United States General Accounting Office

GAO

Testimony

Before the Subcommittee on Oversight and Investigations, Committee on Commerce, House of Representatives

For Release
on Delivery
Expected at
1:00 p.m. EDT
Tuesday
May 12, 1998

# NUCLEAR WASTE

# Management Problems at the Department of Energy's Hanford Spent Fuel Storage Project

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Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss a Department of Energy (DOE) project to change how DOE stores spent (or irradiated) nuclear fuel from its nuclear reactors at the Department's Hanford site in Washington State. The fuel is currently stored in water basins, but health and safety concerns exist because of the deteriorating condition of this fuel and its storage facility. To address these problems, the project currently under development calls for building a facility to dry the spent fuel, placing the fuel in canisters, and moving it to a new interim storage facility. Project-related activities are being directed by a contractor, Duke Engineering & Services Hanford, Inc. (Duke Engineering) and DOE's management and integration contractor, Fluor Daniel Hanford, Inc. (Fluor Daniel). Recently, however, the project has fallen substantially behind schedule, and estimates of the project's cost have significantly increased.

You asked us to address (1) the risks posed by the current storage of the spent nuclear fuel, (2) the project's current status, (3) the major reasons for delays and cost increases, and (4) the measures being taken to address these delays and cost increases, together with an assessment of the likelihood that the latest cost and schedule targets will be met.

In summary,

- As currently stored, most of the spent fuel at Hanford presents a risk of releasing nuclear materials to the environment and a consequent danger both to workers and the public. This fuel currently sits in two water basins that are well beyond their design life and are located just 1,400 feet from the Columbia River. Never designed for long-term storage in water, some of the spent fuel has corroded, creating a radioactive sludge that has accumulated in the storage basins. Because of leaks in the basins, workers risk exposure to radioactive materials if contaminated water is released to the soil, and the public risks exposure if this water moves through the soil to the river. In fact, it is likely that radioactive materials carried in water leaking from one of the basins have reached the river at least twice in the past.
- Although progress has been made in designing and constructing the new facilities, the schedule proposed by the contractors in April 1998 is over 4 years behind the original schedule for completion, and the estimated costs to build and operate the project have almost doubled to about $1.4 billion. The date to begin moving the spent fuel out of the basins, an important milestone for the project, given the health and safety risks associated with

current storage conditions, will be delayed until November 2000—almost 3 years beyond the original plan.

- The original schedule for completing the project was overly optimistic because it provided virtually no flexibility to deal with problems. DOE wanted a compressed schedule for completing the project because of safety concerns at the existing storage basins and because DOE thought that a compressed schedule would improve the contractor's performance. In addition, the lack of adequate management by the companies working on the spent fuel project for DOE—Westinghouse Hanford Company (Westinghouse), the company that managed the project until 1996, and Duke Engineering, the company currently responsible for the project—also contributed to schedule delays and cost overruns. For example, Westinghouse was slow in incorporating severe weather design requirements for the storage building, which delayed the project, and Duke Engineering had difficulty identifying and resolving technical and management problems that affected the project's schedule and cost. Furthermore, oversight by both DOE and its management and integration contractor at the Hanford site—Fluor Daniel—was insufficient to ensure that problems were quickly corrected. In 1997, DOE and Fluor Daniel began taking aggressive action to address these problems.
- Recent management changes have been made, and oversight of the project has become more aggressive. Fluor Daniel has directed Duke Engineering to improve performance or face the possibility of losing the contract. Both contractors' earnings are likely to be affected by reductions in the performance fee that DOE awards if the contractors meet predetermined performance objectives. In addition, Duke Engineering has replaced several key managers and reorganized its operations and procedures. The effect that such changes will have on meeting future schedule and cost targets is uncertain. DOE is negotiating with its regulators—the Environmental Protection Agency and the Washington State Department of Ecology—new milestone dates that DOE believes it can meet. However, in March 1998, DOE told Fluor Daniel that many of the management problems identified earlier continue to plague the project. These problems and unresolved technical questions will continue to affect DOE's ability to set reliable targets.

## Deteriorating Spent Fuel and Storage Basins May Become Unsafe

For many years, DOE obtained plutonium for nuclear weapons by reprocessing spent fuel from some of its nuclear reactors. Before the spent fuel could be reprocessed, however, it had to be stored temporarily in water basins so that short-lived fission products could decay, reducing radiation levels to the point where the fuel could be handled with less

danger to workers and less damage to chemicals used to extract the plutonium. When Hanford's fuel-processing facilities were permanently shut down in 1992, DOE had no strategy for dealing with the stockpiled fuel. Hanford currently has more than 2,100 metric tons of spent fuel—about 80 percent of the Department's total inventory.

