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Report to the Chairman, Committee on Commerce, House of Representatives

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DOE's Hanford Spent Nuclear Fuel Storage Project—Cost, Schedule, and Management Issues

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GAO

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Resources, Community, and
Economic Development Division

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The Honorable Thomas J. Bliley, Jr.
Chairman, Committee on Commerce
House of Representatives

Dear Mr. Chairman:

The Department of Energy (DOE) is undertaking a project to improve the storage of spent (or irradiated) nuclear fuel from its nuclear reactors at the Department's Hanford Site in Washington State. This fuel is currently stored in water basins a few hundred yards from the Columbia River, where the deterioration of some of the fuel and the water basins has raised health and safety concerns. To address these concerns, the project currently under way involves installing equipment in the water basins to retrieve and package the fuel, building a facility to dry the fuel, and moving the dry fuel to a new interim storage facility farther from the river.

In our May 1998 testimony on this project, we stated that the project was over 4 years behind schedule and that its estimated cost had doubled to about $1.4 billion.[1] We identified several reasons for these problems, including an overly optimistic schedule that lacked adequate time to address contingencies, poor performance by the project contractor in managing the schedule and resolving technical issues, and inadequate management and oversight by DOE and its contractor in charge of managing the entire Hanford Site. Since our testimony, DOE and its contractors have been trying to address these deficiencies and increase the progress being made toward finishing the new facilities and beginning to remove and treat the spent fuel. However, ongoing quality and safety problems and recent changes in contractors' responsibilities have raised concerns that the project still may not be effectively managed. Accordingly, you asked us to revisit this project to determine (1) its current status, (2) what problems might affect achieving current cost and schedule estimates, and (3) whether changes have been sufficient to address management weaknesses.

Results in Brief

Although DOE has increased confidence that the project eventually will begin to remove fuel from the water storage basins, uncertainty remains over when the project will be finished and how much it will cost.

[1]See Nuclear Waste: Management Problems at the Department of Energy's Hanford Spent Fuel Storage Project (GAO/T-RCED-98-119, May 12, 1998).

Completion is currently scheduled for July 2007 at a cost of $1.7 billion—about 6 years and $1 billion beyond the original estimates made in 1995. However, the new completion date includes $133.5 million and about 2 years for work activities not included in the original estimate. Compared with conditions that we reported on in May of last year, the amount of progress is substantial, with considerable construction completed and equipment installation under way. Nonetheless, since the current schedule was established in December 1998, the estimated date for completing safety documentation has slipped, operational readiness issues have become major challenges, and most of the extra time built into the schedule for addressing contingencies has already been used up.

DOE's contractors have addressed the three main problems that existed earlier in the project—an unrealistic schedule, poor control over the project's baseline, and unresolved technical issues—but still have several matters to resolve before being able to provide assurance that cost and schedule estimates can be met. In the short term, the time required to reassess the procedures for removing loaded fuel-shipping casks from the basins and the compressed schedule to complete safety documentation and pass readiness reviews place in jeopardy a project milestone to begin removing fuel from the first storage basin by November 2000. In the longer term, to process the fuel within the project's completion dates and cost targets, DOE and its contractors must ensure the reliability of complex one-of-a-kind equipment that has not yet been operated as a system. DOE's contractor must also overcome challenges in hiring operations staff and in processing the spent fuel at a rate that can meet the project's milestones.

Corrective actions have addressed some but not all of the management weaknesses on the project. Although DOE's contractor responsible for overall management of the Hanford Site has consolidated its control over the project and made other changes to strengthen the project's performance, it has been slow to address problems with safety documentation and quality assurance. Similarly, although DOE has increased oversight of its contractors' activities, modified performance fees, and conducted evaluations of the project that led to suggested improvements, continued attention is needed to ensure that DOE's oversight will enhance the contractor's ability to meet cost and schedule targets.

This report makes recommendations to the Secretary of Energy to strengthen leadership and oversight to better ensure that the project is completed as efficiently and effectively as possible.

