TESTIMONY OF

THE DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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SAFETY MANAGEMENT PROBLEMS WITH THE DEPARTMENT OF ENERGY'S HANFORD SPENT NUCLEAR FUEL PROJECT

SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

COMMITTEE ON COMMERCE

UNITED STATES HOUSE OF REPRESENTATIVES

MAY 12, 1998

SUMMARY

Currently there exists at the Department of Energy's (DOE's) Hanford Site, 2,100 metric tons of highly radioactive deteriorating uranium fuel elements in metal-lined, water-filled basins located within 440 yards of the Columbia River.

The Defense Nuclear Facilities Safety Board identified this situation as one of the greatest safety risks within the DOE complex needing to be addressed. In 1994, the Board recommended (Recommendation 94-1) that the fuel elements be removed from the basin, placed in a more safe configuration pending final disposition, and that such stabilization be accomplished within 2-3 years. The DOE agreed and an implementation plan was prepared and issued under the authority and signature of the Secretary. Now, four years later, the fuel elements remain in the basin and continue to corrode and deteriorate. Most disturbing is that the present contractor currently estimates the earliest date for the start of fuel removal will be November 2000, with the first fuel being removed from the Basins in January 2001.

What has caused such a slippage?

The Defense Nuclear Facilities Safety Board, having been informed of schedule slippages in August 1997, instructed its staff to investigate the matter. A staff report (DNFSB/Tech-17) dated October 1997 concluded:

> "The principal reason for the significant and unexpected breach of schedule has been a lack of sound project management. That is, a lack of experienced personnel applying appropriate processes and tools for the management and tracking of the Spent Nuclear Fuel Project schedule."

This report, a copy of which is attached to this testimony, reviews both

the technical and management problems responsible for delays of this project. Some points need to be highlighted:

1. The 2,100 metric tons of radioactive fuel elements in the basins could have been reprocessed and the basins emptied if the PUREX plant had not been prematurely closed down in 1990. That was a mistake that should not be repeated with respect to the reprocessing canyons at the Savannah River Site. Hanford today has no reprocessing capability to stabilize deteriorating radioactive materials; Savannah River continues to have the capability to safely stabilize deteriorating material at Savannah River.

2. During the design and construction phase of this difficult technical undertaking, the DOE changed its contract management concept from Management and Operation to a Management and Integration mode, and changed contractors. Westinghouse was the original contractor reporting directly to the DOE Richland office. In 1996 DOE selected Fluor-Daniel to take overall responsibility for the work at the Hanford Site, with Duke Engineering to assume the Spent Nuclear Fuel Project work. Fluor-Daniel was to “integrate” for DOE but not undertake the actual work, thus adding an extra layer of management between the customer, DOE, and the party responsible for doing the required work. Any time there occurs — for whatever reason — a change of the contractor responsible for a given job, particularly midway in a technically difficult assignment, schedule slippages are bound to result. By adding another layer of management, in this case an integrating contractor new to the site, between itself and the contractor doing the work, the DOE weakened its own management capability.

Notwithstanding the mistakes made to date, and who is responsible, we should not lose sight of what is more important:

- The 2,100 metric tons of highly radioactive material cannot remain indefinitely in the K-Basin, but must be safely removed and stabilized as soon as possible.

- Technically qualified contractor and DOE personnel must be selected, assigned, and adequately funded to accomplish the job.

- The project must have the highest priority within the DOE EM Program and must have strong Headquarters support and direction. The DOE cannot delegate its responsibility for the safety management of this project to an intermediate organization, in this case an integrating contractor.

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

We appreciate the opportunity to present testimony on the Defense Nuclear Facilities Safety Board's (Board) role in ensuring that the health and safety of the public and the workers are adequately protected throughout the Department of Energy's (DOE) defense nuclear complex. As requested by the Subcommittee, we will focus on the delays that the Department of Energy has encountered in removing deteriorating spent nuclear fuel from the Hanford K Basins safely and expeditiously, stabilizing the fuel by suitable processes, and placing it in safe interim storage pending its ultimate disposal. In our testimony, we will very briefly summarize the statutory oversight mission of the Board, and describe the Board's work to aid the Secretary of Energy in eliminating the serious threat to the health and safety of the public and on-site workers as long as deteriorating spent fuel remains in the Hanford K Basins.