DOE and the Defense Nuclear Facilities Safety Board[1] have identified the following safety problems at its spent fuel storage basins:

- The spent fuel, which is made of uranium and has been irradiated in a nuclear reactor, was not intended for long-term storage in water and is corroding and crumbling. The fuel is stored in canisters at the bottom of the basins, which contain about 16 feet of water to absorb heat from the radioactive decay of the fuel and shield workers from radiation. Because DOE's spent fuel is designed to be dissolved during processing in order to remove the plutonium it contains, only a thin coating (called cladding) was placed over the uranium; in some cases, this cladding is broken or damaged. As a result, uranium, plutonium, and other radioactive materials from the spent fuel have accumulated in the bottoms of storage canisters, in sludge at the bottom of the storage basins, and in the filters and other basin components.
- The two storage basins, which were not designed for the long-term storage of spent fuel, are vulnerable to leaks and earthquake damage. Constructed in 1951, the basins are now well beyond their expected useful life of 20 years. They are seismically unsound, and at least one has leaked water directly to the surrounding soils. For example, from 1974 through 1979, about 15 million gallons of contaminated water leaked from one basin. The same basin leaked again in 1993. In both incidents, it is likely that contamination reached the Columbia River.
- The buildings that house the basins are also inadequate, and the location is environmentally precarious. The buildings are not airtight and allow sand, dirt, and dust to enter the water basins, contributing to the buildup of sludge at the bottom of each pool. The basins are about 1,400 feet away from the Columbia River—much too close, in the view of DOE and other parties interested in protecting the river from environmental damage.

The existing storage poses risks of exposing workers, the public, and the environment to radioactive materials. For example, an earthquake or even an industrial accident could cause a basin to rupture, releasing large quantities of contaminated basin water to the soil and the Columbia

[1]The Defense Nuclear Facilities Safety Board is an independent, executive-branch oversight body responsible for evaluating DOE's nuclear facilities. The Safety Board recommends to DOE specific measures that should be adopted to ensure that public health and safety are adequately protected.

River.[2] The loss of water in 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. Evaluations conducted in 1993 by DOE and 1994 by the Safety Board concluded that improving the spent fuel's storage was urgently needed. Because of the deteriorated condition of the spent fuel and one of the storage basins, the Safety Board described the situation as one where "imminent hazards could arise within two or three years," a time period that has already passed. The Safety Board recommended that, among other things, DOE take action to improve the storage of spent fuel on a high-priority, accelerated basis.

## Project Would Stabilize and Dry Fuel for Interim Storage Farther From the River

DOE has responded to the safety concerns about the spent fuel by developing a plan to dry the fuel and store it farther from the Columbia River. This strategy, which has been evolving since 1994, includes cleaning and packaging the fuel in the basins, removing and drying the fuel at a new processing facility to be built near the basins, and transporting the fuel to a new interim storage facility on the Hanford site several miles from the river. The fuel will be stored there in sealed containers until its final disposition occurs, in a permanent geologic repository. The project also involves treating and disposing of the sludge, debris, and water left in the basins after the fuel is removed.[3]

The spent fuel project is organized into subprojects and includes constructing two major facilities—a fuel-drying facility and a canister storage facility. The project also involves designing and constructing a transportation system to move the fuel between the facilities; special canisters to hold the fuel; and various systems and processes to clean, package, and dry the fuel and to move the 14-foot-long canisters to their storage tubes once inside the canister storage building. Although the dry storage of spent fuel is common in the commercial nuclear industry, the specific form of spent fuel that DOE uses—metallic uranium—is more difficult to dry because of its tendency to ignite when in contact with air. Because the spent fuel project at Hanford involves handling, conditioning, and packaging nuclear materials, and DOE eventually expects to be subjected to external regulation for nuclear safety, DOE has required safety

[2]Soil around the basins has already been contaminated during past reactor operations at the site. Additional basin leaks could flush contamination out of the soil and into the river.

[3]The project also includes moving about 30 metric tons of spent fuel stored at other locations on the Hanford site to the new storage facility or to storage pads adjacent to the new facility.

standards for the project equivalent to the Nuclear Regulatory Commission's requirements, to the extent practicable.

DOE wants to achieve at least three goals through this project—eliminating the continued corrosion of the fuel; quickly reducing the safety risks to workers, the public, and the environment; and lowering the costs associated with the safe storage of the fuel until its final disposition occurs. DOE believes that the dry storage of the spent fuel presents the best option for achieving these goals.