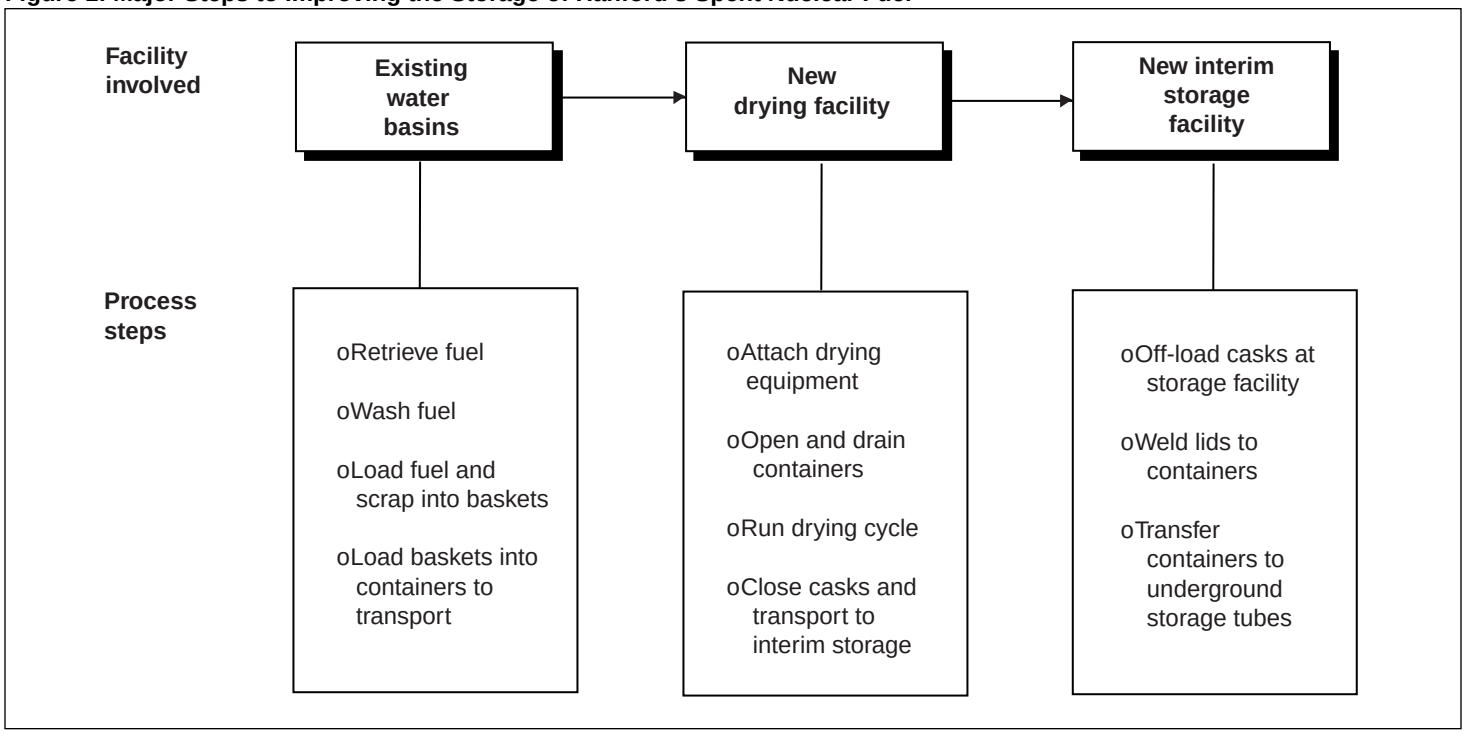
Background

Irradiating nuclear fuel rods was one step in the process of producing plutonium for nuclear weapons. After being irradiated in a nuclear reactor, the "spent" fuel rods were stored in water-filled basins for about 6 months and then moved to a processing facility where plutonium was extracted. DOE stopped producing plutonium in the late 1980s, and now about 2,100 metric tons of fuel rods are stored in Hanford's water basins.

The two water-filled basins where most of Hanford's spent fuel is stored are located about 1,400 feet away from the Columbia River. The basins, which were constructed in 1951, are well beyond their useful life of 20 years and are vulnerable to leaks and earthquake damage. Any rupture of the basins, such as from an earthquake or accident, could release large quantities of contaminated water to the soil and to the Columbia River. A loss of water from the basins could also expose workers and the public to the airborne transmission of radioactive materials released from the corroded fuel and the sludge in the bottom of the basins. Moreover, the fuel itself was not intended for long-term storage in water, and some of it has corroded or crumbled.

DOE has been developing an approach for moving the fuel rods to safer storage since 1994. The strategy being implemented through the current project consists of cleaning and repackaging the fuel in the basins, removing and drying the fuel, and moving it to new interim storage several miles from the river. Two major new facilities are involved—a fuel-drying facility and a storage facility. The project also includes special containers and metal baskets to hold the fuel; a transportation system for moving it between facilities; various systems to clean, package, and dry it; and special cranes to move the loaded containers to their storage tubes inside the storage facility where they may remain for up to 40 years, until being removed to a national repository site. Finally, the project involves treating and disposing of the sludge, debris, and water left in the basins after the fuel is removed, as well as deactivating the basins and project equipment. Figure 1 illustrates the major steps in the drying and storage processes.

Figure 1: Major Steps to Improving the Storage of Hanford's Spent Nuclear Fuel



DOE's overall contractor for managing the Hanford Site, Fluor Daniel Hanford, Inc. (Fluor Daniel), has been responsible for overseeing the project since the company assumed responsibility for the site contract in October 1996.[2] Fluor Daniel contracted with Duke Engineering & Services Hanford, Inc. (Duke Engineering), to manage the spent fuel project. DOE, which also oversees the project contractors, is responsible for meeting legally enforceable project milestones under the provisions of a federal-state agreement (commonly called the Tri-Party Agreement) with the Environmental Protection Agency and the Washington State Department of Ecology.

[2]Westinghouse Hanford Company managed the project until October 1996.

Construction Is Progressing, but the Project's Schedule and Budget Have Increased

The project's major facilities and systems are nearing completion. Construction of the two new facilities—one to dry the fuel and the other to store the loaded fuel containers—is over 80-percent complete. The installation of the equipment in the two facilities and within the water storage basins is in various stages of completion. (See table 1.)

Table 1: Degree of Completion of Major Components of Hanford's Spent Fuel Storage Project

Major component	Status as of July 1999
Water storage basins Modifications to these existing basins include installing specialized fuel-washing equipment, water treatment systems, and overhead cranes and related systems for moving the loaded fuel-shipping casks out of the basins and onto the transport trailers.	**First basin:** The modifications are about 94-percent complete. **Second basin:** The modifications are about 4-percent complete. For both basins, technical problems have been encountered with these systems, and some of the components have had to be redesigned. For example, a critical bearing on the equipment to be used to wash the fuel rods failed initial testing and had to be redesigned.
Fuel-drying facility: This new facility has been designed to remove water from the fuel containers after they are removed from the water basins.	**Construction:** The building is about 82-percent complete; the building's equipment installation is about 50-percent complete.
Storage building: This new facility has been designed to store containers of dry spent fuel for up to 40 years until the material can be shipped to a permanent repository.	**Construction:** The building and equipment are about 90-percent complete.

While progress is being made on constructing facilities and installing equipment and systems, the project's schedule has been extended several times as it became apparent that the contractors could not meet the schedule. The latest extension, approved in December 1998, called for DOE to complete the project by July 2007, almost 6 years beyond the original schedule.[3] The expected date to begin removing the spent fuel from the first basin—November 30, 2000—an important milestone for the project given the health and safety risks associated with current storage conditions, is almost 3 years later than originally scheduled. (See table 2.)

