive and chemically hazardous waste—or how these by-products were to be permanently disposed of. About 46 different radioactive elements represent the majority of the radioactivity currently residing in Hanford's tanks. Once Hanford tank waste is separated by the WTP waste treatment process, the high-level waste stream will contain more than 95 percent of the radioactivity but constitute less than 10 percent of the volume to be treated. The low-activity waste stream will contain less than 5 percent of the radioactivity but constitute over 90 percent of the volume. The tanks also contain large volumes of hazardous chemical waste, including various metal hydroxides, oxides, and carbonates. These hazardous chemicals are dangerous to human health and can cause medical disorders including cancer, and they can remain dangerous for thousands of years. Over the years, the waste contained in these tanks has settled; today it exists in the following four main forms or layers:

- *Vapor*: Gases produced from chemical reactions and radioactive decay occupies tank space above the waste.
- *Liquid*: Fluids (supernatant liquid) may float above a layer of settled solids or under a floating layer of crust; fluids may also seep into pore spaces or cavities of settled solids, crust, or sludge.
- *Saltcake*: Water-soluble compounds, such as sodium salts, can crystallize or solidify out of wastes to form a salt-like or crusty material.
- *Sludge*: Denser water-insoluble or solid components generally settle to the bottom of a tank to form a thick layer having the consistency similar to peanut butter.

DOE's cleanup, treatment, and disposal of radioactive and hazardous wastes are governed by a number of federal and state laws and implemented under the leadership of DOE's Assistant Secretary for Environmental Management. Key laws include the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as

amended,[4] and the Resource Conservation and Recovery Act of 1976, as amended.[5] In addition, most of the cleanup activities at Hanford are carried out under the Hanford Federal Facility Agreement and Consent Order among DOE, the Washington State Department of Ecology, and EPA. Commonly called the Tri-Party Agreement, this accord was signed in May 1989 and has been amended a number of times since then to, among other things, establish additional enforceable milestones for certain WTP construction and tank waste retrieval activities. The agreement lays out a series of legally enforceable milestones for completing major activities in Hanford's waste treatment and cleanup process. A variety of local and regional stakeholders, including county and local government agencies, citizen and advisory groups, and Native American tribes, also have long-standing interests in Hanford cleanup issues. These stakeholders make their views known through various public involvement processes, including site-specific advisory boards. DOE's ORP administers Hanford's radioactive liquid tank waste stabilization and disposition project including the construction of the WTP. The office has an annual budget of about $1 billion and a staff of 151 federal employees, of which 54 support the WTP project. Other cleanup projects at Hanford are administered by DOE's Richland Operations Office.

DOE has attempted and abandoned several different strategies to treat and dispose of Hanford's tank wastes. In 1989, DOE's initial strategy called for treating only part of the waste. Part of this effort involved renovating a World War II-era facility in which it planned to start waste treatment. DOE spent about $23 million on this project but discontinued it because of technical and environmental issues and stakeholder concerns that not all the waste would be treated. In 1991, DOE decided to treat waste from all 177 tanks. Under this strategy, DOE would have completed the treatment facility before other aspects of the waste treatment program were fully developed; however, the planned treatment facility would not have had sufficient capacity to treat all the waste in a time frame acceptable to EPA and the Washington State Department of Ecology.

[4]42 U.S.C. § 9601 et seq. The act, among other things, provided the federal government with authority to respond to releases or threatened releases of hazardous substances.

[5]42 U.S.C. § 6901 et seq. Under the act, the owners or operators of facilities located on sites where hazardous waste was or is treated, stored, or disposed of must, among other things, clean up present and past contamination within the boundaries of their sites, as well as contamination that may have spread beyond those boundaries.

DOE spent about $418 million on this strategy. Beginning in 1995, DOE attempted to privatize tank waste cleanup. Under its privatization strategy, DOE planned to set a fixed price and pay the contractor for canisters and containers of stabilized tank waste that complied with contract specifications. If costs grew as a result of contractor performance problems, the contractor, not DOE, was to bear these cost increases. Any cost growth occurring as a result of changes directed by DOE was to result in an adjustment to the contract price and was to be borne by DOE. Under the privatization strategy, DOE's contractor would build a demonstration facility to treat 10 percent of the waste volume and 25 percent of the radioactivity by 2018 and complete cleanup in 2028. However, because of dramatically escalating costs and concerns about contractor performance, DOE terminated the contract after spending about $300 million, mostly on plant design. Following our criticisms of DOE's earlier privatization approach,[6] DOE decided that a cost-reimbursement contract with incentive fees would be more appropriate than a fixed-price contract using a privatization approach for the Hanford project and would better motivate the contractor to control costs through incentive fees. In total, since 1989 when cleanup of the Hanford site began, DOE has spent over $16 billion to manage the waste and explore possible ways to treat and dispose of it.

DOE's current strategy for dealing with tank waste consists of the construction of a large plant—the WTP—to treat and prepare the waste for permanent disposal. Begun in 2000, the WTP project is over half completed and covers 65 acres and is described by DOE as the world's largest radioactive waste treatment plant. As designed, the WTP project is to consist of three waste processing facilities, an analytical laboratory, and over 20 smaller supporting facilities to treat the waste and prepare it for permanent disposal. The three waste processing facilities are as follows (see fig. 2):

- *Pretreatment Facility* – This facility is to receive the waste from the tanks and separate it into high-level and low-activity components. This is the largest of the WTP facilities—expected to be 12-stories tall with a foundation the size of four football fields.