## Project Is Behind Schedule and Over Budget

The original project schedule established in April 1995 called for starting the fuel's retrieval in December 1997 and completing the project in September 2001. The schedule has been revised twice since then, and in April 1998, the contractors proposed a new schedule that would begin the fuel's retrieval in November 2000 and complete the project by December 2005. (See table 1.)

**Table 1: Schedule Slippage for Key Dates in Hanford's Spent Nuclear Fuel Project**

| Schedule | Begin fuel retrieval | Complete fuel retrieval | 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 (proposed) (Apr. 1998) | Nov. 2000 | Aug. 2003 | Dec. 2005 | 51 |

DOE's recurring revisions to the project's schedule reflect an uncertainty about DOE's ability to meet a firm completion date—an uncertainty that has not abated. For example, the April 1998 proposed schedule revision has occurred for two reasons. First, Duke Engineering officials identified additional schedule slippage beyond the dates shown in the December 1997 schedule. Second, EPA and Ecology have demanded enforceable

milestones in the Tri-Party Agreement for the spent fuel project.[4] DOE's Assistant Manager for Waste Management said that DOE did not want to establish project milestones with its regulators on the basis of the December 1997 schedule, which was an accelerated schedule with high risk, only to have the dates change before the negotiations were complete.[5] Milestone commitments under the Tri-Party Agreement represent contractual commitments that, if not met, can result in fines being assessed against DOE. To establish a schedule that it had a better chance of meeting, and one that hopefully would not change again during negotiations with the regulators, in April 1998, Duke Engineering and Fluor Daniel proposed a schedule that includes contingency for unforeseen problems. DOE and its regulators expect to have an enforceable agreement on the project's milestones by July 31, 1998.

With each change in the schedule, the estimates of the project's total costs have increased. The original cost estimate was about $740 million,[6] while the cost estimate associated with the April 1998 proposed schedule is about $1.4 billion—an 84 percent increase. (See table 2.)

**Table 2: Changes in Total Cost Estimates for Hanford's Spent Nuclear Fuel Project**

Dollars in millions

| Date of cost estimate | Cost estimate | Cumulative cost increase |
|---|---|---|
| October 1995 | $740 | N/A |
| April 1997 | 814 | $74 |
| December 1997 | 1,089 | 349 |
| April 1998 (proposed) | 1,365 | 625 |

In a February 9, 1998, letter to this Committee, DOE stated that the estimates of spent fuel project costs of over $1 billion and 9 years to complete the project (the December 1997 revision) were still less than early estimates of the cost of addressing the spent fuel storage problem at

[4]The Tri-Party Agreement is a legally binding agreement between DOE, EPA, and Ecology. Among other things, the agreement establishes a schedule for cleaning up the various environmental hazards at the Hanford site. Until the recent negotiations, the Tri-Party Agreement milestones related to spent fuel called for encapsulating and removing the spent fuel and sludge from the storage basins by December 2002.

[5]This has already happened once during the project. In 1997, DOE and the regulators tentatively agreed on the enforceable milestones for the project. However, while public comments were being obtained on a draft of the agreement, DOE learned from its contractors that the milestones could not be achieved. Because DOE would not sign the agreement, the enforceable project dates had to be renegotiated.

[6]At the time when DOE's original project schedule was approved in April 1995, no corresponding cost estimate was available, according to contractor officials. In October 1995, DOE's contractor for the project estimated that the project would cost about $740 million. All project cost estimates used in this report are in current dollars and include both capital construction costs and operating costs over the life of the project.

Hanford, which were projected to cost up to $2 billion and take up to 15 years to complete.[7] DOE reasoned that, even with the cost increases now being experienced, the project would still cost roughly $1 billion less and take 6 years less than the original project concept. However, we believe that to evaluate cost and schedule performance on a specific project that DOE is implementing, current estimates need to be compared with the original estimates for this project. Such a comparison shows that estimated costs have nearly doubled and that the project's duration has been extended by over 4 years.

Cost and schedule growth on a DOE major system acquisition project (generally projects costing $100 million or more) are not unusual. In our 1996 report on DOE's major system acquisitions, we reported that at least half of the ongoing projects and most of the completed projects had cost overruns and/or schedule slippage.[8] Some of the reasons for cost overruns and schedule slippage are similar to the management problems that have occurred on this spent fuel project. For example, our 1996 report notes that the management of one project was criticized for insufficient attention to technical, institutional, and management issues. Also in that report, we cited a 1993 report that described the causes of cost increases in the environmental restoration program, including design changes, poor project definition, and turnover within the project team. We noted in our report that in recent years, DOE had implemented several initiatives to improve its overall management of these large projects.