STATUTORY MISSION OF THE BOARD

The Board is an independent technical organization external to DOE with statutory oversight responsibility for the safety of DOE's defense nuclear operations, and the only independent organization with oversight of nuclear safety at DOE's defense nuclear facilities. These DOE operations include: conduct of research associated with nuclear weapons; assembly, disassembly, and dismantlement of nuclear weapons; alternative means of testing and confirming the safety of nuclear weapons; maintenance and surveillance of the aging nuclear weapons stockpile. The Board must also consider other longer-term nuclear safety issues such as the storage of tritium, plutonium and uranium, the stabilization of the residues of special nuclear material processing and corroding nuclear fuel elements, the decontamination and

decommissioning of numerous defense nuclear facilities, and the interim storage of radioactive waste.

REVIEW OF THE HANFORD SPENT NUCLEAR FUEL PROJECT

The Board's health and safety oversight efforts have been focused upon two broad areas: (1) Basic elements and structure of DOE's safety management program, and (2) Facilities and situations representing the greatest hazards. In this latter category of facilities, the Board has long considered the safe storage of deteriorating spent nuclear fuel in the K Basins at the Hanford Site as one of its top priorities. The risk to the public, the workers, and the environment from tons of corroded, highly radioactive fuel elements in vulnerable storage pools located as close as 440 yards from the Columbia River is unacceptable.

The Board has contributed substantially to interim improvements made in the storage conditions of the spent fuel. After a number of visits to the Hanford Site, the Board in 1994, recommended that the Department of Energy (DOE) place the spent fuel in a stable configuration for interim storage within 2 - 3 years. In response to Recommendation 94-1, DOE committed to a schedule acceleration of more than two years from its previous planning estimates. DOE assured the Board that Richland's K Basin spent nuclear fuel remediation, as well as other Recommendation 94-1 commitments, were adequately funded and is a "high visibility" project which is managed with joint Headquarters field management.

Subsequently, DOE's schedule for beginning removal of the spent fuel from the K Basins slipped substantially. Continued effort on the part of DOE and its contractors has resulted in identification of further schedule

slippage. The DOE has repeatedly asserted, and the Board agrees, that no significant technical issues stand in the way of successfully completing removal of the spent fuel from the basins. Unfortunately, poor project management continues to plague the project.

BACKGROUND

At the Hanford Site in Washington State, contractors for the Department of Energy (DOE) and its predecessor agencies operated nine different reactors for the purpose of generating plutonium for use in nuclear weapons. Spent reactor fuel elements, highly radioactive and thermally hot from reactor operations, were removed from the reactors and temporarily stored in pools where they could be cooled before being reprocessed to remove the plutonium and uranium. Generally, the cooling period was relatively short — only long enough to permit the radiation to drop to a level that would permit the fuel elements to be handled with less danger to the workers and less radiation damage to processing chemicals. To facilitate dissolution of the fuel elements during reprocessing, reactor designers intentionally made the thickness of the fuel's protective cladding thinner than that used in commercial fuel. It was never contemplated that the fuel elements would be stored in the basins for extended periods — and certainly not for decades.

The KE and KW Basins, located in the 100-K Area of the Hanford site, served KE and KW Reactors from 1956 until the reactors were shut down in 1970 and 1971, respectively. After shutdown, all KE and KW Reactor spent nuclear fuel was reprocessed. The basins then remained idle, still filled with water, until 1975, when spent fuel from N Reactor was transferred into KE Basin. N Reactor spent fuel shipments to KE and KW Basins continued until 1990.