[3]In April 1998, the contractor proposed beginning fuel removal in November 2000, completing fuel removal in August 2003, and completing the project in December 2005. However, DOE did not approve the proposal, and the contractor reassessed the project, leading to the December 1998 schedule. The July 2007 date includes 23 months for basin deactivation—an activity not originally included in this project.

Table 2: Changes in Key Milestones for Hanford's Spent Fuel Storage Project

Schedule	Date to begin fuel removal	Date to complete fuel removal	Date to complete project	Cumulative delay to project's completion (months)
Original schedule (Apr. 1995)	Dec. 1997	Dec. 1999	Sept. 2001	N/A
First revision (Apr. 1997)	May 1998	July 2000	Sept. 2001	0
Second revision (Dec. 1997)	July 1999	July 2001	Sept. 2003	24
Third revision (Dec. 1998)	Nov. 2000	Dec. 2003	July 2007[a]	70

[a]This date includes 23 months for the deactivation work transferred to the project in April 1998.

The schedule approved in December 1998 was intended to address the major problems associated with the previous schedules, including the lack of flexibility for addressing unforeseen problems and the unrealistic estimates of the time needed to complete specific work. DOE and its contractor expressed a "high confidence" of success in meeting the December 1998 schedule. For example, to address the lack of flexibility in the previous schedules, the latest schedule included about 7 months of contingency time to be used if unforeseen problems were encountered. By August 1999, however, all but 1 week of the 7 months of the contingency time had been used because of two developments:

- Because of an error in the original safety analysis, the system for removing loaded fuel-shipping casks from the water basins had to be reevaluated to ensure that it was safe.[4]
- When design work for the fuel-drying facility ran longer than expected, purchasing equipment and completing the final safety analysis report for the facility were delayed.

Each time the schedule was revised, DOE and its contractors also revised the estimate of the project's total cost. The project's cost estimate is now $1.7 billion, or about $1 billion more than the original 1995 estimate.[5] This

[4]A decision by DOE and Fluor Daniel not to redesign the cask-lifting system may add a few weeks of contingency time back into the schedule.

[5]At the time of the May 1998 hearing on this project, the proposed cost estimate was about $1.4 billion. However, that estimate had not been fully reviewed. After the hearing, DOE and the contractors developed new cost estimates based on an internal and external review. Subsequently, a cost estimate of $1.7 billion was formally approved in December 1998 and was characterized as having a 90-percent probability of success.

cost estimate includes $133.5 million for work activities not included in previous cost estimates. The additional work is for decontaminating and deactivating the water basins.[6] (See table 3.)

Table 3: Changes in Total Cost Estimates for Hanford's Spent Fuel Storage Project

Dollars in millions

Date of cost estimate	Cost estimate	Cumulative cost increase
Oct. 1995	$740	N/A
Apr. 1997	$814	$74
Dec. 1997	$1,089	$349
Dec. 1998	$1,720[a]	$980

[a]This amount includes $133.5 million for deactivation activities.

Problems Make Achieving the Short-Term Milestone Unlikely and Achieving the Project's Longer-Term Goals Uncertain

DOE and its contractors have made progress in resolving some of the cost, scheduling, and technical issues that have plagued the project, but they still face short-term and long-term challenges in meeting the project's milestones. In the short term, a November 2000 milestone to start removing fuel from the basins is in jeopardy. In the longer term, complex equipment and systems must perform reliably for several years, and sufficient staff must be hired—a recruiting task that has so far proven difficult. However, DOE and Fluor Daniel believe that some flexibility in the operations phase of the project may help in addressing these challenges.

DOE Has Made Efforts to Improve Project Controls and Resolve Technical Issues

Our 1998 report pointed out three main types of problems DOE had not resolved: an unrealistic schedule, poor control over the project's baseline, and unresolved technical issues. DOE and Fluor Daniel have resolved these problems. The actions taken to deal with the first problem were discussed previously. With regard to the second problem, DOE and Fluor Daniel have implemented a formal project baseline management system that includes a process for making changes to the project's baseline. Under this system, any changes to cost or schedule must be documented and go through a structured review and approval process. Fluor Daniel holds weekly meetings with managers of the subprojects and other key staff to discuss any events or problems that could affect the schedule. This discipline was missing earlier in the project.

[6]In April 1998, these tasks were transferred to the project because DOE and its contractors decided it would be a cost-effective way to accomplish the activities associated with removing the debris and water from the basins. Until April 1998, this work was planned and budgeted as a separate project.

With regard to the third problem, a number of the technical issues present when we issued our previous report have been resolved. For example, fuel elements were found to have water-bearing aluminum hydroxide coatings that could contribute to pressurization of the loaded container of fuel during interim storage, and decisions had not been made about how best to obtain data on temperature, pressure, and gas composition once fuel storage containers are in the storage building. As of July 1999, these issues had been resolved. For the most part, doing so required the contractor either to demonstrate that its proposed processes were safe or to revise its procedures to add an additional margin of safety.

Beginning Fuel Removal by November 2000 Will Be Difficult

Although DOE and its contractors have made progress, several challenges make it difficult for the contractor to begin removing fuel from the water basins by November 2000. These challenges include taking time to resolve a new technical issue, completing safety documentation, and meeting an aggressive schedule to demonstrate the readiness of the project's operations.

Resolving a New Technical Issue

Fluor Daniel has been evaluating the possibility that as the loaded shipping casks are lifted out of the water basins and onto the transport trailers, a cask might accidentally be dropped back into a basin. Dropping a cask into a water basin could damage the basin and lead to a discharge of contaminated water to the soil and to the Columbia River. An earlier safety analysis had not properly analyzed this potential occurrence. A reassessment of the risk and appropriate corrective actions have taken most of the remaining contingency time in the project's schedule. In August 1999, Fluor Daniel and DOE decided not to redesign the cask-lifting system but instead to modify operational procedures and develop a way to plug a basin leak if a cask is dropped. According to Fluor Daniel's acting project manager, this approach will add a few weeks of contingency time back into the project's schedule. DOE decided that accepting the additional risk associated with dropping a cask in the basins was preferable to the delays and additional costs associated with redesigning the cask-lifting system.

