March 23, 2001

The Honorable Spencer Abraham
Secretary of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Abraham:

The Defense Nuclear Facilities Safety Board (Board) has been following closely the Department of Energy's (DOE) response to recently discovered leaks in Tank 6, a high-level waste (HLW) storage tank at the Savannah River Site (SRS). While this issue must be addressed on a specific basis, it is only a symptom of a much larger problem—the critical shortage of tank space in the HLW system—that threatens to delay stabilization of nuclear materials at SRS and may result in suspending vitrification of HLW at the Defense Waste Processing Facility (DWPF). Furthermore, this problem has led to a reduced margin of safety and a short-sighted emphasis on solving immediate problems at the expense of investing in comprehensive efforts to enhance the safety and flexibility of the HLW system.

As a result, the Board, on March 23, 2001, unanimously approved Recommendation 2001-1, *High-Level Waste Management at the Savannah River Site*, which is enclosed for your consideration. After your receipt of this recommendation and as required by 42 U.S.C. § 2286d(a), the Board will promptly make it available to the public in DOE's regional public reading rooms. The Board has confirmed with DOE that the recommendation contains no information that is classified or otherwise restricted. Providing this recommendation does not include information restricted by DOE under the Atomic Energy Act of 1954, 42 U.S.C.
§§ 2161-68, as amended, please arrange to have it promptly placed on file in your regional public reading rooms. The Board will also publish this recommendation in the *Federal Register*.

Sincerely,

John T. Conway
Chairman

Enclosure

c: The Honorable Carolyn L. Huntoon
Mr. Mark B. Whitaker, Jr.
Mr. Greg Rudy

**DEFENSE NUCLEAR FACILITIES SAFETY BOARD**
**RECOMMENDATION 2001-1 TO THE SECRETARY OF ENERGY**
**Pursuant to 42 U.S.C. § 2286a(a)(5)**
**Atomic Energy Act of 1954, As Amended**

**Dated: March 23, 2001**

## Background

The mission of the Savannah River Site (SRS) high-level waste (HLW) system is to safely store and treat HLW while also supporting site initiatives such as the stabilization of remnants of nuclear weapons production. Storage of HLW is provided by 49 tanks, referred to collectively as the Tank Farms, which contain approximately 34 million gallons of HLW. Presently, treatment primarily consists of waste concentration in evaporators and sludge vitrification at the Defense Waste Processing Facility (DWPF). DWPF currently produces more than 225 vitrified waste canisters per year and during its lifetime is expected to produce a total of approximately 6,000 canisters. Recently, the most pressing challenge at the SRS Tank Farms has been managing available tank space.

Average annual waste inflow to the Tank Farms totals approximately 2.5 million gallons, generated primarily from vitrification activities and nuclear material stabilization. The largest portion of the inflow, approximately 1.3 million gallons, is the DWPF return waste stream (DWPF recycle). Another 500,000 gallons consists of sludge wash water, generated during the preparation of sludge feed to DWPF. Nuclear material stabilization operations at the chemical processing canyons generate approximately 600,000 gallons of annual inflow, and another 100,000 gallons is generated through several miscellaneous operations.

Reducing the volume of waste in the Tank Farms is currently accomplished primarily by concentrating dilute waste through evaporation. The operation of all three Tank Farm evaporators can reduce the required storage volume by more than 2.5 million gallons annually. However, the evaporators have recently experienced significant problems, limiting the two newest and highest-capacity evaporators to little or no operation. The vitrification of sludge at DWPF does not reduce the volume of waste in the Tank Farms because the volume of DWPF recycle and sludge wash water returned to the Tank Farms is significantly greater than the volume of sludge removed. The lack of adequate volume reduction, combined with the waste produced during vitrification operations, has led to a situation in which available tank space has steadily decreased.

Contributing to the tank space problem is an emphasis on the operation of the DWPF at the expense of the overall operability of the Tank Farms. This situation is evident in the HLW Performance-Based Incentives in the contract, which are weighted more than 60 percent toward the production of vitrified waste canisters. Tank space has now been reduced to a critically low level, which threatens to halt DWPF vitrification.

Several options have been identified at SRS which could help alleviate the tank space shortage. These include operation of a salt processing facility, reduction or elimination of the DWPF recycle stream, recovery of former In-Tank Precipitation (ITP) Facility process tanks for HLW operation, and solution of problems that have significantly limited evaporator operation. These options are discussed in more detail below.

**Salt Processing**

An essential element missing from the current HLW treatment operations is salt processing. Salt processing would remove key radionuclides from HLW liquids and saltcake, allowing the remaining large volumes of water and soluble salts to be disposed of as low-level waste. The design, construction, and operation of a salt processing facility would be required to solve the tank space problems at the Tank Farms. Originally, the contractor attempted to backfit a salt processing capability into three HLW tanks that became the ITP Facility. Conceived as a cost-effective approach toward salt processing, the project was suspended in early 1998 because of safety and operability issues.