## Unrealistic Schedules and Inadequate Management and Oversight Contributed to Project Difficulties

The schedule for the project that DOE approved in April 1995 was intentionally optimistic and had virtually no contingency for unforeseen problems. DOE insisted on a very optimistic schedule for the project because of the deteriorated condition of the spent fuel and the storage basins and the need to resolve the storage problems expeditiously. In addition, DOE officials thought that a tight schedule would force Westinghouse to accomplish the project more quickly. However, virtually no schedule or cost flexibility existed to address either the technical problems disclosed after characterizing the fuel or other changes implemented as the project progressed.

[7]According to the Assistant Manager for Waste Management at Hanford, the $2 billion estimate refers to a cost that was reported in DOE's 1995 Baseline Environmental Management Report. In that report, the cost of dealing with Hanford's spent fuel was estimated to be well over $2 billion.

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

When the initial project proposal was presented to DOE's Assistant Secretary for Environmental Management in November 1994, under the proposed schedule, the removal of the fuel from the basins was to begin in December 1998, and the project was to be completed by April 2006. The proposal was developed by Westinghouse, the company that was the management and operations contractor at Hanford until October 1996. In order to meet those dates, the proposal included several shortcuts to normal DOE procedures, such as (1) allowing some of the project's activities, including procurement actions, to start before the Environmental Impact Statement Record of Decision was issued and (2) allowing a "fast-track" approach in which the project's activities—such as the characterization of the fuel, design of facilities and equipment, safety analyses, and construction—would proceed concurrently instead of sequentially.[9]

The Assistant Secretary approved the proposal but directed that the schedule be compressed so that beginning the retrieval of the fuel could be moved up by 18 months—to June 1997. DOE and Westinghouse officials reevaluated the project and determined that there was virtually no chance that the date specified by the Assistant Secretary could be met. Westinghouse proposed—and DOE accepted—a compromise schedule under which retrieval of the fuel would start by December 31, 1997—12 months earlier than under the initial Westinghouse proposal. Westinghouse estimated that it had an 80-percent chance of meeting the date.

As part of its program to reduce costs while accelerating cleanup, DOE rewarded Westinghouse for the estimated savings associated with adjusting the project to an accelerated schedule by making an additional incentive fee payment. The program, called Challenge 170, provided incentives for Westinghouse to improve its productivity and eliminate unnecessary work. Westinghouse's fee was calculated as a percentage of the productivity increase or reduction in work scope. Westinghouse submitted formal change requests on the spent fuel project to reflect the compressed schedule and other savings, and DOE estimated that these actions would save $6.9 million, of which, about $2.5 million could be attributed to accelerating the schedule. In 1996, DOE paid Westinghouse as

[9]For a discussion of DOE's use of a fast track approach on other projects with cost and schedule problems, see Nuclear Waste: Department of Energy's Project to Clean Up Pit 9 at Idaho Falls Is Experiencing Problems (GAO/RCED-97-180, July 28, 1997) and Nuclear Waste: Defense Waste Processing Facility—Cost, Schedule, and Technical Issues (GAO/RCED-92-183, June 17, 1992).

much as $368,000 in fees for these expected savings.[10] However, because of certain cost increases in future years, these claimed savings appear to be deferrals of work that were performed in succeeding years that would not be eligible for an award fee. DOE would need to conduct a detailed analysis to determine if the $2.5 million was a savings. It is unclear, according to a DOE contracting officer, if DOE has the contractual authority to demand that Westinghouse repay any of the $368,000 fee if DOE determines that the savings did not materialize. He said that at the time of our review, DOE had not assessed its legal basis for seeking repayment of the fee.

Unfortunately, the compressed schedule, including the deadline of December 31, 1997, for beginning the retrieval of the fuel had little chance of being achieved because it was based on an underlying premise that the project would encounter few problems that would affect the schedule. Therefore, the schedule had virtually no flexibility to address unforeseen problems. Actual experience, however, did not match the assumption; problems were encountered that changed the scope of work required and affected the project's schedule. For example:

- Characterization activities after the schedule was established revealed several surprises, including the poor condition of the fuel in closed canisters[11] (which necessitated developing a new water treatment system for one basin); the presence of aluminum hydroxide on some of the fuel, which in part, led to a redesign of the storage canisters to better withstand any buildup of hydrogen gas; and the presence of uranium particles and polychlorinated biphenyls (PCBs) in the pool sludge, which necessitated chemical treatment of the sludge before disposal.
- Strategies for drying the fuel and for controlling pressure in the fuel storage canisters changed significantly. Fuel-drying strategies evolved from a hot-conditioning system, in which the fuel would be heated to 300 degrees centigrade; to a two-step approach of cold drying at 50 degrees centigrade followed by hot conditioning; to a strategy approved in April 1998 to eliminate hot conditioning and rely solely on the cold drying of the fuel. For the fuel storage canisters, the strategy evolved from using closed containers with a pressure relief system to sealed containers with no pressure relief. These changes occurred as DOE and its contractors