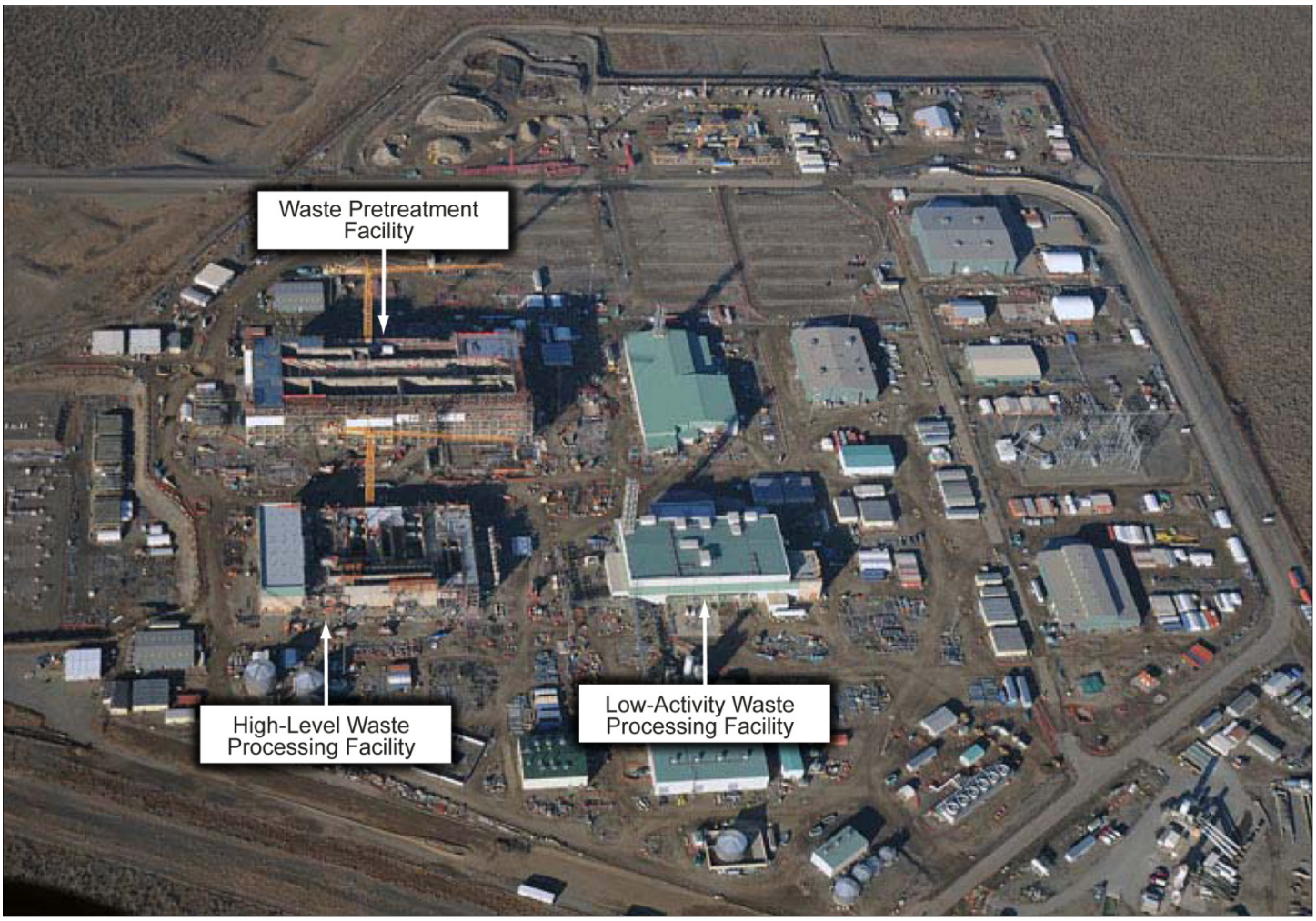
[6]See GAO, *Nuclear Waste: Observations on DOE's Privatization Initiative for Complex Cleanup Projects,* GAO/T-RCED-00-215 (Washington, D.C.: June 22, 2000).

- *High-Level Waste Facility* – This facility is to receive the high-level waste from the pretreatment facility and immobilize it by mixing it with a glass-forming material, melting the mixture into glass, and pouring the vitrified waste into stainless-steel canisters to cool and harden. The canisters filled with high-level waste were initially intended to be permanently disposed of at a geological repository that was to be constructed at Yucca Mountain in Nevada. However, in 2010, DOE began taking steps to terminate the Yucca Mountain project and is now considering other final disposal options.[7] In the meantime, high-level waste canisters will be stored at Hanford.

- *Low-Activity Waste Facility* – This facility is to receive the low-activity waste from the pretreatment facility and vitrify it. The containers of vitrified waste will then be permanently disposed of at another facility at Hanford known as the Integrated Disposal Facility.

[7]GAO, *Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned,* GAO-11-229 (Washington, D.C.: May 10, 2011).

Figure 2: WTP Construction Site as of March 2012



Source: DOE.

Constructing the WTP is a massive, highly complex, and technically challenging project. For example, according to Bechtel documents, the completed project will contain almost 270,000 cubic yards of concrete and nearly a million linear feet of piping. The project also involves developing first-of-a-kind nuclear waste mixing technologies that will need to operate for decades with perfect reliability because, as currently designed, once WTP begins operating, it will not be possible to access parts of the plant to conduct maintenance and repair of these technologies due to high radiation levels.

Significant Technical Challenges Remain Unresolved

Since the start of the project, DOE and Bechtel have identified hundreds of technical challenges that vary in their significance and potential negative impact, and significant technical challenges remain. Technical challenges are to be expected on a one-of-a-kind project of this size, and DOE and Bechtel have resolved many of them. However, because such challenges remain, DOE cannot be certain whether the WTP can be completed on schedule and, once completed, whether it will successfully operate as intended.

Among others, the significant technical challenges DOE and Bechtel are trying to resolve include the following:

- *Waste mixing*—One function of the WTP will be to keep the waste uniformly mixed in tanks so it can be transported through the plant and to prevent the buildup of flammable hydrogen and fissile material that could inadvertently result in a nuclear criticality accident. The WTP project has been developing a technology known as "pulse jet mixers" that uses compressed air to mix the waste. Such devices have previously been used successfully in other materials mixing applications but have never been used for mixing wastes with high solid content like those to be treated at the WTP. In 2004 and again in 2006, we reported that Bechtel's inability to successfully demonstrate waste mixing technologies was already leading to cost and schedule delays.[8] Our 2004 report recommended that DOE and Bechtel resolve this issue before continuing with construction. DOE agreed with our recommendation, slowed construction on the pretreatment and high-level waste facilities and established a path forward that included larger-scale testing to address the mixing issue. In 2010, following further testing by Bechtel, DOE announced that mixing issues had been resolved and moved forward with construction. However, concerns about the pulse jet mixers' ability to successfully ensure uniform mixing continued to be raised by the Safety Board, PNNL, and DOE engineering officials on site. As a result, in late 2011, DOE directed Bechtel to demonstrate that the mixers will work properly and meet the safety standards for the facility. According to DOE officials, no timeline for the completion of this testing has been set.