Recognizing the urgency of continuing salt processing development, the contractor aggressively examined alternatives and, in 1999, recommended pursuing a modified precipitation process. DOE chose to delay a decision on this recommendation and directed the contractor to study the problem further. Now, more than 3 years after the cancellation of ITP, there is still no decision on the basic technology to be used for salt processing. The salt processing facility is currently delayed until at least 2010. The most recent milestone for this program, issuance of a draft request for proposals to design and build the facility, has been overdue since December 2000, primarily because of funding priorities.

**DWPF Recycle**

Currently, DWPF produces the largest volume of waste received at the Tank Farms. The combination of the waste generated within DWPF and the large volume of water and corrosion inhibitor added to make the waste acceptable for tank storage produces more than 1 million gallons of DWPF recycle each year. The contractor has long recognized that very large volumes of waste were being sent from DWPF to the Tank Farms, and many planning documents suggest that an evaporator could be installed at DWPF to nearly eliminate the recycle stream. However, DOE has never pursued this activity.

In 1999, a contractor system engineering team again recommended that an evaporator be used to eliminate DWPF recycle, but also requested that DWPF staff consider other means of reducing the recycle volume. Through modification to the facility, the DWPF staff found ways to reduce the recycle volume from more than 2 million gallons per year to the present level of approximately 1.3 million gallons per year.

This great volume savings notwithstanding, the DWPF recycle continues to place a significant strain on the HLW system. DWPF recycle generates the largest volume of waste receipts, and silicates contained in the recycle have been found to cause significant problems with the evaporators.

**Former ITP Process Tanks**

Approximately 3 million gallons of tank space could be added by returning Tanks 48, 49, and 50 from the former ITP Facility to HLW service. During the development of the ITP process, these modern, fully compliant tanks were dedicated exclusively to ITP service. The contractor has planned to recover Tanks 49 and 50 for some time, but progress has been slow. The contractor is working to return Tank 49 to HLW service this year. However, restoration of Tank 50 is not being aggressively pursued, and the tank is not scheduled to be available until the end of 2002. There are currently no plans for near-term recovery of Tank 48, which contains tetraphenylborate precipitates generated during ITP process testing. Although recovery of Tank 48 poses significant technical issues, restoration of Tank 50 is limited primarily by the resources applied to the effort.

**Evaporator Operation**

The three HLW evaporators (2F, 2H, and 3H) have the combined capacity to recover more than 2.5 million gallons of tank space per year and are needed to provide sufficient tank space to support Tank Farm operation until a salt processing facility becomes operational. However, the actual productivity of the evaporators has been severely limited by waste compatibility issues and degradation of equipment.

**Waste Compatibility Issues**—In late 1999, the contractor discovered unexpected solids accumulating in the 2H evaporator pot. These solids are believed to be generated by silicates in DWPF recycle reacting with aluminum in canyon wastes. The deposits contain enriched uranium and present a potential criticality hazard. The 2H evaporator has been shut down since January 2000 while this issue is being resolved.

The contractor is working to remove these deposits and restart the 2H evaporator by July 2001. In the meantime, DWPF recycle waste, as well as other wastes high in silicon content, are prohibited from the 2F and 3H evaporator systems until the mechanism of the deposition has been understood and a solution devised.

Tritium is found in many of the HLW tanks and continues to enter the Tank Farms as the result of spent nuclear fuel processing at the SRS canyon facilities. The concentration of tritium varies from tank to tank. Tritium passes through the system during HLW pretreatment and evaporation, eventually being released at the Effluent Treatment Facility. Evaporator operations are limited on occasion by the need to coordinate Tank Farm activities and monitor the tritium levels to prevent the release of tritium from the system in excess of release limits. Like the silicate problem, the need to segregate tritiated waste streams adversely affects the ability to use tank space efficiently.

**Equipment Issues**—Several emergent equipment issues have also limited the ability of evaporators to concentrate waste. In 1999 and 2000, startup of the 3H evaporator was delayed for months because of problems with a valve in the system. In November 2000, the contractor discovered that all five of the cooling coils for the tank that receives concentrate from this evaporator were leaking.

Because of temperature limits in this tank, the 3H evaporator, which is the newest and highest-capacity evaporator, is now limited to only a few days of operation each month.

