DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004
(202) 208-6400

August 3, 1995

The Honorable Thomas P. Grumbly
Assistant Secretary for Environmental Management
Department of Energy
Washington, D.C. 20585

Dear Mr. Grumbly:

A Defense Nuclear Facilities Safety Board (Board) staff team visited the Savannah River Site on June 20-21, 1995, to review spent nuclear fuel activities related to implementation of Board Recommendation 94-1. They noted that dry storage for aluminum spent fuel is being considered as an alternative to chemical processing. The enclosed report identifies some issues that are not being adequately considered in the evaluation of remediation alternatives. In addition, the enclosed report identifies badly corroding foreign fuel that is currently categorized by the Department of Energy as stable.

Sincerely,

John T. Conway
Chairman

c: The Honorable Tara O'Toole
Mr. Mark Whitaker
Dr. Mario Fiori

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

July 14, 1995

MEMORANDUM FOR: G.W. Cunningham, Technical Director

COPIES: Board Members

FROM: J. Kent Fortenberry

SUBJECT: Spent Nuclear Fuel at the Savannah River Site (SRS)

1. **Purpose:** This report discusses the activities being pursued at the SRS to safely manage spent nuclear fuel, and documents a June 20-21, 1995, site visit.

2. **Summary:** Contrary to the Implementation Plan for Recommendation 94-1, it appears that dry storage is being considered as the preferred alternative to remediate Mark-16 & 22 fuel assemblies at the SRS. Although dry storage, as well as chemical separation, can achieve stable conditions, the following concerns could affect the decision to dry store this deteriorating fuel:

    a. The requirements for dry storage of highly enriched aluminum-clad spent nuclear fuel have not been developed. This represents a large uncertainty in the time and effort required to achieve dry storage and a large uncertainty in the time during which continued wet storage will be required.

    b. The waste acceptance criteria needed to transition dry stored aluminum-clad spent nuclear fuel to a geologic repository have not been developed. This raises the possibility of having to rehandle, repackage, or even process this material in the future to meet storage requirements.

    c. Lengthy delays needed to implement dry storage will extend by years the period of wet storage of the deteriorating spent fuel and allow continued corrosion. This will aggravate the problems of continued degradation, potential environmental insult, radiation exposure, and waste generation.

    In addition, corroding spent fuel in the Receiving Basin for Offsite Fuel (RBOF) is releasing more than twice the amount of fission products into the basin water than the corroding Mark-31 targets are releasing into the L-Basin. This significant corrosion is contaminating the facility, generating significant waste, and contributing to personnel exposure. Surprisingly, the Department of Energy (DOE) plans to keep the current inventory of fuel at RBOF in wet storage for the next 10 years. A more urgent response is merited.

3. **Background:** The Savannah River Site stores significant amounts of spent nuclear fuel. The general types of material are: Mark-31 targets (aluminum clad/uranium metal core), Mark-16 and 22 fuel assemblies (aluminum clad/aluminum-uranium core), research reactor fuel assemblies (various types of aluminum, zircalloy and stainless steel clad fuel), and miscellaneous targets and nuclear materials. DOE's plans for the disposition of this spent nuclear fuel at the SRS are broadly outlined in the following five documents.

   The *Implementation Plan for Board Recommendation 94-1* outlines expedited actions to get deteriorating spent nuclear fuel at the SRS into a form suitable for safe storage. Specifically, DOE identified the "deteriorating reactor fuel" at the SRS to be the Mark-31 targets and the Mark-16 & 22 fuel assemblies. To meet the Board's recommendation, DOE proposed to stabilize Mark-31 targets and Mark-16 & 22 fuel assemblies by processing in F-Canyon and H-Canyon. Stabilization of this fuel is required to prevent environmental insult resulting from suspected chronic leakage or potential seismic induced catastrophic failure of the basins, continuous waste generation resulting from corroding fuel, chronic radiation exposure resulting from basin water activity, and increased remediation difficulties as fuel and facilities continue to degrade.

   The *Plan of Action to Resolve Spent Nuclear Fuel Vulnerabilities* provides corrective actions to address facility vulnerabilities at the SRS spent nuclear fuel storage facilities: namely, improvements in water quality, water treatment systems, water level monitoring systems, and facility operation and safety basis. This plan of action has, for all practical purposes, been incorporated into the Implementation Plan for Board Recommendation 94-1.

   The *Programmatic Spent Nuclear Fuel Environmental Impact Statement* (and corresponding Record of Decision) outlines a plan to consolidate all of the DOE aluminum-clad fuel, including the aluminum based Foreign Research Reactor spent nuclear fuel, at the SRS.

   The *SRS Interim Management of Nuclear Material (IMNM) Environmental Impact Statement (EIS)* addresses interim (10 years) management of both the deteriorating fuel and the fuel considered to be stable at the SRS. This EIS looks at alternatives for continued wet storage, future dry storage, and chemical separation.

   The *Foreign Research Reactor (FRR) Spent Nuclear Fuel EIS* examines the management of spent nuclear fuel from foreign research reactors over the next 30 to 50 years, or until ultimate disposition. This EIS looks at storage alternatives such as wet storage, dry storage, chemical separation, and other types of processing.