[8]GAO, *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 GAO-06-602T.

- *Preventing erosion and corrosion of WTP components*—Excessive erosion or corrosion of components such as mixing tanks and piping systems in the WTP is possible. Such excessive erosion and corrosion could be caused by potentially corrosive chemicals and large dense particles present in the waste that is to be treated. This excessive erosion and corrosion could result in the components' failure and lead to disruptions of waste processing. Bechtel officials first raised concerns about erosion and corrosion of WTP components in 2001, and these concerns were echoed in 2006 by an independent expert review of the project. Following further testing, DOE project officials declared the issue closed in 2008. However, DOE and Bechtel engineers recently voiced concerns that erosion and corrosion of components is still a significant risk that has not been sufficiently addressed. Furthermore, in January 2012, the Safety Board reported that concerns about erosion in the facility had still not been addressed, and that further testing is required to resolve remaining uncertainties. Bechtel has agreed to do further work to resolve technical challenges surrounding erosion and corrosion of the facilities internal components; however, DOE and Bechtel have not yet agreed upon an overall plan and schedule to resolve this challenge.

- *Preventing buildup of flammable hydrogen gas*—Waste treatment activities in the WTP's pretreatment and high-level waste facilities can result in the generation of hydrogen gas in the plant's tanks and piping systems. The buildup of flammable gas in excess of safety limits could cause significant safety and operational problems. DOE and Bechtel have been aware of this challenge since 2002, and Bechtel formed an independent review team consisting of engineers and other experts in April 2010 to track and resolve the challenge. This team identified 35 technical issues that must be addressed before the hydrogen buildup challenge can be resolved. Bechtel has been working to address these issues. However, a 2011 DOE construction project review noted that, while Bechtel continues to make progress resolving these issues, the estimated schedule to resolve this challenge has slipped.[9] According to DOE and Bechtel officials, Bechtel is still conducting analysis and is planning to complete the work to resolve this challenge by 2013.

[9] DOE, *Department of Energy Review Committee Report on the Construction Project Review of the Waste Treatment and Immobilization Plant Project at the Office of River Protection at Hanford* (Washington, D.C.: August 2011).

- *Incomplete understanding of waste*—DOE does not have comprehensive data on the specific physical, radiological, and chemical properties of the waste in each underground waste tank at Hanford. In the absence of such data, DOE has established some parameters for the waste that are meant to estimate the range of waste that may go through the WTP in an effort to help the contractor design a facility that will be able to treat whatever waste—or combination of wastes—is ultimately brought into the WTP. In 2006, an independent review team stated that properly understanding the waste would be an essential key factor in designing an effective facility. In 2010, the Consortium for Risk Evaluation with Stakeholder Participation, PNNL, and the Safety Board reviewed the status of DOE's plans to obtain comprehensive data on the characteristics of the waste, and each concluded that DOE and Bechtel did not have enough information about the waste and would therefore need to increase the range of possible wastes that the WTP is designed to treat in order to account for the uncertainty. Officials at PNNL reported that not having a large enough range is "a vulnerability that could lead to inadequate mixing and line plugging." The Safety Board reported that obtaining representative samples of the waste is necessary to demonstrate that the WTP can be operated safely, but that DOE and its contractors have not been able to explain how those samples will be obtained. In its 2011 review of the WTP project, a DOE headquarters construction project review report notes that progress has been made on including additional information and uncertainties in the efforts to estimate and model the waste that will be fed to the WTP. However, DOE officials stated that more sampling of the waste is needed. An expert study is under way that will analyze the gap between what is known and what is needed to be known to design an effective facility. This study is expected to be completed in August 2014.

The risks posed by these technical challenges are exacerbated because once the facility begins operating, certain areas within the WTP (particularly in the pretreatment and high-level waste facilities) will be permanently closed off to any human intervention in order to protect workers and the public from radioactive contamination. To shield plant workers from intense radiation that will occur during WTP operations, some processing tanks will be located in sealed compartments called "black cells." These black cells are enclosed rooms where inspection, maintenance, repair, or replacement of equipment or components is extremely difficult because high radiation levels prevent access into them. As a result, plant equipment in black cells must last for WTP's 40-year

expected design life without maintenance. According to a recent review conducted by the DOE Inspector General, premature failure of these components could result in radiation exposure to workers, contaminate large portions of the WTP and/or interrupt waste processing for an unknown period.[10] Significant failures of components installed in the WTP once operations begin could render the WTP unusable and unrepairable, wasting the billions of dollars invested in the WTP. In August 2012, DOE announced that it was asking a team of experts to examine the WTP's capability to detect problems in the black cells and the plant's ability to repair equipment in the black cells, if necessary. According to DOE officials, the team will, if needed, recommend design changes to improve the operational reliability of the black cells and the WTP. In addition, the Secretary of Energy has been actively engaged in the development of a new approach to managing WTP technical challenges and has assembled subject matter experts to assist in addressing the technical challenges confronting the WTP.

Substantial Additional Cost Increases and Schedule Delays Are Likely

The estimated cost to construct the WTP has almost tripled since the project's inception in 2000, its scheduled completion date has slipped by nearly a decade, and additional significant cost increases and schedule delays are likely to occur because DOE has not fully resolved the technical challenges faced by the project. In addition, DOE recently reported that Bechtel's actions to take advantage of potential cost savings opportunities are frequently delayed and, as a result, rising costs are outpacing opportunities for savings.

DOE Has Not Yet Fully Estimated the Cost and Schedule Impact of Resolving Technical Challenges

DOE's original contract price for constructing the WTP, approved in 2000, stated that the project would cost $4.3 billion and be completed in 2011. In 2006, however, DOE revised the cost baseline to $12.3 billion, nearly triple the initial estimate, with a completion date of 2019. As we reported in 2006, contractor performance problems, weak DOE management, and technical challenges resulted in these cost increases and schedule delays.[11] A 2011 DOE headquarters review report on the WTP projected

[10] U.S.DOE Office of Inspector General, *Audit Report: The Department of Energy's $12.2 Billion Waste Treatment and Immobilization Plant—Quality Assurance Issues—Black Cell Vessels, DOE/IG-0863* (Washington D.C.: April 2012).