[10]DOE confirmed Westinghouse's savings of nearly $300 million for the entire Challenge 170 program and paid, as a fee, 3.93 percent of the first $170 million in savings and 15 percent of the savings over $170 million. Applying the 15-percent marginal rate, the amount of the fee paid on the $2.452 million estimated savings for accelerating the spent fuel project schedule was about $368,000.

[11]One basin has closed fuel canisters, the other, open canisters. In both basins, however, water is in direct contact with fuel elements.

learned more about the characteristics of the spent fuel and incorporated new strategies to increase safety and reduce long-term storage costs.

According to the Assistant Manager for Waste Management at Hanford, the optimistic schedule for the project reflected a trade-off between the health and safety risks associated with continuing to store the spent fuel in the basins and the management risks associated with setting an optimistic schedule and knowing that it would be difficult to meet. The Assistant Manager said that DOE wanted to resolve the basin storage problems quickly and that DOE was also looking for ways to improve the performance of its contractors. Setting an optimistic schedule for the spent fuel project was one strategy that DOE used to try to obtain improved performance.

## Management by Companies in Charge Exacerbated Problems With Original Schedule

During the project's history, two different companies have been responsible for the project. Westinghouse, which at the time, was the overall Hanford management and operations contractor for DOE, managed the project from its inception in late 1994 until October 1996. In October 1996, the responsibility for the spent fuel project shifted to Duke Engineering, a company that has managed the project as a subcontractor to Fluor Daniel, the new site contractor.[12] Under both Westinghouse and Duke Engineering, the project has suffered from management problems that exacerbated the problems already inherent in the project's schedule. The following are examples:

- Westinghouse had difficulty implementing sound project management practices. According to DOE officials and available documentation, Westinghouse did not use consistent and reliable estimating procedures to develop project baseline costs or make effective use of the baseline schedule as a tool to manage the project. For example, although Westinghouse developed a baseline for the project and had a system for controlling changes to the baseline, DOE officials said that Westinghouse did not have a sound planning basis for some of its cost estimates. DOE found that some cost estimates had inadequate supporting documentation and that estimating procedures were not applied consistently. In addition, when Duke Engineering assumed responsibility for the project in October 1996, several adjustments had to be made to the project baseline to incorporate more realistic estimates of the time needed to accomplish certain tasks and to add work scope not previously included in the

[12]In October 1996, the site management contract at Hanford was awarded to Fluor Daniel. The Fluor Daniel team included five major subcontractors. Duke Engineering assumed responsibility for the spent nuclear fuel storage project and also provides support for other companies at the site.

schedule. The former Westinghouse spent fuel project director disagreed that these adjustments were needed and said that when Westinghouse turned over the project to the new contractors in October 1996, the project was on schedule and within budget. DOE officials at Hanford, however, said the Westinghouse schedule did not have a good planning basis or sound justifications and that it never met the requirements for baseline management and control that Westinghouse agreed to in the project management plan.

- Severe weather design requirements were not incorporated into the canister storage building in a timely manner. The former Westinghouse spent fuel project director said that neither the requirement nor the options for meeting it were clear, but DOE's position has been that the requirement was clear and that Westinghouse failed to implement the requirement in a timely manner, extending the construction schedule for the building and jeopardizing the start of spent fuel retrieval from the basins.
- Duke Engineering was unable to keep the various subprojects working in accordance with the project's schedule. When Duke Engineering took responsibility for the project in October 1996, with the help of Fluor Daniel, it established an integrated project baseline schedule and a system of controlling change that DOE approved in April 1997. However, DOE's evaluation of the project in September 1997 found significant problems with the management of the project, including Duke Engineering's poor management and contracting practices. For example, DOE criticized Duke Engineering for the weak management of subcontractors when the subcontractors did not perform satisfactorily. In October 1997, the Safety Board reported that the project had management deficiencies, including the inadequate identification of problems, inadequate actions to resolve problems, and a failure to communicate changes and performance expectations to project personnel. Fluor Daniel and DOE officials told us that, in their opinion, these problems occurred because Duke did not have the management and technical expertise in place to properly manage the project. The current president of Duke Engineering told us he agreed with these assessments.
- Duke Engineering also has had problems with the management and staffing of the project's safety analysis documentation effort. The Safety Board, in its October 1997 report, concluded that a key element in the ultimate success of the project was the timely completion of a number of subproject safety analyses. We found delays in getting the safety documentation prepared and approved on various subprojects. For example, the approval of the final safety analysis report for the canister storage building is now 9 months later than originally planned. The safety