Concurrently, from 1984 to 1990, much of the spent fuel in KE and KW Basins was shipped to the Plutonium-Uranium Extraction (PUREX) Plant for reprocessing. Reactor operations were curtailed at Hanford in 1987. The PUREX Plant was shut down in 1990. In retrospect, this was a mistake. The loss of PUREX reprocessing capability left KE and KW Basins with approximately 2,100 metric tons of spent fuel in storage. The basins were designed for temporary storage of the fuel, i.e., no more the 2 - 3 years. As of today, some of this fuel is as much as 25 years old. This extended storage time, as well as the thinner cladding, has provided an environment favorable for the excessive corrosion and deterioration of the fuel.

In December 1989, the Board inspected the K Basins and observed firsthand the deteriorating condition of the fuel and the generally poor condition of the facility. In the KE Basin, the fuel is stored in open stainless steel or aluminum canisters and is exposed to the basin water. Much of the fuel is visibly broken and heavily corroded. A large sludge layer consisting of oxidized fuel, a significant amount of uranium, as well as other radionuclides, covers the bottom of the basin. In the KW Basin, the fuel is stored in covered, but still water-filled, stainless steel or aluminum canisters. Although the radionuclide concentration in the KW Basin is significantly lower than that in the KE Basin, excessive storage time has contributed to some fuel corrosion.

The radionuclide content in the basin water, particularly in the KE Basin represents a radiation hazard to the workers who must continue to maintain the facility and monitor the fuel. Additionally, in the past, the aging KE Basin has leaked and may do so again. The K Basins are located as close as 440 yards to the Columbia River and represent a risk to the public and the environment. If the basins were to leak again, it is likely that

radioactive contamination would reach the river. Moreover, the structural integrity of the basins would be severely challenged in a seismic event. A large leak resulting from an earthquake would likely have severe consequences to the river.

SPENT NUCLEAR FUEL PROJECT SCHEDULE

Before 1994, DOE planned to reencapsulate the fuel for continued storage in the basins. A milestone in the Tri-Party Agreement, Hanford's Federal facility compliance agreement, required that the fuel be removed from the basins by 2002, but actions to accomplish this goal were only vaguely defined. The Board pointed out the lack of a technical basis for DOE's planned course of action and urged DOE to identify engineering alternatives, the criteria for selecting an alternative, and the anticipated radiological consequences of proposed actions to resolve the recognized safety issues. Most distressing to the Board was the lack of urgency exhibited by DOE to take action to rectify the deteriorating situation at the K Basins. At the urging of the Board, DOE directed the contractor, Westinghouse Hanford Company (Westinghouse), to create a dedicated project team with a technically strong manager to run the new Spent Nuclear Fuel Project and to give the project the urgency it deserved.

After a complex-wide Board review of spent nuclear fuel storage in 1993, the issuance of DNFSB/TECH-1, *Plutonium Storage Safety at Major Department of Energy Facilities* (April 14, 1994), and a DOE study on spent nuclear fuel vulnerabilities completed in November 1993, the Board issued Recommendation 94-1. This recommendation called for complex-wide effort to accelerate the stabilization of plutonium-bearing compounds and spent nuclear fuel, particularly the fuel currently stored in the K Basins. Stabilization of the

spent nuclear fuels requires that it be treated in such a manner as to be essentially non-reactive with its surroundings. The fuel must also be stored such that the risk of contamination of the environment is minimal.

In February 1995, in response to Board Recommendation 94-1, DOE submitted its Implementation Plan for achieving these goals. In accordance with this implementation plan, the initial schedule for the Spent Nuclear Fuel Project was aggressive and was designed to initiate fuel retrieval by December 1997 and complete removal and stabilization of the fuel by December 1999. This DOE commitment to complete fuel retrieval by December 1999 was more than two years sooner than originally planned by DOE.

In October 1996, DOE changed contractors and adopted a Management and Integration approach for the lead contractor for the Hanford Site. The Management and Integration contractor does not perform the actual work, but rather, serves as the manager and general contractor of major subcontractors who do the work. Fluor Daniel Hanford (Fluor) was awarded the integrating contract with the overall responsibility for the work of five subcontractors. Fluor is responsible for issuing direction to the subcontractors and coordinating their efforts in order to meet the contract requirements stipulated by DOE. The major subcontractor responsible for the Spent Nuclear Fuel Project is Duke Engineering and Services Hanford (Duke).