Completing Safety Documentation

Completing safety documentation, which involves analyzing and demonstrating that the facility or operation can be conducted safely, has been a significant and long-standing problem. We discussed this problem in our May 1998 testimony, and it has continued to adversely affect the project. For example, since the latest schedule was approved in December 1998, the dates for completing safety documents for each of the

project's major activities have slipped between 5 and 9 months. (See table 4.)

Table 4: Delays in December 1998 Schedule for Completing Safety Documentation

Safety document	December 1998 schedule	Current schedule	Delay (months)
Storage building	May 1999	Dec. 1999	7
Fuel-drying facility	June 1999	Nov. 1999	5
Water basins	July 1999	Mar. 2000[a]	8
Fuel container	Feb. 1999	Nov. 1999	9

[a]On July 13, 1999, DOE and Fluor Daniel signed an agreement for revising the process to review and approve the safety documentation for the water basins. According to the agreement, the revised process may reduce the delay in completing the documentation by several months.

Completing safety documentation is a critical step in the process of getting approval to operate a nuclear facility. The safety documentation serves as the basis for facility operations and is needed to develop the operating procedures and subsequent employee training. Therefore, any delay in getting the safety documentation approved also affects the completion of other aspects of the project that must be in place before a review of the project's readiness to begin operation can occur.

Since February 1999, the contractor has been addressing safety documentation problems by assigning more staff to the effort, reorganizing the workload, and working more closely with the DOE staff who review the documentation. While it is too soon to gauge the overall effectiveness of these changes, early indications are that the corrective actions may be making a difference. For example, the safety documentation for the fuel-drying facility that the contractor submitted to DOE in June 1999 generated only about one-third of the number of comments that DOE had raised in an earlier review of safety documents for the fuel storage building. Even so, the remaining safety documentation must be completed on an aggressive schedule if the contractor is to begin removing fuel from the first basin by November 2000.

Meeting an Aggressive Readiness Schedule

Before Fluor Daniel can begin to remove fuel from the basins, the project must pass an extensive assessment known as an operational readiness review. This review, conducted by team members who are independent of the work being reviewed, represents the culmination of the contractor's work to ensure that the project is operationally ready and takes place after the contractor's self-assessment of readiness. The fieldwork portion of the readiness review involves a careful assessment of whether the facilities,

systems, operating procedures, personnel, and management oversight processes are in place and effective enough to ensure that the facility can be operated safely. Considerable concern exists, however, that the current schedule does not allow sufficient time to complete an operational readiness review and to implement all needed corrective actions.

The schedule approved in December 1998 allowed 5 months for completing the operational readiness review process, beginning with the contractor's self-assessment in May 2000 and ending with DOE's authorization for the contractor to proceed in October 2000. In contrast, the current schedule for demonstrating readiness to operate has been compressed to about 3 months because delays with other parts of the project have deferred the start of the contractor's self-assessment until July 2000. Fluor Daniel is compressing the schedule for completing the readiness review because of its desire to meet the milestone to begin removing fuel from the basins by November 2000. Doing so will, among other things, make Fluor Daniel eligible for about $4.9 million in contract incentive fees for fiscal year 1999 and additional fees for fiscal years 2000 and 2001. According to Fluor Daniel's start-up integration manager, the compressed schedule for demonstrating operational readiness is very aggressive and will require that all systems and personnel work perfectly when tested. He said that the current schedule allows only 1 month to correct problems identified in the contractor's self-assessment before the DOE readiness review starts and that a more normal schedule would allow 2 or 3 months to make those corrections.

In a June 1999 review of the project, DOE recommended adding 90 days to the readiness review schedule. As an alternative, however, DOE encouraged Fluor Daniel to relieve some of the time pressures caused by the previous delays on the project by testing some of the systems earlier than originally planned. As a result, the company is planning earlier testing of the water treatment system and the fuel retrieval system in the first basin using actual fuel elements. DOE and Fluor Daniel believe that this early testing initiative will allow additional time to identify and react to any unexpected results, will better prepare the project for the readiness review, and will increase the company's chances of meeting the November 2000 date to start removing fuel from the basins.

Achieving the Project's Long-Term Goals Is Uncertain

If the project is to meet its long-term goals of removing all fuel from the basins by December 2003 and completing all work by July 2007, the systems involved must operate successfully over this extended period.

Concerns exist, however, about the long-term reliability of the various systems and equipment and about whether the contractor can obtain sufficient staff for the multiple shifts of operations it has planned to process the fuel. Equipment failures and other operational concerns could affect the rate at which the contractor dries and packages the fuel for storage and, ultimately, whether the project's cost and schedule targets are achievable. Because of the nature of the uncertainties remaining, it is too early to determine whether the project will be able to meet the long-term schedule.

Ensuring Equipment and Systems Reliability

The spent fuel project involves one-of-a-kind equipment and system designs, much of which has not been operated under the conditions to be found at Hanford. Because some of the equipment and systems must operate continuously for a minimum of 3 years in a highly contaminated environment, reliable performance is critical. Furthermore, if any of several components in the basins that are critical to continued operations need unscheduled maintenance or repair, a whole series of activities must stop. For example, to prepare fuel for transport from the basins to the drying facility, the water treatment system, fuel retrieval system, and the crane used to remove the loaded fuel casks must all be operational. Failure of any one of those components would stop operations in the basin and delay fuel-processing activities.

Early testing has led to opportunities to improve the performance of some systems. For example, early testing allowed improvements to be made in the equipment to be used to extract moisture from the loaded fuel containers. Also, in June 1999, DOE learned that a critical bearing on the equipment to be used to wash the fuel rods was failing after only 30 seconds of use. The equipment had to be redesigned. DOE's own studies have expressed concern about the need for additional testing to ensure that the project's systems will work together. For example, a June 1999 DOE study raised concerns about system reliability and noted that the systems have never performed together.[7] The study recommended that the contractor operate the fuel retrieval systems under actual conditions as soon as practical to ensure that they operate properly. According to the Fluor Daniel Vice President in charge of the spent fuel project, the project plans to begin this testing in December 1999 and continue the testing for several months.