analysis report for the cold vacuum drying facility is now 13 months late and was recently rejected by DOE as unacceptable. Because safety documentation for the drying facility is on the "critical path" for the project schedule, delays in completing the documentation will add an estimated 46 days to the overall project.[13] According to DOE's Assistant Manager for Waste Management, safety documentation has been inadequate because of problems with the underlying engineering and design work on the project. He said that Duke Engineering and its subcontractors have not been doing acceptable engineering work on the project and that Duke Engineering did not have people with sufficient skills assigned to prepare safety documents. Duke Engineering officials agreed that there have been design and engineering problems associated with the safety documentation process. They said that they recently added staff with additional safety expertise and made other changes to address these problems.

## Oversight Was Not Sufficient to Get Problems Corrected Quickly Once Identified

Although DOE and Fluor Daniel were aware of the problems that were causing the schedule to slip, their oversight actions were not effective in resolving those problems. During the time that Westinghouse was still in charge of the project, DOE officials did not take aggressive action to improve contractor performance. These officials said they could not get Westinghouse to develop a sound planning basis for the project baseline and cost estimate or improve its management controls. According to DOE's spent fuel project manager and the Assistant Manager for Waste Management at Hanford, Westinghouse staff did not have the skills necessary to implement project management techniques. However, we found only limited documentation showing that DOE officials were pointing out these deficiencies to Westinghouse and asking for improved performance.

The former Westinghouse spent fuel project director disagreed with this assessment of Westinghouse's performance. He said that Westinghouse had made substantial progress on the project and that DOE's evaluations of Westinghouse's performance were generally positive. DOE's Assistant Manager for Waste Management told us that Westinghouse did make progress while managing the project but that, overall, Westinghouse's performance was mixed and left considerable room for improvement, especially in the areas of developing a sound basis for the project baseline and making effective use of project management tools. He added that DOE

[13]Duke Engineering officials estimate that revising the safety documentation to address DOE's concerns will cost an additional $450,000.

was trying to get improved performance from Westinghouse by focusing performance reviews on the positive aspects of performance, not by emphasizing the deficiencies. In addition, the Manager of DOE's Richland Operations Office told us that changing site management contractors in October 1996 from Westinghouse to Fluor Daniel resulted from DOE's actions to deal with Westinghouse's performance, including the problems with Westinghouse's performance on the spent fuel project.

After Duke Engineering assumed responsibility for the project as part of the new site management contract, Fluor Daniel provided primary oversight of the project for DOE. According to Fluor Daniel's spent fuel project director, it became apparent in December 1996 that Duke Engineering was struggling to establish an integrated project baseline, and in April 1997, after the baseline was approved, Duke Engineering had difficulty ensuring that the various subprojects stayed on schedule. She described Fluor Daniel's oversight of Duke Engineering as increasing in scope and intensity during this period as Duke Engineering struggled to perform on the project.

During this period, DOE officials expressed to Fluor Daniel several concerns about the project, including poor quality assurance, unresolved technical issues, and schedule slippage. In its evaluation of Fluor Daniel's performance at Hanford during fiscal year 1997, DOE gave the company a marginal rating for its performance on the spent fuel project. While giving Fluor Daniel credit for having a strong project director and for aggressively pursuing project-related issues, DOE said the marginal rating was justified because of unfavorable cost and schedule variances, missed milestones, and safety issues. Fluor Daniel assessed its own performance on the project as marginal because of construction safety problems, safety analysis reporting issues, and the large slippage in the schedule resulting from Duke Engineering's performance. Despite these oversight actions by DOE, in October 1997, the Safety Board reported that DOE officials at Hanford were not sufficiently aware of the technical details of the project to prevent delays from occurring. They also reported that, up to that point, DOE had not been able to accurately determine the status of the project on a routine basis.

## Recent Corrective Actions May Not Stop Cost and Schedule Growth

DOE and its contractors have been working to improve their performance on the project. The December 1997 revision to the project's schedule was first proposed in August 1997, and it became a catalyst for action on the project. The Safety Board and DOE both conducted reviews that were critical of Duke Engineering's project management. Fluor Daniel stepped up its oversight activities, and in December 1997, it sent Duke Engineering a letter (called a cure notice) requiring the company to correct problems and improve performance on the project or face possible contractual remedies, including termination for default or recompetition of the subcontract rather than extending it.