[11] GAO-06-602T.

additional cost increases of $800 million to $900 million over the revised 2006 cost estimate of $12.3 billion and additional delays to the project schedule.[12] Furthermore, in November 2011, the Department of Justice notified the state of Washington that there is a serious risk that DOE may be unable to meet the legally enforceable milestones required by legal agreement, for completing certain activities in Hanford's WTP construction and startup activities, as well as tank waste retrieval activities.[13] The Department of Justice did not identify the cause of the delay or specify the milestones that could be affected. As of May 2012, according to our analysis, the project's total estimated cost had increased to $13.4 billion, and additional cost increases and schedule delays are likely, although a new performance baseline has not yet been developed and approved.

DOE ORP officials warn that cost increases and schedule delays will occur as a result of funding shortfalls and will prevent the department from successfully resolving technical challenges the WTP project faces. However, from fiscal years 2007 to 2010, the project was appropriated the $690 million that DOE requested in its annual congressional budget request.[14] In fiscal years 2011 and 2012, DOE received approximately $740 million each year—a $50 million increase over fiscal year 2010 funding. DOE project management officials and Bechtel representatives told us that $740 million for fiscal year 2012 was not enough to support planned work and, as a result, project work would slow down and project staffing levels would be reduced. However, according to senior DOE officials, including the acting Chief Financial Officer, the primary cause of the increasing costs and delayed completion has been the difficulty in resolving complex technical challenges rather than funding issues.

DOE and Bechtel have not yet fully estimated the effect of resolving these technical challenges on the project's baseline. In February 2012, DOE directed Bechtel to develop a new, proposed cost and schedule baseline

[12]DOE, *Department of Energy Review Committee Report on the Construction Project Review of the Waste Treatment and Immobilization Plant Project at the Office of River Protection at Hanford* (Washington, D.C.: August 2011).

[13]Consent Decree at 4 and Appx A in *Washington v. DOE*, Case No. 08-5085-FVS (E.D. WA. October 25, 2010).

[14]DOE's 2008 enacted appropriation of $690 million was later reduced by a rescission of .91 percent to $683.721 million.

for the project and, at the same time, to begin a study of alternatives that includes potential changes to the WTP's design and operational plans to resolve technical challenges faced by the project. The study is to also identify the cost and schedule impact of these alternatives on the project. For example, according to a DOE official, one alternative Bechtel is studying is to construct an additional facility that would process the tank waste by removing the largest solid particles from the waste before it enters WTP's pretreatment facility. This advance processing would reduce the risks posed by insufficient mixing of the waste in the pretreatment facility by the pulse jet mixers. A DOE official told us that this alternative could add $2 to $3 billion to the overall cost of the project and further delay its completion by several years.

According to DOE officials, other alternatives being studied involve reducing the total amount of waste the WTP treats or operating the WTP at a slower pace for a longer period of time to accomplish its waste processing mission. However, these alternatives could delay the total time needed to process Hanford's waste and add billions of dollars to the total cost to treat all of Hanford's tank waste. Further delays constructing the WTP could also result in significant cost increases to treat all of Hanford's waste. For example, DOE has estimated that a 4-year delay in the WTP start-up date could add an additional $6 to $8 billion to the total cost of the Hanford Site tank waste treatment mission.

In June 2012, DOE announced that the new cost and schedule baseline Bechtel is developing would not include the pretreatment and high-level waste facilities. According to DOE officials, additional testing and analysis is needed to resolve the facilities' technical challenges before a comprehensive new cost and schedule baseline can be completed. DOE officials responsible for overseeing the WTP project are uncertain when the new baseline for these facilities will be completed. As a result, our May 2012 cost estimate of $13.4 is highly uncertain and could grow substantially if the technical challenges that the project faces are not easily and quickly resolved.

Project Cost and Schedule Increases Could Be Partially Offset by Opportunities for Savings

DOE and Bechtel have identified some opportunities for cost savings, but these opportunities are not always pursued in a timely fashion. For example, Bechtel has identified an estimated $48 million in savings that could be achieved over the life of the project by accelerating specific areas of the project scope. Specifically, some of these savings could be achieved by acquiring material and equipment in bulk to maintain the pace of construction activities and avoid delays. In addition, another $24

million in savings could be achieved by reducing the amount of steel, pipe, wire, and other materials needed in remaining design work. DOE reported in March 2012, however, that Bechtel's actions to take advantage of potential cost savings opportunities are frequently delayed and, as a result, rising costs have outpaced opportunities for savings. For example, DOE reported that Bechtel continues to perform poorly in meeting planned dates for material delivery due to delayed identification and resolution of internal issues impacting procurement of plant equipment. Specifically, DOE noted that, of 95 needed project equipment deliveries scheduled for July 2011 through October 2011, 42 were delivered on time and that this poor performance trend is expected to continue.

DOE Is Taking Steps to Address Some Management and Oversight Problems but Continues to Face Challenges to Completing the WTP

DOE is taking steps to improve its management and oversight of Bechtel's activities, including levying penalties on the contractor for quality and safety problems but continues to face challenges to completing the WTP project within budget and on schedule. For example, DOE's continued use of a fast-track, design-build management approach where construction on the project has moved forward before design activities are complete has resulted in costly reworking and schedule delays.

DOE Is Taking Steps to Improve the Management and Oversight of the WTP Project

DOE is taking steps to improve its management and oversight of Bechtel's activities. For example, in November 2011, DOE's Office of Enforcement and Oversight started an investigation into Bechtel's potential noncompliance with DOE's nuclear safety requirements. Specifically, this DOE office is investigating Bechtel's processes for designing, procuring, and installing structures, systems, and components and their potential noncompliance with DOE nuclear safety requirements. If the contractor is found to not be complying with DOE requirements, DOE's Office of Enforcement and Oversight is authorized to take appropriate action, including the issuance of notices of violations and proposed civil penalties against Bechtel. Since 2006, DOE's Office of Enforcement and Oversight has conducted six investigations into Bechtel's activities at WTP that resulted in civil penalty against Bechtel. Five of the six investigations involved issues related to the design and safe operation of the WTP. For example, in 2008, DOE's Office of Enforcement and Oversight investigated Bechtel for circumstances

associated with procurement and design deficiencies of equipment for the WTP and identified multiple violations of DOE nuclear safety requirements. This investigation resulted in Bechtel receiving a $385,000 fine.