[7]Baseline Review of the Richland Spent Nuclear Fuel Project, U.S. DOE, Office of Environmental Management, Office of Project Management, June 1999.

Even after systems are successfully tested, the efficiency of the overall process cannot be known until operations actually begin. An example can be seen in the water treatment system, which is designed to capture the sludge and other debris coming off the fuel rods as they are being cleaned. Effective performance of the water treatment system is critical to basin operations. If the water becomes cloudy and the operators cannot readily see the fuel rods being washed and handled below the surface of the water, cleaning operations will have to stop until the water clears. According to the June 1999 DOE review, the water treatment system must operate 95 percent of the time to meet the project's production schedule of one fuel container loaded per day.[8] Fluor Daniel officials believe that the equipment and systems will meet the required reliability standards, but they have also developed maintenance plans and work-around strategies to attempt to minimize the effects of potential equipment failures. However, with no operating experience under actual conditions, the overall reliability of the equipment and systems has not been established.

Obtaining Qualified Staff for Operations

Concerns also exist about obtaining enough staff to fully support the project during its operational period. Although the approximately 280 operations staff currently on the project apparently are sufficient to begin the removal of the fuel from the first basin, Fluor Daniel plans to increase the total number of operations staff to a peak of at least 680 by 2002—more than double the current number. Fluor Daniel officials are concerned about being able to hire sufficient numbers of staff to support the continuous operations being planned. According to the Fluor Daniel operations manager, the company has already had difficulty filling positions at the current staffing level. Reasons given for the difficulty include the commuting distance required to reach the remote location of the water basins and the concerns voiced by potential applicants about their employment opportunities being unclear after the project is completed. Fluor Daniel's Executive Vice President said the company is developing a set of employee incentives to help overcome these hiring barriers. However, the staffing difficulties are already affecting the scope of work that can be performed. For example, a shortage of nuclear operations staff caused Fluor Daniel to curtail the installation of equipment in the second water basin so that work in the first basin could be fully supported.

In contrast to the concerns about obtaining enough staff for the project, others have questioned the need for so many staff. For example, a

[8]A loaded fuel container will generally hold between 216 and 240 fuel rods and a basket of scrap material.

June 1999 DOE study recommended that the contractor reassess whether fuel has to be extracted from both basins simultaneously because doing so will require substantially more staff than removing the fuel from one basin at a time. In addition, a June 1998 review of the project's baseline by an independent reviewer raised several questions about the proposed staffing and suggested that about 100 proposed positions could be eliminated. Fluor Daniel officials have agreed that operational aspects of the project, including staffing requirements, have not been fully planned and need further development.

Combining Deactivation Activities With the Current Project

In April 1998, DOE added the activities associated with deactivating the basins and the project's equipment to the spent fuel project's scope of work. Originally, the deactivation was planned and budgeted as a separate project. Adding deactivation to the existing project increased the project's budget by $133.5 million and lengthened the schedule for project completion by 23 months. However, substantial uncertainty exists about the duration and the cost of deactivating the basins because detailed plans for deactivation have not been completed.

Flexibility in the Current Plans May Help the Project Achieve Cost and Schedule Targets

According to DOE and Fluor Daniel officials, a degree of flexibility in both cost and schedule during the operational period of the project may exist that could be used to help address some of the challenges facing the project beyond November 2000. This added flexibility comes from two sources—revised strategies for treating the sludge in the basins and the unexpended contingency funds built into the cost estimates.

The project budget includes about $76 million to remove and treat about 50 cubic meters of sludge before adding it to the other wastes stored in Hanford's underground high-level waste tanks.[9] When subsequent estimates of the costs of treating the sludge grew to $150 million or more, officials of DOE, Fluor Daniel, and the Environmental Protection Agency developed an alternative strategy. This strategy calls for removing and packaging the sludge for storage elsewhere on the Hanford Site until it can be combined with a larger Hanford project that also involves treating some of the waste at the site. Although the ultimate cost of disposing of the sludge is unclear, this strategy may help reduce both the cost and the time necessary to complete the spent fuel project. A detailed estimate of the effects of this strategy on the project's cost and schedule is not expected until fiscal year 2000.

[9]Treatment is required to eliminate organics and flammable components from the sludge to meet the acceptance criteria for waste to be stored in the underground tanks.

The project's baseline approved in December 1998 included about $112 million in contingency funds for uncertainties associated with completing the project. As of June 1999, over $100 million in contingency funds was still available for use over the remainder of the project.

Management and Oversight Have Improved, but Weaknesses Remain

DOE and Fluor Daniel have taken steps to address several of the management and oversight weaknesses discussed in our May 1998 testimony. Despite this progress, concerns continue to exist about the project's management and oversight. Continued and focused management attention is needed to successfully address both the short-term and long-term challenges on the project and, ultimately, to bring the project to completion.

Types of Management and Oversight Changes Made

In the last year, many changes have been made in the management of the project. Significant among those changes has been a shift in the role of Duke Engineering. Originally, Duke Engineering was a subcontractor to Fluor Daniel and was the company primarily responsible for managing the project. Fluor Daniel's responsibilities were primarily to integrate the activities of the various subcontractors on the site and to oversee those activities. Poor performance by Duke Engineering, however, led to a significant expansion of Fluor Daniel's role on the project.