In response, Duke Engineering prepared a recovery plan and added several new managers, including a new spent fuel project director. The company also made several organizational changes to strengthen the management of the subprojects, establish greater accountability for meeting the project's schedule, and speed the resolution of technical issues. In addition, Duke Engineering modified its procedures to better identify emerging issues and control changes to the project's technical baseline.

On May 1, 1998, Flour Daniel notified Duke Engineering that it had remedied the problems identified in the cure notice and that if improvements continued, Duke Engineering's subcontract would probably be extended. DOE's Manager, Richland Operations Office, however, was concerned with these decisions and asked Flour Daniel for (1) information on its basis for deciding that the problems had been remedied and (2) a recommendation with supporting justification by May 29, 1998, to either extend or recompete the subcontract with Duke Engineering.

DOE has also strengthened its oversight of the project and has taken steps to improve its process for reviewing safety documentation. For example, the Assistant Manager for Waste Management at Hanford began devoting more of his time to the project and specifically to overseeing the contractors' actions. DOE also worked with the contractors to clarify expectations for safety documents and improve the safety review process to reduce the number of duplicative, conflicting, or insignificant comments being made.

DOE also increased its use of incentive fees to influence contractor performance. Both Fluor Daniel and Duke Engineering have cost-reimbursement contracts under which the incentive fees are based on the achievement of certain performance objectives. To a more limited

extent, this was also true when Westinghouse was the site contractor. For example, for fiscal year 1996, DOE reduced the incentive fees paid to Westinghouse by $625,000 below the $3 million available, primarily because of the company's delays in finishing the design of the canister storage building.[14] Fees paid to Fluor Daniel and Duke Engineering are also being affected by performance. Although DOE has not completed its evaluation of the fees to be paid to Fluor Daniel and Duke Engineering for fiscal year 1997, Fluor Daniel's director of contract management estimated that Fluor Daniel and Duke Engineering will earn only about $1.0 million of the $3.2 million fee available on the spent fuel project.[15] For fiscal year 1998, at least $8.1 million in incentives is available for the spent fuel project.[16]

DOE officials at Hanford are negotiating a revised project schedule with the regulators that, the Assistant Manager for Waste Management said, includes a contingency to address unforeseen problems so DOE and its contractors are more confident that the dates can be met. In addition, Duke Engineering is exploring opportunities to shorten the project's time frame by providing the suppliers and lower tier subcontractors with incentives.[17]

Despite recent actions to improve contractors' performance and to make the schedule more realistic, however, remaining uncertainties with the project make it difficult for DOE to predict project outcomes with a high degree of reliability. The following are the main uncertainties:

- Technical questions and changes continue. For example, concerns persist about the discovery of an aluminum hydroxide coating on some of the fuel. Aluminum hydroxide is about 35 percent water and not easy to remove from the fuel. As radiation breaks down the water in the aluminum hydroxide into its basic elements, it could become a significant source of pressure in the storage canisters. According to DOE's spent fuel project

[14]This fee reduction was independent of the fees that DOE paid to Westinghouse under the Challenge 170 program discussed earlier in this testimony.

[15]The maximum amount available to the contractors through accomplishing a "critical few" performance measures for the project was $3.2 million. In addition, the contractors could earn fee by accomplishing other performance measures tied to a single "mega" objective. Several of the measures for the mega objective pertain to the spent fuel project. The mega objective has a maximum of $20.6 million in available fee if all of the measures are met.

[16]DOE and Fluor Daniel officials said that although they have been unable to agree on the specific performance measures, DOE included the performance measures it proposed in a contract modification and expects Fluor Daniel to work in accordance with those measures.

[17]In its review of the project in October 1997, the Safety Board criticized DOE and the project contractors for failing to use incentives and penalties to influence the performance of vendors and suppliers on the project.

director, the companies working on this part of the project believe they have a technical solution but it has not yet been approved. Any delay in completing the safety basis for dealing with the increased pressure, or implementing methods to remove the aluminum hydroxide coating, could delay the start of fuel removal.