In addition, in January 2012, DOE's Office of Health, Safety, and Security reported that some aspects of the WTP design may not comply with DOE safety requirements.[15] Specifically, under DOE safety regulations, Bechtel must complete a preliminary documented safety analysis—an analysis that demonstrates the extent to which a nuclear facility can be operated safely with respect to workers, the public, and the environment. However, Bechtel's preliminary documented safety analyses have not always kept pace with the frequently changing designs and specifications for the various WTP facilities and DOE oversight reviews have highlighted significant deficiencies in the project's safety analyses. In November 2011, according to DOE officials, DOE ordered Bechtel to suspend work on design, procurement, and installation activities for several major WTP systems including parts of the pretreatment facility and high-level waste facility until the contractor demonstrates that these activities are aligned with DOE nuclear safety requirements. This suspension remains in effect.

DOE has also taken steps to address concerns about the project's safety culture. According to DOE's *Integrated Safety Management System Guide*, safety culture is an organization's values and behaviors modeled by its leaders and internalized by its members, which serves to make safe performance of work the overriding priority to protect workers, the public, and the environment. In 2011, the Safety Board issued the results of an investigation into health and safety concerns at WTP. The investigation's principal conclusion was that the prevailing safety culture of the WTP project effectively defeats DOE's policy to establish and maintain a strong safety culture at its nuclear facilities. The Safety Board found that both the DOE and Bechtel project management behaviors reinforce a subculture at WTP that deters the timely reporting, acknowledgement, and ultimate resolution of technical safety concerns. In addition, the Safety Board found a flawed safety culture embedded in the project at the time had a substantial probability of jeopardizing the WTP mission. As a result of

[15]DOE, Office of Health, Safety, and Security, Office of Enforcement and Oversight, *Independent Assessment of the Nuclear Safety Culture and Management of Nuclear Safety Concerns at the Hanford Site Waste Treatment and Immobilization Plant* (Washington, D.C.: January 2012).

these findings, the Safety Board made a series of recommendations to DOE to address WTP project safety problems. DOE has developed implementation plans to address the Safety Board's recommendations. In addition, DOE itself has raised significant concerns about WTP safety culture. In 2011 DOE's Office of Health, Safety, and Security conducted an independent assessment of the nuclear safety culture and management of nuclear safety concerns at the WTP. As a result of this assessment, DOE determined that most DOE and Bechtel WTP staff at the WTP believed that safety is a high priority. However, DOE also determined that a significant number of DOE and Bechtel staff expressed reluctance to raise concerns about safety or quality of WTP facilities design because WTP project management does not create an atmosphere conducive to hearing concerns or for fear of retaliation. Employees' willingness to raise safety concerns without fear of retaliation is an essential element of a healthy safety culture and creating an atmosphere where problems can be identified. DOE's assessment also determined that DOE has mechanisms in place to address safety culture concerns. For example, according to a January 2012 issued DOE Office of Health, Safety, and Security report on the safety culture and safety management of the project, the project has an employee's concerns program and a differing professional opinion program that assist staff to raise safety concerns. In addition, the January 2012 issued report stated that several DOE reviews of the WTP project have been effective in identifying deficiencies in WTP designs and vulnerabilities that could impact the future operation of waste treatment facilities.

DOE's Fast-Track, Design-Build Management Approach and Other Management and Oversight Problems Have Led to Cost Increases and Schedule Delays

DOE has taken some steps to improve its management and oversight of Bechtel's activities, but some problems remain. For example, DOE's ongoing use of a fast-track, design-build approach continues to result in cost and schedule problems. As we reported in 2006, DOE's management of the project has been flawed, as evidenced by DOE's decision to adopt a fast-track, design-build approach to design and construction activities, and its failure to exercise adequate and effective oversight of contractor activities, both of which contributed to cost and schedule delays.[16] According to DOE officials, DOE's current project management orders will not allow the use of the fast-track, design-build

[16]GAO-06-602T.

approach for first-of-its-kind complex facilities such as the WTP.[17] However, DOE was able to start the project using the fast-track, design-build approach before this order was in place. In a February 2012 written statement, DOE defended the fast-track, design-build management approach for the WTP project by stating that: (1) it allows for a single contract that gives the contractor responsibility for designing, building, and commissioning the facility, thus helping ensure that the design works as expected; (2) it allows the contractor to begin construction on parts of the facility for which design was complete; and (3) doing so would encourage construction to be completed faster.

According to DOE officials, construction of the WTP is currently more than 55 percent complete, though the design is only about 80 percent complete. Nuclear industry guidelines suggest that design should be complete to at least 90 percent before starting construction of nuclear facilities. Furthermore, according to current DOE orders, construction should not begin until engineering and design work on critical technologies is essentially complete, and these technologies have been tested and proven to work. According to DOE's analysis in 2007, several years after the beginning of WTP construction, several critical technologies designed for the WTP had not yet reached this level of readiness.[18] In addition, current DOE guidance states that the design-build approach can be used most successfully with projects that have well-defined requirements, are not complex, and have limited risks.

Using the fast-track, design-build approach, DOE has moved the project forward constructing and fabricating WTP components that may not work and may not meet nuclear safety standards. For example, as discussed above, pulse jet mixer technology continues to be tested to evaluate its effectiveness. Moreover, some already procured and installed equipment may need to be removed, refabricated, and reinstalled. For example, to

[17]DOE, *Program and Project Management for the Acquisition of Capital Assets,* DOE Order 413.3B (Washington, D.C.: Nov. 29, 2010). The order also states that "aggressive risk mitigation strategies are required" for fast-tracked, design-build projects.

[18]DOE measures technology readiness using Technology Readiness Levels, which range from 1 to 9; where 9 represents a fully tested and proven technology. DOE guidance indicates that critical technologies should be at Technology Readiness Level 6 or higher before construction begins. However, in 2007, the last time DOE assessed Technical Readiness Levels for the entire project, DOE found that 14 out of 21 critical technologies assessed were at a Technology Readiness Level lower than 6.

keep pace with the construction schedule, Bechtel fabricated 38 vessels containing pulse jet mixers and installed 27 of them into the WTP pretreatment and high-level waste facilities. However, according to DOE officials, Bechtel has been forced to halt construction on the pretreatment facility and parts of the high-level waste facility because it was unable to verify that several vessels would work as designed and meet safety requirements. Bechtel is currently analyzing potential alternatives that include, among other things, scrapping 5 to 10 already completed vessels and replacing them with vessels with more easily verifiable designs, according to DOE officials. The cost and schedule impact of these alternatives has not yet been fully estimated.