In December 1997, Fluor Daniel issued a letter (called a cure notice) to Duke Engineering, requiring the company to correct problems and improve performance on the project or face termination for default or other possible contractual remedies, including recompetition of the subcontract at the end of its initial 2-year term. Duke Engineering prepared a recovery plan and made other organizational changes to try to strengthen its management of the project. Although Duke Engineering subsequently passed the conditions set forth in the cure notice and received conditional approval to continue to manage the project, Fluor Daniel's management began to take greater control of the day-to-day activities. Key technical staff from Duke Engineering have remained with the project, but Fluor Daniel is now fully responsible for managing the project. After assuming control, Fluor Daniel integrated the staff working on the project into a single organization. According to Fluor Daniel's spent fuel project director, these actions eliminated many of the organizational conflicts plaguing the project and allowed the project director to more directly influence the activities involved.

Fluor Daniel also took other steps to improve the project, including replacing several subproject managers; adding a senior manager at the vice president level to oversee the transition from a construction project to an operational project; and initiating increased interaction with DOE managers and technical staff to improve communications, identify potential problems earlier, and address those problems. According to DOE officials, the management of the project has substantially improved since these changes occurred.

DOE also took steps to improve the oversight and management of the project:

- DOE not only denied performance fee payments to Fluor Daniel for the project for fiscal year 1998, it imposed a "negative incentive" and required Fluor Daniel to repay DOE $351,000.[10] Also, based on commitments made at a hearing on the project in May 1998 before the Subcommittee on Oversight and Investigations of the House Commerce Committee,[11] DOE modified its contract with Fluor Daniel to tie part of the performance fees for fiscal years 1999 and 2000 to meeting the November 2000 milestone to begin removing spent fuel from the first basin. For these years, the amount of the fee in excess of $1 million is contingent on Fluor Daniel's beginning to remove the first fuel by November 30, 2000.[12]
- In March 1999, DOE's Acting Assistant Secretary for Environmental Management sent a letter to Fluor Daniel and Duke Engineering emphasizing the importance of completing the project on time and making clear that the performance fee would continue to be at risk regardless of the organizational structure that Fluor Daniel chose for managing the project.
- DOE conducted two reviews of the project: an assessment of the incentive fee structure and an assessment of the reasonableness of the project's cost and schedule baseline. Although the baseline review concluded that strong

[10]While Fluor Daniel earned no fee for fiscal year 1998 on this project, a subcontractor to Duke Engineering that also has organizational ties to Fluor Daniel—Fluor Daniel Northwest—received about $1 million in fees for work on the spent fuel project under a cost-plus-fixed-fee subcontract with Duke Engineering.

[11]Department of Energy's Hanford Spent Nuclear Fuel Project, testimony by Dr. Ernest Moniz, DOE, before the U.S. House of Representatives, Subcommittee on Oversight and Investigations, Committee on Commerce, 105-90, May 12, 1998.

[12]The 1999 fee will be awarded to Fluor Daniel before November 2000. However, if the company subsequently misses the milestone, it will not be permitted to retain the contingent portion of the fee that was awarded. Fluor Daniel could recoup some of the contingent portion of the fee by beginning fuel movement no later than January 31, 2001. After that date, however, none of the contingent portion of the fee will be available to Fluor Daniel. Any fee that has already been paid and that Fluor Daniel is not permitted to retain is to be offset against the next fee payment. The fee for fiscal year 2001 could also be affected by this provision.

and effective DOE and contractor management teams were in place, both reviews identified risks or problems and recommended actions to improve the project. For example, the baseline review concluded that difficulties in developing safety documents were having a significant adverse effect on the project and recommended reengineering the development and approval process for safety documentation to increase its effectiveness.

- In June 1999, DOE's Deputy Secretary announced that as part of a DOE-wide initiative to improve project management, the spent fuel project was being placed on a "watch list" monitored by DOE's Chief Operating Officer. The purpose of the watch list is to increase the level of DOE's oversight of the project's activities.
- The newly appointed manager of DOE's Richland Operations Office reviewed the project and suggested several changes, including (1) implementing the early start initiative discussed previously to test the equipment in the basin sooner than initially planned and (2) establishing a team of senior DOE and contractor executives (called the Process Improvement Team) to discuss overall management procedures and job processes that need improvement and to take steps to make those improvements.
- DOE's Richland Operations Office added expertise to its group responsible for overseeing the project's cost and schedule.

These actions are positive steps, but whether they will be sufficient to stop the upward creep in both cost and schedule remains to be seen. To some extent, the project continues to be affected by decisions made much earlier to "fast track" the project by doing testing, design, construction, and safety documentation phases concurrently. This approach has led to technical and managerial problems as DOE and its contractors discovered that earlier assumptions were not correct and that redesign and rework were required. For example, the Defense Nuclear Facilities Safety Board said in July 1999 that incomplete engineering and design work contributed to delays in completing the safety documentation on the project. The Board said that changes in design caused significant amounts of safety documentation to be done over because the documentation was being prepared concurrently with design and testing. This fast-track approach has also led to inefficiencies. For example, the fuel-drying facility was designed and constructed with four separate bays in which to dry the fuel containers. After construction was well under way, however, Fluor Daniel determined that no more than three bays would be needed to meet the project's requirements.

The Contractor's Response to Problems Has Sometimes Been Slow

The large number of unexpected technical and managerial problems has contributed to Fluor Daniel's sometimes being slow to fully address problems until they threaten the project's cost or schedule, as these examples show:

- Quality assurance. Fluor Daniel was slow to address quality assurance problems, even after repeated communications from DOE that the problems were not being corrected. Quality assurance involves ensuring, among other things, that subcontractors are qualified to do the work; that the work meets performance standards; and that poor-quality work is identified, corrected, and prevented from recurring. Even after repeated warnings from DOE, Fluor Daniel did not take adequate steps to correct quality assurance problems. In May 1999, DOE took enforcement action by issuing a civil penalty of $330,000 for violations of nuclear safety requirements. According to Fluor Daniel officials, the penalty was issued for sitewide violations, of which a significant portion were on the spent fuel project. This was the largest penalty issued in almost 4 years of the enforcement program and also the first time that DOE had issued a compliance order specifying a deadline by which a contractor must correct the deficiencies.[13] Fluor Daniel paid the penalty and is now working to address these deficiencies.
- Safety documentation. Completing safety documentation was a significant concern that we reported on in May 1998. Fluor Daniel has been slow to correct these problems. Delays in completing the safety documentation have contributed to the loss of the 7 months of contingency time added to the project's schedule in December 1998. In early 1999, DOE and Fluor Daniel involved senior management to identify the underlying causes of the problem and to implement corrective actions. They found that disputes over safety documentation issues, such as how much detail the documentation should contain, were not being elevated to higher levels for resolution. Instead, the disputes were shuffled back and forth between contractor and DOE review staff. According to a DOE official, the involvement of senior management has facilitated better communication on safety issues, but problems continue to exist below the senior management levels. It remains to be seen whether the management of this important process has been significantly improved.