Upon taking over the Spent Nuclear Fuel Project from Westinghouse, Duke determined that the project did not have a current validated integrated schedule. In January 1997, Duke completed a Technical Baseline Validation that determined that the schedule would be five months delayed, moving the scheduled start of fuel retrieval to May 1998. Part of this delay was reportedly because of a number of technical issues including the realization

that the fuel in KW Basin, thought to be in better condition than that in KE Basin, was also corroded and its retrieval would require a water treatment system. The five-month delay was formalized in the Hanford Multi-Year Work Plan issued in April 1997.

As work progressed, Duke management determined that the schedule, already delayed by five months, was at risk. A schedule risk assessment was completed in August 1997 to develop a schedule with greater chance of success. Duke concluded in August 1997 that an additional fourteen months would be required before the start of fuel retrieval. Initiation of fuel retrieval was now delayed to July 1999. At the time, Duke reported that the confidence in this schedule was less than 20%. Despite repeated demands from DOE for technical justification for this schedule change, Fluor did not pass on Duke's baseline change request until December 1997. By that time, it was already apparent that additional problems were delaying the project further.

In March 1998, DOE provided a letter to Fluor critical of the contractors' management of schedule and technical issues. The letter took serious issue with Fluor and Duke's ability to produce adequate design and safety documentation in a timely manner. In the letter, DOE requested that Fluor provide an updated schedule and path forward for the project. This information was to be used during negotiations with the State of Washington and the Environmental Protection Agency to commit to project milestones as part of the Tri-Party Agreement. Preliminary indications from Fluor are that an additional 16-month delay in the start of fuel retrieval may be encountered.

If this further delay is realized, the date for initiation of fuel retrieval will be moved to November 2000, a delay of 35 months beyond the

original date of December 1997 committed to in the Department's 94-1 Implementation Plan.

SPENT NUCLEAR FUEL PROJECT DESCRIPTION

The fundamental strategy of the Spent Nuclear Fuel Project is to retrieve the fuel from the basins, package it in storage containers, remove all excess water and sufficient chemically bound water to inhibit reaction with the fuel, and then temporarily store it in a facility at the Hanford Site awaiting final disposition. In the early stages of planning, Westinghouse originally pursued a strategy of reencapsulating the fuel in newer containers, still in the basins. In 1994, at the urging of the Board, DOE commissioned MAC Technical Services Co., Inc. to perform an independent technical assessment to investigate an alternate storage scheme as a potential path forward for long-term interim storage. The assessment was led by John C. DeVine, an expert experienced in the recovery of degraded fuel from the Three Mile Island nuclear power plant. The assessment was completed in September 1994 and its report, *Dry Storage of N Reactor Fuel, Independent Technical Assessment*, recommended that, for the Hanford spent nuclear fuel, dry storage be pursued. The report concluded that dry storage would provide a more stable environment for the fuel, minimize the potential for release to the environment, and be more cost effective.

A critical consideration in any dry storage strategy is the risk of flammable gas generation from interaction of the fuel with any residual water in the canister. To mitigate this risk, from 1995 until 1996, Westinghouse pursued a strategy using a hot drying step, termed Hot Conditioning, and vented fuel storage containers. Then, after objection by DOE to the amount of continued surveillance required, Westinghouse changed its approach to one that

used sealed containers with pressure relief capability. Hot Conditioning was still required.