- Operational performance has not been proven. According to DOE's spent fuel project director, other than some limited testing, systems and equipment to clean basin water, handle the spent fuel, and dry the fuel have not been operated to test reliability, the speed of operation, or the adequacy of operator training. She said that operational performance is now the area of greatest uncertainty with the project.
- The overall project continues to lose ground against the baseline schedule. For example, 1 month after the December 1997 schedule revision, the project was already $22 million over budget and the schedule was beginning to slip. Only 3 months later, in April 1998, the contractors proposed a new schedule adding over 2 more years and $277 million to the project. This latest proposed schedule included about 5 months and $47 million in contingency for unforeseen problems. Even so, it is unclear if all of the delays and new work have been identified, or if the factors contributing to these cost and schedule increases have been discovered and dealt with.
- Although Duke Engineering has recently made changes to its management team and operating procedures and Fluor Daniel has stepped up its oversight of the project, it is too early to tell if these changes will improve Duke Engineering's ability to manage the project within cost and schedule constraints. However, DOE's Assistant Manager for Waste Management said in a March 1998 letter to Fluor Daniel that many of the management problems identified 6 months earlier continue to exist. He also cited a lack of teamwork between Fluor Daniel and Duke Engineering that was interfering with technical integration of the work and overall progress on the project.

## Observations

The management and oversight problems with the spent fuel project at Hanford are examples of a long DOE history of difficulties in managing major construction projects. The projects that do get finished are usually late and well over budget. The spent fuel project at Hanford is no exception—DOE and its contractors have clearly not met cost and schedule targets. The original project schedule contained virtually no flexibility to deal with unforeseen problems, and management and oversight problems exacerbated problems inherent in the original schedule. Although adding time to the schedule and contingency funding and taking steps to improve

the project's management and oversight should improve the probability of meeting future cost and schedule targets, several remaining uncertainties affect DOE's and its contractors' ability to reliably predict a completion date or cost. As a result, it is important that DOE continue to be vigilant and aggressive in its oversight of contractors' activities if the project is to be completed within the latest proposed schedule and cost.

## Agency and Companies' Comments

We provided DOE with a draft of our testimony for its review and comment. We met with DOE officials, including the Manager of the Richland Operations Office. DOE generally agreed with our testimony, but said the testimony did not clearly state that spent fuel project costs include both capital construction costs and operating costs over the life of the project. We have clarified the testimony accordingly. DOE also said we should recognize that its action to replace Westinghouse as the Hanford site management contractor was due, in part, to DOE's dissatisfaction with Westinghouse's performance on the spent fuel project and represented a significant action on DOE's part. We added this information to our testimony. In addition, DOE noted that it had aggressively identified contractor problems since the inception of the project but had addressed them with Westinghouse informally. Because there was only limited documentation of these actions and contractor management problems continued, we did not add this information to the body of the testimony. Finally, DOE said that our testimony did not make it clear that (1) some of the changes to the project schedule were due to unavoidable increases in project scope as solutions to technical problems were developed and (2) the April 1998 proposed project schedule and cost estimate included a contingency for additional unforeseen problems. We clarified our testimony accordingly. DOE also suggested several technical corrections, which we incorporated as appropriate.

We also discussed our findings with Fluor Daniel, Duke Engineering, and Westinghouse. Fluor Daniel and Duke Engineering generally agreed with our findings and provided several technical corrections, which we incorporated as appropriate. Westinghouse disagreed with our findings regarding its performance on the project. Westinghouse officials said that when they turned over the project to the new contractors it was on schedule and within budget, that they had made substantial progress on the project, and that DOE's evaluations of Westinghouse's performance were generally positive. We have summarized Westinghouse's views in our testimony. However, we believe we have described Westinghouse's

performance accurately. Westinghouse also suggested several technical corrections, which we incorporated as appropriate.

Our scope and methodology are included as an appendix to our testimony.

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

# Scope and Methodology

To determine the risks associated with current spent fuel storage at Hanford and the Department of Energy's (DOE) plans to reduce those risks, we reviewed DOE and Defense Nuclear Facilities Safety Board reports on current storage conditions and DOE documents describing the spent fuel storage project. We also reviewed the environmental impact statement for the spent fuel project. In addition, we interviewed DOE and contractor officials, as well as officials from the Environmental Protection Agency and the Washington State Department of Ecology.

To determine the current status of the project, we reviewed project schedules and cost estimates approved by DOE, as well as related project documents, including safety basis documentation, project status reports, and correspondence. We also interviewed DOE and contractor officials to understand the project's history, the reasons for the changes to schedule and cost estimates, and the major events leading to those changes.

To determine the major causes of schedule delays and cost increases, we reviewed 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.

To determine what steps have been taken to correct the project's problems, any penalties for poor performance, and the likelihood of meeting the latest schedule and cost estimates, we reviewed the contractors' records, correspondence, and contract files. We also interviewed DOE and contractor officials.

Our review was performed from January through April 1998, in accordance with generally accepted government auditing standards.

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