Fluor Daniel also appears to be behind in planning for the operational phase of the project. Until recently, most of the planning has focused on achieving the November 2000 milestone to begin removing the fuel from

[13]For a more complete discussion of DOE's nuclear safety enforcement program, see Department of Energy: DOE's Nuclear Safety Enforcement Program Should Be Strengthened (GAO/RCED-99-146, June 10, 1999).

the first basin. Detailed plans for significant aspects of the operational phase of the project are only now being developed. Limited planning for operations activities has led to increased uncertainties about such matters as the number and types of staff needed to operate the facilities, the extent that staff will need administrative support facilities at the basins, and the overall cost of the operational period of the project. In its June 1999 report on the project, DOE confirmed that little detailed planning for operations beyond November 2000 had been done and recommended that planning for those activities begin as soon as practicable.

Fluor Daniel managers told us that initiatives are under way to improve both the quality assurance program and the safety documentation process. Fluor Daniel said these changes should overcome the recent problems. The managers said that detailed planning for the operational phase is also under way and will be completed in time to support the project. However, the effectiveness of these initiatives is not yet known.

Continued Attention to DOE's Oversight Is Needed

Although DOE has taken steps to improve its oversight of the project and has supported many of the contractor's actions to improve performance, several areas of concern require ongoing attention. These areas of concern include the structuring of the contractor's incentive fees, decision-making about long-term storage requirements, and sustaining the continuity of leadership on the project.

DOE's approach to performance fees may have contributed to less than optimal performance by the contractors. DOE conducted an assessment of the effect of contract incentives and penalties on performance and concluded, among other things, that[14]

- the incentive fee structure may have contributed to a lack of management attention by Fluor Daniel and Duke Engineering;
- the improbability of earning a fee in fiscal year 1998 likely caused Duke Engineering to not reassign staff from more profitable work to help address the problems on the spent fuel project; and
- the contract mega incentive,[15] which includes performance in noncritical and support areas, has diverted attention and fees from the major cleanup objectives.

[14]See Hanford Spent Nuclear Fuels Project Incentives Review, June 4, 1999.

[15]The contract's mega incentive consists of a variety of performance factors that are secondary to safely storing the spent fuel, such as the number of new jobs created in the community.

The DOE report makes several recommendations, including developing financial incentives and other options for reducing the costs during the operational period of the project and further defining the appropriate roles of DOE's staff in managing performance-based contracts. As of August 1999, these recommendations were being considered but had not been implemented.

Concerns also exist about possible changes in packaging requirements for the spent fuel. Because the spent fuel may eventually be placed in a national repository for long-term storage, the fuel baskets and the storage containers may have to meet the repository's rigorous quality assurance standards, which are required of those items determined to be important to safety. In November 1998, DOE decided that the baskets and storage containers did not have to meet the quality assurance standards and directed Fluor Daniel to contract for containers and baskets under standards less rigorous than the repository's standards. This decision was also expected to reduce costs and to allow the containers and baskets to be obtained in time to meet the November 2000 milestone. However, DOE is now reconsidering whether these items serve a safety function. If DOE decides that the containers and baskets must meet the repository's standards, then project managers will have to show that the items and all associated work processes met quality assurance standards that are equivalent to the repository's standards. If the project managers are unable to do this, they would be faced with either (1) modifying the current procurement contracts (if packaging of the spent fuel has not already occurred) to incorporate the requirements, further delaying the project and potentially increasing costs by $2 million to $5 million, or (2) repackaging the fuel, which DOE believes would be very costly.

Finally, there has been significant turnover within DOE's team of staff responsible for overseeing the project. For example, during 1999, both of DOE's key day-to-day managers on the project—the Assistant Manager for Waste Management and the Spent Fuel Project Manager—left Hanford to assume positions elsewhere in the DOE complex. DOE has not permanently filled either position. In explaining why DOE allowed a disruption in the continuity of management at such a critical time in the project, the then Acting Assistant Secretary for Environmental Management said that although he would have preferred that these managers remain with the spent fuel project, career opportunities took them elsewhere.

Problems with the continuity of management are not new for DOE. A 1995 study by Independent Project Analysis, Inc., concluded that the turnover among DOE project managers was nearly twice the industry average and was increasing in frequency.[16] Furthermore, our 1996 report on DOE's major system acquisitions disclosed that many of the ongoing projects and most of the completed ones had cost overruns or delays.[17] Given the overall status of the spent fuel project and the challenges that Fluor Daniel and DOE face in successfully completing it, DOE's leadership will continue to be important as construction is completed and the project begins operations.

Conclusions

The spent fuel storage project at Hanford has had a history of problems. Actions by Fluor Daniel to take managerial control of the project from Duke Engineering have helped to strengthen the management of the project. DOE and Fluor Daniel have been working to correct deficiencies and to complete the construction of facilities and to begin removing fuel from the water basins. Progress has been made in constructing facilities, but many challenges remain in ensuring that the project is successful. Given the challenges remaining to make the project operational, the lingering management weaknesses, and the need to ensure that performance incentives help to control costs during operations, effective leadership and oversight by DOE are needed to increase the chances that the project will be completed within current cost and schedule targets.