Because of the assumed possibility of release of flammable gas, both of these strategies required significant surveillance and facility operation costs that were not desired by DOE. Included in these costs were those required to support inert handling equipment, particularly in the interim storage facility. The strategy requiring Hot Conditioning was based on conservative calculations that predicted the development of high hydrogen gas pressures within the fuel canisters during storage and the potential for escape of hydrogen to the environment. The calculations assumed significant water would remain following the initial drying step until the Hot Conditioning was performed. The equipment needed to implement this strategy was complex and expensive to design and build, and also complex to operate. A technical review was performed to determine if the process could be simplified. As more data became available demonstrating the excessive conservatism used in the original calculations, a new strategy was developed to seal the storage canisters without pressure relief after the initial drying step and to eliminate the Hot Conditioning step. Consequently, much of the inerting equipment design was also eliminated.

In a letter to Fluor dated November 3, 1997, DOE formally ordered the above strategy to be pursued. Currently, the following are the major components of the Spent Nuclear Fuel Project:

Fuel Retrieval System. This system consists of remotely operated equipment and a sorting table that operators will use to remove spent nuclear fuel from existing storage canisters, clean the fuel, then sort and repackage the fuel into baskets of fuel elements and scrap pieces. The freshly loaded

spent fuel and scrap baskets will then be loaded into a Multi-Canister Overpack staged in the south load-out pit of the basin.

Integrated Water Treatment System. This system is a treatment system that pumps water laden with sludge and soluble contaminants away from the Fuel Retrieval System. Solid particles will be removed by knock-out pots, settling tanks and sand filters to prevent them from degrading basin water clarity. Soluble compounds will be removed by ion exchange. The treated water will then be returned to the basin.

Multi-Canister Overpack and Transportation. The Multi-canister Overpacks are cylindrical, stainless steel containers that will each carry six spent fuel baskets (nominally 5 fuel baskets and one scrap basket) and hold the fuel during shipment, conditioning and interim storage at the Canister Storage Building. During fuel removal from the basins, spent fuel conditioning, and transportation, the Multi-canister Overpack will always be inside a shielded shipping cask. The Multi-canister Overpack and shipping cask will be secured on a specially designed transport trailer during transportation and fuel conditioning.

Cold Vacuum Drying Facility. This facility, adjacent the K Basins, will include four processing bays where the Multi-canister Overpacks will be drained of free water. The spent fuel, still inside the Multi-canister Overpack, will then be conditioned (dried) at temperatures up to 50° (Celsius) and at a vacuum of less than 0.1 torr to remove additional free water and chemically bound water.

Canister Storage Building. This building is located in the 200 East Area of the Hanford site, approximately ten miles from the K Basins. It is

designed to provide interim storage of conditioned spent fuel for up to 50 years. The Canister Storage Building consists of three large underground storage vaults and an enclosed operating building that houses a receiving crane and a large, shielded bridge crane for handling the Multi-canister Overpacks. The first vault will hold all of the Multi-canister Overpacks from the Spent Nuclear Fuel Project and consists of 220 storage tubes that extend down 40 feet below the operating deck. Each storage tube is designed to hold 2 Multi-canister Overpacks and be cooled by natural circulation air flow.

BOARD SAFETY OVERSIGHT

The Board was created to review the design, construction, operation, and decommissioning of DOE's defense nuclear facilities to ensure that the activities at those facilities are conducted in such a way that the health and safety of the public, including the environment and workers, are protected. The Board and its staff routinely conduct reviews of conditions across the complex to identify potential health and safety concerns. One of the Board's primary action-forcing mechanisms is to issue formal recommendations to the Secretary of Energy where safety improvements can be made. However, ultimate responsibility for the design, construction, and operation of the defense nuclear complex rests with DOE. The Board does not manage DOE's work, but rather reviews DOE's activities and communicates to the Department where it sees risks to health and safety.

The Board considers the threat to the public, the workers, and the environment from the continued storage of the deteriorating spent nuclear fuel to be one of the greatest risks in the defense nuclear complex today. Because of the condition of the fuel and the age and condition of the facilities in

which it is stored, the K Basins represent a risk to the workers who are in the facility daily and they represent an additional risk to the environment, particularly the Columbia River. Every day the fuel is allowed to exist in these storage conditions, corrosion of the fuel continues thereby increasing the source term of potentially dispersible radioactive material. The basins continue to age, increasing the possibility of leakage. Additionally, because the facility is not fully seismically qualified, an earthquake could result in major basin leakage and severe contamination of the environment. Any delay in the fuel removal schedule to which DOE and its contractors are working is a safety issue of concern to the Board.