DOE has also experienced continuing problems overseeing its contractor's activities. For example, DOE's incentives and management controls are inadequate for ensuring effective project management and oversight of the WTP project to ensure that the WTP project is completed within budget and on schedule. As we reported in 2006, 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.[19] We also questioned the adequacy of project incentives for ensuring effective project management. Specifically, because of cost increases and schedule delays, we noted that the incentive fees in the original contract—including more than $300 million in potential fees for meeting cost and schedule goals or construction milestones—were no longer meaningful. Since that time, some problems have continued. For example, Bechtel's current contract, which was modified in 2009, allows the contractor to receive substantial incentives, such as an award fee for achieving specified project objectives, and DOE has paid this fee, although events subsequently revealed that the project was likely to exceed future cost and schedule estimates. Since 2009, DOE has paid Bechtel approximately $24.2 million or 63 percent of its $38.6 million incentive fee based, in part, on Bechtel's adherence to cost and schedule targets and its resolution of technical challenges associated with waste mixing. However, the WTP project is now at serious risk of missing major future cost and schedule targets, and it was subsequently determined by DOE that the waste mixing technical challenges were not resolved after all. According to DOE officials, substantial further effort is needed that will take at least an additional 3 years of testing and analysis until project scientists and engineers can fully

[19]GAO-06-602T.

resolve this challenge. In the current contract, there is no contractual mechanism for recovering an incentive fee that was paid to a contractor for work that was subsequently determined to be insufficient, according to DOE officials.

Furthermore, under its project management order, DOE is to incorporate and manage an appropriate level of risk—including critical technical, performance, schedule, and cost risks—to ensure the best value for the government.[20] However, DOE has no assurance that the incentives included in the WTP construction contract are assisting in the effective management of these risks. The contract provides that "incentives are structured to ensure a strong financial motivation for the Contractor to achieve the Contract requirements."[21] However, the contract requirements have been, and continue to be, revised to provide for a longer schedule and higher cost. For example, DOE has already announced that the project will not be completed within the 2006 performance baseline and has directed the contractor to prepare a revised performance baseline. Further, since 2009, DOE has awarded $15.6 million in incentive fees to Bechtel for meeting periodic schedule and cost goals, even though the WTP's schedule has slipped, and construction costs have continued to increase.[22] Bechtel has estimated, as of May 2012, that costs to complete the project are currently more than $280 million over the amount specified in the construction contract.

DOE's Inspector General has also found that DOE may have awarded Bechtel fees without the contractor adequately fulfilling work. A 2012 DOE Office of Inspector General report notes that DOE may have overpaid $15 million of potentially $30 million in incentive fees for the delivery and installation of vessels into the WTP facility.[23] When DOE learned that one

[20]DOE, *Program and Project Management for the Acquisition of Capital Assets,* DOE Order 413.3B (Washington, D.C.: Nov. 29, 2010). The order also states that "aggressive risk mitigation strategies are required" for fast-tracked, design-build projects.

[21]Contract No. DE-AC27-01RV14136, § B.4 (conformed through modification No. 287).

[22]The contract specifically links schedule incentives with overall progress under the contract: "Each milestone represents and measures progress towards achieving the Contract requirements and do not represent payment for the specific named milestone itself." Contract No. DE-AC27-01RV14136, § B.4(c) (conformed through modification No. 287).

[23]DOE Office of Inspector General, *Audit Report: The Department of Energy's $12.2 Billion Waste Treatment and Immobilization Plant —Quality Assurance Issues—Black Cell Vessels,* DOE/IG-0863 (Washington, D.C.: April 2012).

of the vessels did not have quality assurance records and therefore did not conform to contract requirements, it instructed Bechtel to return $15 million of the performance fee. However, according to the DOE Office of Inspector General report, neither DOE nor Bechtel could provide evidence that the fee was returned to DOE.

DOE's oversight of Bechtel's activities may also be hampered because project reviews, such as external independent reviews or independent project reviews—which are a key oversight mechanism—are only required by DOE's project management order to occur at major decision points in a project. These reviews examine a project's estimated cost, scope, and schedule and are intended to provide reasonable assurance that the project can be successfully executed on time and within budget. For example, these independent reviews are to occur when a cost and schedule baseline is completed for the project or when construction is authorized to begin. A 2006 review conducted by the U.S. Army Corps of Engineers, for example, identified serious problems with Bechtel's progress on the WTP project and indicated that the project would significantly exceed both cost and schedule targets. [24] In 2009, the Office of Project Management also conducted an external independent review. Such reviews are an important mechanism for overseeing DOE contractor activities. In a large, complex, multiyear project such as WTP, however, many years can pass between these critical decision points and the associated independent reviews. DOE officials noted that other reviews, such as Construction Project Reviews, were also completed between 2009 and 2011 for the WTP project. While officials stated that these reviews did examine the project's cost and schedule, they noted that the reviews were not as extensive as the 2006 and 2009 reviews.

Conclusions

DOE is responsible for one of the world's largest environmental cleanup projects in which it must stabilize large quantities of hazardous and radioactive waste and prepare it for disposal at a permanent national geologic repository that has yet to be identified. By just about any definition, DOE's WTP project at Hanford has not been a well-planned, well-managed, or well-executed major capital construction project. Daunting technical challenges that will take significant effort and years to

[24]U.S. Army Corps of Engineers, *Independent Validation Review of the May 2006 Estimate at Completion for the Hanford Waste Treatment and Immobilization Plant Project (*U.S. Army Corps of Engineers Walla Walla District: Aug. 28, 2006).

resolve combined with a near tripling of project costs and a decade of schedule delays raise troubling questions as to whether this project can be constructed and operated successfully. Additional cost increases amounting to billions of dollars and schedule delays of years are almost certain to occur. DOE and Bechtel officials have stated that the most recent cost increases and schedule delays are the result of, among other things, Congress not providing the required funding to resolve technical issues. In our view, however, the more credible explanation continues to be DOE's decision to build what the department itself describes as the world's largest and most complex nuclear waste treatment plant using a fast-track, design-build strategy that is more appropriate for much simpler, smaller scale construction projects. Where nuclear industry guidelines suggest completing 90 percent of design prior to beginning construction, DOE instead began construction when design of the facility was in the early stages and insisted on developing new technologies and completing design efforts while construction was ongoing. The result has been significant design rework, and some already procured and installed equipment to possibly be removed, refabricated, and reinstalled.