4. **Discussion:** Consistent with DOE's Implementation Plan for Recommendation 94-1, the draft SRS IMNM EIS identified a preferred alternative to process and chemically separate the Mark-31 targets and the Mark-16 & 22 fuel assemblies. A final EIS was to be issued in May 1995, and a Record of Decision was then to be issued by July 1995. However, the preferred alternative for remediating the deteriorating Mark-16 & 22 fuel assemblies is now

being reconsidered. DOE is considering revising its remediation plans such that the Mark-16 & 22 fuel assemblies would be placed into dry storage for the next 30 to 50 years, rather than processed by chemical separation. Dry storage, as well as chemical separation, can achieve stable conditions. However, lengthy delays needed to implement dry storage will extend by years the period of unstable wet storage.

The deterioration seen in the aluminum-clad spent fuel at SRS is due to corrosion during wet storage. Scratches and imperfections in the aluminum cladding, the storage configuration (providing galvanic coupling), and high water conductivity have resulted in significant pitting corrosion. Conditions in the K-Basin during 1992-93 were shown to cause pitting depths penetrating 30 mils of aluminum cladding after only 45 days.

The water quality at the SRS reactor basins has been improved recently. Conductivities are being reduced, but remain in the range of 100 - 160 μmho/cm (typical fuel storage basins that have good water chemistry maintain a water conductivity near 1 μmho/cm). One source of high conductivity is the basin sludge. Sludge removal is planned at the Savannah River basins, but will not occur until late in 1997. Meanwhile, sludge is being vacuumed and consolidated in the basins. A one time "shock" deionization of the K- and L-Basins will be performed in 1996 and continuous deionization systems will then be installed. These activities will significantly improve water quality, but plans to extend wet storage should prompt more expeditious actions to control water chemistry.

Initial evaluations of the dry storage alternative estimated that the transfer of Mark-16 & 22 fuel assemblies to a dry storage facility could begin late in the year 2004. Even with maximum compression of the schedule, with many aggressive assumptions, the transfer of fuel to dry storage would not start until late in the year 2000. These long delays conflict with the Board Recommendation 94-1, and the entire concept is at variance with the Secretary's Implementation Plan for Recommendation 94-1. At best, the start of fuel removal from the basins would be delayed four years. At worst, the delay could exceed a decade. During this additional time required to implement dry storage, the deteriorating fuel would have to remain in wet storage. Improvements in water quality, if aggressively pursued and maintained, should reduce the initiation of new pitting corrosion during this extended storage period. However, pits, once initiated, tend to contribute to a local water chemistry that is more corrosive than the average basin chemistry. Because of this, further corrosion in existing pits will likely continue as long as the fuel is stored in water.

There seems to be a general consensus that aluminum-clad spent nuclear fuel can be stored safely in a dry condition. However, the experience with the dry storage of aluminum-clad spent nuclear fuel is very limited. DOE will have to develop technical and regulatory acceptance criteria for dry storage of this fuel. DOE's Spent Nuclear Fuel Technology Integration Plan has identified the need for technology development relative to controlling fuel corrosion, acceptable moisture conditions, hydrogen limits, fission product gases, criticality requirements, temperature limits, and blanket gas limits. Technology development needs were also identified for characterizing the fuel, and for transfer and interface equipment. The initial schedule for dry storage assumes that development will proceed smoothly and estimates that ten years will be required to begin transferring fuel to dry storage. It is clear that there is significant uncertainty in this schedule.

After an interim period of dry storage (30 to 50 years), the aluminum-clad fuel would be transferred to ultimate disposal under the commercial spent nuclear fuel program. If appropriate waste acceptance criteria are not developed, or if extended wet storage causes significant degradation of the fuel, transitioning to ultimate disposal could be difficult. The commercial spent nuclear fuel program has expended considerable resources evaluating performance and developing waste acceptance criteria for spent commercial nuclear fuel in a geologic repository. There have been no such efforts for the highly enriched aluminum-clad fuel. Questions of fuel disintegration and criticality have not been explored. One could foresee the possibility of having to rehandle, repackage, or even process the fuel in order to transition from dry storage to ultimate disposal.

The deteriorating spent nuclear fuel at the SRS has been identified as the Mark-31 targets and the Mark-16 and 22 fuel assemblies. No other material is considered by DOE to require stabilization within the next ten years. However, corroding fuel in RBOF is releasing about twice the amount of fission products to the basin water as is being released to the L-Basin. Spent fuel stored in a vented canister at RBOF was observed by the Board's staff to be releasing a significant amount of gas (not just an occasional bubble). The significant ongoing corrosion of this fuel merits a more urgent response than the continued storage action proposed by DOE.

5. **Future Staff Actions:** The staff will continue to assess activities being pursued at the SRS to manage spent nuclear fuel. As described, these actions include improving wet storage conditions, as well as stabilizing deteriorating fuel. The staff will specifically follow actions taken to resolve the significant corrosion of fuel in RBOF.