Since its inception, the Board Members have taken 28 trips to the Hanford Site, most of which included inspections and briefings associated with the K Basins. The Board's staff has taken 39 trips to Hanford to review the Spent Nuclear Fuel Project and the conditions at the K Basins, and has written 28 separate technical reports. Initial efforts of the Board and its staff concentrated on the material condition of the basins, the excessive dose to the workers resulting from the contaminated basin water, and the threat of basin leakage. Largely as a result of Board and staff interaction, DOE has made some improvement in the storage conditions at the basins. For example, as a result of the Board's urging, Westinghouse installed barriers to isolate the spent fuel and sludge from the seismically vulnerable and leak-prone basin chute. Additionally, the water temperature and the chemistry in the basins are now better controlled to minimize continued corrosion.

Since 1994, the Board has maintained coverage at the Hanford Site with the use of full-time resident Site Representatives. Currently the Board has two full-time Site Representatives assigned to the Hanford Site. The Site Representatives maintain daily cognizance of the Spent Nuclear Fuel Project

including attending management meetings, performing technical reviews, and conducting general inspections of the facilities. The Site Representatives communicate their findings in official weekly reports to the Board and in more frequent direct means of communication.

When the Board was made aware of the overall 19-month delay in the Spent Nuclear Fuel Project in August 1997, the Board directed its staff to perform a detailed review of the project. The purpose of this review was to determine the cause of the significant delays and identify any means of schedule improvement. In late September 1997, members of the Board staff traveled to the Hanford Site for this review. The findings of this review were documented in DNFSB/TECH-17, *Review of the Hanford Spent Nuclear Fuel Project,* a copy of which is attached to this testimony. The fundamental conclusion of TECH-17 was that the significant delays encountered in the Spent Nuclear Fuel Project were the result of poor project management through all levels, including DOE. Communication is poor, resolution of technical issues is protracted, and the quality and timeliness of design and safety documentation are poor. These problems persist today.

An example of the continued poor project management is the loss of cost control of subcontractor expenditures, resulting in a projected shortfall in Fiscal Year 1998 funding and a contractor initiated deferral of some currently planned work to Fiscal Year 1999 with a significant project delay. Poor communication among all parties is evident in the continuing impasses over the shared expectations of the quality and content of the safety analysis documentation, which are essential to safe operations, and are currently on the project critical path. Timely resolution of technical issues still remains elusive, as evidenced by the proposed date of September 1998 for completion of the safety approach to address the aluminum hydroxide coating on

some of the spent fuel elements that were discovered last summer.

The response of the DOE to DNFSB/TECH-17 report was provided to the Board on March 31, 1998. This response was found to be deficient. It did not provide a critical and comprehensive joint evaluation by DOE and its contractors of past problems and effective solutions. One of the most important suggestions of TECH-17 was the need for a frank and thorough evaluation of past problems, identification of root causes, and implementation of needed changes by all involved parties. Instead, there have been segmented, incomplete evaluations, the root causes have not been identified, and corrective actions have not resulted in significant project improvement.

PATH FORWARD

DOE is currently negotiating with the Washington Department of Ecology and the Environmental Protection Agency to establish revised Tri-Party Agreement milestones for the initiation and completion of the removal of the spent fuel from the K Basins. Concurrently, DOE must formally provide the Board with a revised Implementation Plan for Recommendation 94-1. The Board and its staff will continue to pay close attention to this issue and ensure that DOE’s corrective action plans are sound and show an urgency commensurate with the risk of continued storage of the deteriorating spent fuel.

Thank you for the opportunity to report on the Board’s efforts to ensure that public and worker health and safety are adequately protected as DOE and its contractors attempt to remove, stabilize, and store the deteriorating spent nuclear fuel stored in the Hanford K Basins. I will be happy to answer any questions you may have.