The technical challenges are especially acute in the WTP's pretreatment and high-level waste facilities. Technologies for these facilities require perfect reliability over the plant's 40-year lifetime because no maintenance or repair will be possible once waste treatment begins. According to DOE's analysis, several critical technologies designed for the WTP have not been tested and verified as effective. Additional expensive rework in the pretreatment and high-level waste facilities, particularly in the area of waste mixing, is likely to occur. Further, an additional facility to treat tank waste before the waste arrives at the WTP's pretreatment facility may be required. This additional facility could add billions to the cost of treating Hanford's waste. All the while, DOE and outside experts continue to raise safety concerns, and Bechtel continues to earn incentive fees for meeting specific project objectives even as the project's costs and timelines balloon far beyond the initially planned goals. DOE's recent actions to identify cost savings opportunities and to hold Bechtel accountable for the significant deficiencies in its preliminary documented safety analyses and requiring the contractor to comply with DOE's nuclear safety regulations are steps in the right direction. However, we continue to have serious concerns not only about the ultimate cost and final completion date for this complex project, but whether this project can successfully accomplish its waste treatment mission given that several critical technologies have not been tested and verified.

Recommendations for Executive Action

To improve DOE's management and oversight of the WTP project, we recommend that the Secretary of Energy take the following three actions:

- Do not resume construction on the WTP's pretreatment and high-level waste facilities until critical technologies are tested and verified as effective, the facilities' design has been completed to the level established by nuclear industry guidelines, and Bechtel's preliminary documented safety analyses complies with DOE nuclear safety regulations.
- Ensure the department's contractor performance evaluation process does not prematurely reward contractors for resolving technical issues later found to be unresolved. For example, DOE could seek to modify its contracts to withhold payment of incentive fees until the technical challenges are independently verified as resolved.
- Take appropriate steps to determine whether any incentive payments made to the contractor for meeting project milestones were made erroneously and, if so, take appropriate actions to recover those payments.

Agency Comments and Our Evaluation

We provided DOE with a draft of this report for its review and comment. DOE generally agreed with the report and its recommendations. In its written comments, DOE described actions under way to address the first recommendation, as well as additional steps it plans to take to address each of the report's recommendations.

DOE stated that it has recently taken action that is, in part, aligned with the first recommendation. Specifically, it issued guidance to the contractor, which directed the contractor to address remaining WTP technical and management issues sufficient to produce a high confidence design and baseline for the pretreatment and high-level waste facilities of the WTP. DOE also established a limited construction activity list for the high-level waste facility, as well as a much more limited set of construction activities in the pretreatment facility, which DOE stated will allow it to complete construction of some portions of the facilities while taking into account the unresolved technical issues. DOE stated that it believes this approach balances the intent of the recommendation and the need to continue moving forward with the project and preparations to remove waste from Hanford waste storage tanks. While this approach appears reasonable, we would caution that DOE should sufficiently monitor the construction activities to ensure that additional construction

beyond the activities specifically named on the approved list not be undertaken until the technical and management issues are satisfactorily resolved. DOE also noted that the Secretary of Energy has been actively engaged in the development of a new approach to managing the WTP and, together with a group of independent subject matter experts, is working to resolve long-standing technical issues. As requested by DOE, we did incorporate information into the report to indicate the Secretary's personal involvement in addressing the WTP issues and the technical teams assembled to help resolve these persistent technical issues. In addition, DOE stated that the department and the contractor have implemented a plan to assure that the WTP documented safety analysis will meet the department's nuclear safety requirements and DOE established a Safety Basis Review Team that will provide a mechanism for reviewing the documented safety analyses for each facility to ensure it meets nuclear safety requirements. DOE's planned actions to address the recommendations in this report are discussed more fully in DOE's letter, which is reproduced in appendix I. DOE also provided technical clarifications, which we incorporated into the report as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the Secretary of Energy; the appropriate congressional committees; the Director, Office of Management and Budget; and other interested parties. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or trimbled@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix II.

David C. Trimble
Director
Natural Resources and Environment

Appendix I: Comments from the Department of Energy

Department of Energy
Washington, DC 20585

November 30, 2012

David Trimble
Director
Natural Resources and Environment
Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Trimble:

The U.S. Department of Energy (DOE) has reviewed the Government Accountability Office (GAO) draft report entitled: *Hanford Waste Treatment Plant: DOE Needs to Take Action to Resolve Technical and Management Challenges,* GAO-13-38, that was provided to the Secretary of Energy on November 1, 2012. I am responding with comments on the GAO's findings, conclusions, and recommendations on behalf of the Secretary.

Your report contains three recommendations. The first recommendation states: "*Do not resume construction on the WTP's pretreatment and high-level waste facilities until critical technologies are tested and verified as effective, the facilities' design has been completed to the level established by nuclear industry guidelines, and Bechtel's preliminary documented safety analyses complies with DOE nuclear safety regulations.*" The Department has recently taken action that is, in part, aligned with this recommendation. The DOE issued guidance to the contractor on August 16, 2012, which included direction to address remaining Waste Treatment and Immobilization Plant (WTP) technical and management issues sufficient to produce a high confidence design and baseline for the Pretreatment and High-Level Waste facilities of the WTP. At the same time, DOE established a limited construction activity list for the High-Level Waste facility which allows for completing construction of some portions of the facility, such as structural walls, to continue while taking into account the remaining open technical issues, and a much more limited set of activities in the Pretreatment Facility, primarily devoted to preserving the installed components and structure. We believe that this path forward balances the intent of this recommendation with prudent project management at this stage of the project and the need to expeditiously remove waste from the storage tanks. In addition, DOE directed the contractor to continue construction on the Low Activity Waste and Analytical Laboratory facilities, which are at 76 and 72 percent design complete, respectively, as of September 2012. I would note that for the latter facility most of remaining design effort is for development of laboratory methods to support operations.

Since mid-July, the Secretary has been actively engaged in the development of a new approach to managing the WTP, and has been working with a personally handpicked group of independent, highly capable subject matter experts since mid-July to resolve long-standing technical issues. The Secretary and his expert group have been devoting about five to ten hours per week over the past four months, including nights and weekends. Because of this work, the DOE is in the process of revamping the WTP project team structure to facilitate a more efficient and effective approach to executing our mission at Hanford. Recently, a new functional structure was created to bring synergy to the project and finally resolve the myriad of technical issues. A management core team and eight technical teams have been assembled from DOE, national laboratories, and contractor personnel in order to mitigate the environmental hazards and the risks in completing and operating the waste treatment plant. The Secretary and his group of experts will remain fully engaged. We respectfully request that your report acknowledge the Secretary's personal involvement and the resulting new management approach to resolving the technical issues.