Recommendations

To ensure that the Department of Energy provides effective leadership and oversight to the project, we recommend that the Secretary of Energy immediately take steps to permanently fill the positions of the key day-to-day managers that oversee the project. In addition to establishing a continuity of DOE leadership during this critical time, the Secretary of Energy should take steps to ensure that the Hanford spent fuel project is completed as efficiently and effectively as possible by (1) ensuring that the contractor's performance incentive fees contain the proper balance between the incentives to achieve the interim milestone to begin moving spent fuel and the incentives to achieve efficiencies during the operational period of the project and (2) clarifying the quality assurance standards to be applied to the fuel containers and baskets to minimize the long-term costs of packaging and eventually shipping the fuel to a repository.

[16]Project Performance Study: Waste Management Addendum, Independent Project Analysis, Inc., 1995.

[17]Department of Energy: Opportunity to Improve Management of Major System Acquisitions (GAO/RCED-97-17, Nov. 26, 1996).

Agency and Contractor Comments

We provided a draft of this report to DOE for review and comment. DOE generally agreed with the report's conclusions and recommendations. In particular, it recognized the need to permanently fill the positions of Spent Fuel Project Director and Assistant Manager for Waste Management and discussed its efforts for doing so. It similarly agreed that contractor performance incentive fees need to contain a proper balance between incentives to begin fuel movement and incentives to achieve operational efficiencies and identified activities it is undertaking to this end. Finally, it said it is actively working to clarify quality assurance standards to be applied to fuel containers and baskets.

DOE also provided several technical clarifications that we have incorporated as appropriate. Appendix I includes DOE's comments.

We also provided a draft of this report to DOE's contractor, Fluor Daniel Hanford. Fluor Daniel chose not to comment separately but provided comments to DOE.

Scope and Methodology

To determine the current status of the project, we reviewed our past work on the project and DOE documents describing the spent fuel storage project, project schedules, and cost estimates approved by DOE. We also reviewed status reports and correspondence from DOE and other pertinent information. We interviewed DOE and contractor officials as well as officials from the Defense Nuclear Facilities Safety Board and the Environmental Protection Agency about the project's history, the reasons for the changes to schedule and cost estimates, and the major events leading to those changes.

To determine what problems still exist that might affect DOE's ability to achieve its current cost and schedule estimates, we reviewed our past work and DOE's, the Safety Board's, and the contractors' records and reports. We also interviewed officials from those organizations to obtain their views on the causes of the project's difficulties. We also reviewed reports on other DOE projects to understand why some of those projects had cost and schedule problems. In addition, we interviewed DOE and contractor officials, including the Principal Deputy Assistant Secretary for Environmental Management and officials from the Office of Civilian Radioactive Waste Management and the DOE National Spent Fuel Program.

To determine whether the changes that DOE and its contractors have made since last year have been sufficient to address management weaknesses,

we reviewed the contractors' records, correspondence, and contract files. We also interviewed DOE and contractor officials and attended various project meetings between DOE and Fluor Daniel. In addition, we interviewed DOE safety officials and members of DOE's Independent Review Panel.

We performed our review from April 1999 through September 1999 in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Honorable Bill Richardson, the Secretary of Energy. We will also make copies available to others on request. If you or your staff have any questions or need additional information, please call me at (202) 512-3841.

Sincerely yours,

(Ms.) Gary L. Jones
Associate Director, Energy,
Resources, and Science Issues

Contents

Abbreviations

DOE	Department of Energy
GAO	General Accouting Office

Comments From the Department of Energy

Department of Energy
Washington, DC 20585

August 27, 1999

Ms. Gary L. Jones
Associate Director
Energy, Resources, and Science Issues
U.S. General Accounting Office
Washington, D.C. 20548

Dear Ms. Jones:

Thank you for the opportunity to comment on your draft report entitled "Nuclear Waste: Status of the Department of Energy's (DOE's) Hanford Spent Nuclear Fuel Storage Project" (GAO/RCED-99-267). In general, we agree with your conclusions and recommendations. Enclosed are DOE's comments on the draft report.

The Hanford Spent Nuclear Fuel Project is one of the DOE's most complex and highest priority projects. DOE believes a strong and effective management team is in place, and we will continue to provide effective leadership and oversight to increase the probability of completing the project within the current cost and schedule baseline. Steps are currently being taken to permanently fill the positions of DOE's key day-to-day managers. The Richland Operations Office Manager has selected Phillip Loscoe as the Director, Spent Nuclear Fuel Project Division and final approval by DOE Headquarters is pending. The Assistant Manager for Waste Management will be addressed under the current Richland reorganization review which is expected to be implemented by October 1, 1999.

Efforts are underway to ensure that the contractor's performance incentive fees contain the proper balance between incentives to begin fuel movement and incentives to achieve efficiencies during the operational period of the project. DOE and the contractor have reached a multi year contract agreement with incentive fee tied to beginning fuel movement. FY 2000 performance incentives are currently being developed with a focus on transition to operations. FY 2001 and out year performance incentives will have a proactive emphasis on increased movement of fuel volume above the current project baseline, with an expected reduction in schedule duration and total project costs.

DOE is actively working to clarify the quality assurance standards to be applied to the fuel containers and baskets prior to packaging of the fuel in order to minimize the long-term costs of packaging and increase the likelihood of eventually shipping the fuel to a geological repository.

Randall Kaltreider of my office is available to discuss our comments. He can be reached at 301-903-4259.

Sincerely,

Carolyn L. Huntoon

Carolyn L. Huntoon
Assistant Secretary for
Environmental Management

Enclosure

GAO Contacts and Staff Acknowledgments

GAO Contacts

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Acknowledgments

In addition to those named above, Chris Abraham, Margaret Armen, Dwayne Curry, Nancy Kintner-Meyer, Tom Perry, Charles Sylvis, and Stan Stenersen made key contributions to this report.

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