Because of the problems with the 2H and 3H evaporators, operation of the 2F evaporator is now providing most of the space gains for the HLW system. The 2F evaporator pot has been in service for more than 10 years and has exceeded its designed service life. Failure of this pot would further reduce the ability to regain space in the Tank Farms. Additionally, the contractor's plan for handling space issues during the next few years relies heavily on the ability to perform many inter-area transfers (i.e., between F- and H-Areas). Significant failures of equipment or systems associated with the inter-area transfer system would also impact the Tank Farm system.

Many of the significant equipment issues identified with the Tank Farms were unexpected. However, given the age of the HLW system at SRS, it is likely that additional significant issues will be identified in future years.

**High-Level Waste Tank 6**

In late 2000, the contractor evaluated various short-term alternatives for addressing the lack of tank space threatening to shut down DWPF operations. The alternative chosen started with a transfer of 330,000 gallons of DWPF recycle to Tank 6, a 1950s-vintage Type I tank. Although 5 of the 12 original Type I tanks had already leaked, the prior service of Tank 6 and primary tank wall inspections indicated that the tank was sound. Before the transfer to Tank 6, the contractor made preparations to pump liquid from the tank annulus back into the primary tank in the event of a large leak. In January 2001, shortly after the transfer to Tank 6, the contractor discovered approximately 90 gallons of liquid in the tank annulus and, upon further video inspection, found 6 leak sites on the primary tank wall.

After the primary tank wall, the next barrier to the release of waste is the 5-foot-tall annulus pan in which the primary tank sits. The annulus pan was not designed for the long-term storage of waste and cannot be adequately inspected. Therefore, the condition of the pan is not well known, and it cannot be relied upon as a long-term containment for liquid waste. If the annulus were to leak waste to the environment, it would likely take several years to detect the leak through the use of external monitoring wells.

DOE and the contractor have thus far proposed transferring only that portion of waste in Tank 6 above the three highest, most visibly active, leak sites. The waste level would remain above the other three leak sites. DOE and the contractor prefer this course of action because it would have the least impact on the operation of DWPF, in that it would minimize waste transfers from Tank 6 into tanks that would otherwise receive DWPF recycle or sludge wash water. However, this course of action represents a reduction in the margin of safety in the containment of liquid HLW. Furthermore, because of the elevated tritium content in the waste, the contractor plans to continue storage in Tank 6, and avoid transfers to other tanks and evaporators until additional space becomes available in Tank 8 in approximately two years.

The use of Tank 6 to alleviate pressing storage problems is an example of the need to fall back on doubtful engineering solutions for short-term mitigation of problems at SRS. Lack of sound engineering inevitably narrows desirable options.

**Recommendation**

In the Board's view, DOE has not proceeded with due diligence to address the worsening condition of the SRS Tank Farms. Continued delays in achieving long-term solutions increase the pressure to accept conditions that reduce the safety margin and increase operational complexity. The continuing reliance on old HLW tanks whose design would be unacceptable today, on support systems that have exceeded their design life, and on tanks known to have numerous cracks, has been required to manage the Tank Farms and to make partial progress toward the ultimate goal of immobilization of HLW. However, the Board is not convinced that continued storage of readily removable HLW liquid above known leak sites is necessary to achieve this goal. Accordingly, the Board recommends the following actions:

1. Initiate actions to remove transferable HLW liquid from Tank 6 to a level below all known leak sites.

2. Reassess the schedule and priority for selecting a technology for a salt processing capability, and vigorously accelerate the schedule leading to operation of a salt processing facility.

3. Develop and implement an integrated plan for HLW tank space management that emphasizes continued safe operation of the Tank Farms throughout its life cycle. This plan should include enough margin to accommodate contingencies and reduce overall programmatic risk. The plan should also restore operating margin to the Tank Farms by including action to:

    a. reduce or eliminate the DWPF recycle stream,

    b. recover former ITP tanks for Tank Farm operations,

    c. assess the desirability of adding an additional HLW evaporator to support Tank Farm operations,

    d. assess the feasibility of constructing new HLW tanks, and

    e. resolve waste compatibility and equipment degradation problems to allow unconstrained operation of the three existing evaporators.

4. Reassess contractor incentives to ensure that near-term production at DWPF is not overemphasized at the expense of safety margin in the Tank Farms.

Actions provided by this recommendation are known to the contractor and DOE. In fact, all of these actions either have been or are being pursued to some degree. However, the unfocused manner in which they are being pursued is evident in the continued year-to-year delays. Meanwhile, problems caused by these delays are being resolved in part through reductions in margins of safety.

Given the time-sensitive nature of the actions identified by this Recommendation, the Board suggests that the Secretary of Energy avail himself of the authority under the Atomic Energy Act to "implement any such Recommendation (or part of any such Recommendation) before, on, or after the date on which the Secretary of Energy transmits the implementation plan to the Board under this subsection." See 42 U.S.C. § 2286d(e).

John T. Conway
Chairman