In addition, the Department and the contractor have implemented a plan to assure that the WTP documented safety analysis will meet the Department's nuclear safety requirements. In January 2012 the contractor completed a root cause analysis to identify underlying reasons regarding misalignments between the preliminary documented safety analysis and the approved plant design. That review identified two primary reasons and consequently the contractor has identified and is implementing actions to address these issues. DOE has also established a Safety Basis Review Team that will provide a mechanism for reviewing the documented safety analyses for each facility to ensure they meet DOE nuclear safety requirements.

The second recommendation, which DOE accepts, states: *"Ensure the department's contractor performance evaluation process does not prematurely reward contractors for resolving technical issues later found to be unresolved. For example, DOE could seek to modify its contracts to withhold payment of incentive fees until the technical challenges are independently verified as resolved."* While there have been improvements in the process and documentation for contract fee milestones, the contractor performance evaluation process continues to be an area that needs improvement. There are currently 60 fee-bearing activity milestones in the contract. DOE has added a new attachment to the WTP contract that specifies the requirements the contractor must meet to successfully complete the milestones (reference WTP Contract Section J – List of Attachments, Attachment P "Completion Definition Sheets for Incentive Fee C.1 Activity Milestone Completion Incentive"). When the contractor believes it has completed a milestone, the contractor completes an Activity Milestone Definition Sheet, attaches all supporting documentation, and submits it to the Office of River Protection (ORP) for review. ORP then performs a formal review of the contractor's submission within 30 days of its receipt, which includes review of the documentation submitted by the contractor, in addition to a physical review of the work in the field. After completion of this review, ORP either disapproves the contractor's milestone submittal; requests additional

information to complete the review and validation process; or validates the completion of the milestone and authorizes the contractor to submit an invoice for payment. The entire process is formally documented and included in the contract file. DOE continues to strive for continuous improvement in the administration of its contracts, including administration of fee structures and management of risks ensuring the best value for the government. DOE is currently evaluating the entire fee structure of the WTP contract, and will negotiate a new contract fee structure as part of the ongoing re-baseline and re-plan of the project.

The third recommendation, which DOE accepts, states: *"Take appropriate steps to determine whether any incentive payments made to the contractor for meeting project milestones were made erroneously, and if so, take appropriate actions to recover those payments."* In response to an earlier Inspector General report, ORP investigated whether there were irregularities regarding payment of a fee to the WTP contractor for a milestone for which quality assurance issues were identified. ORP noted that with regard to previous payments of fee, a modification of the contract was issued in January 2009. That contract modification essentially determined that the final fee determinations for work performed prior to that modification totaled a specific dollar value. ORP noted that the final fee determinations consisted of previously paid fee for scheduled milestones, and previously paid provisional fee, which was deemed earned at the time, and was not subject to further clawback. ORP will perform a review of all milestone and incentive fee payments between January 2009 and the current date. The Department is supportive of clawback of fees paid to its contractors where appropriate, for instance when the quality of an item has been subsequently determined not to have met requirements.

In addition to our responses to the three GAO recommendations, below are some additional comments on the report.

On Page 5, the report describes the original approach adopted for WTP as being a fast-track, design-build approach and subsequently notes that DOE's project management directives require approval to begin construction after technology development is completed and design of facilities is essentially complete. The WTP construction approach had already been incorporated in the project strategy prior to the Department's issuing guidance on the use of design-build approaches.

On page 10, in regard to DOE terminating a contract on a privatization approach after spending $300 million, it is important to note that the conceptual design developed by the privatization contractor was retained by the current engineering, procurement, construction and commissioning contractor, as the fundamental design approach for the WTP.

In the highlights section and on page 18, the report mentions Bechtel National, Inc. (BNI) studying alternatives for processing the waste and operating the WTP. These alternatives were discussed in a BNI-hosted May 2012 workshop that included representatives from

DOE Headquarters, DOE ORP, BNI, ORP Tank Farm contractor Washington River Protection Solutions, State of Washington Department of Ecology, Pacific Northwest National Laboratory and Savannah River National Laboratory. Three of the aforementioned eight technical teams are now evaluating many of the alternatives discussed during this workshop. Based on the merits of the alternatives, they may be pursued as potential solutions to waste processing issues.

The last three sentences of the paragraph on page 21 do not provide a full description of the situation regarding safety culture reviews by the Office of Health Safety and Security (HSS). In 2010 HSS performed their first evaluation of the WTP safety culture in response to a request by the Assistant Secretary for Environmental Management. In response to a commitment made to the Defense Nuclear Facilities Safety Board, HSS conducted a follow-on safety culture review at WTP in 2011 using a more rigorous assessment process, and reported the results in a January 2012 report. Although the subsequent 2012 assessment report does not identify any substantive program improvements in the areas of employee concerns, differing professional opinions, or ORP oversight, it noted that most personnel at WTP believed that safety was a high priority. We also acknowledge the existence of a cultural challenge on the WTP project wherein employees were reluctant to raise safety concerns because of an overriding perception that issues would not be addressed in an aggressive and timely manner. We are working with HSS and the Secretary to change and improve the safety culture at ORP and across the DOE complex.

Thank you for the opportunity to comment on your draft GAO-13-38 report regarding DOE's management of the Waste Treatment and Immobilization Plant. If you have any further questions, please call Kenneth G. Picha, Jr., Deputy Assistant Secretary for Tank Waste and Nuclear Material, at (202) 586-2003.

Sincerely,

David Huizenga
Senior Advisor
for Environmental Management

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

David C. Trimble, (202) 512-3841, or trimbled@gao.gov

Staff Acknowledgments

In addition to the individual named above, Ryan T. Coles and Janet Frisch, Assistant Directors; Gene Aloise; Scott Fletcher; Mark Gaffigan; Richard Johnson; Jeff Larson; Mehrzad Nadji; Alison O'Neill; Kathy Pedalino; Tim Persons; Peter Ruedel; and Ron Schwenn made key contributions to this report.