DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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May 23, 2000

The Honorable Carolyn L. Huntoon
Assistant Secretary for
Environmental Management
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Dr. Huntoon:

The Defense Nuclear Facilities Safety Board (Board) is reviewing the Savannah River Site's plans for returning Tank 49, currently part of the In-Tank Precipitation (ITP) facility, to a high-level waste storage mission. Tank 49 contains benzene-generating byproducts of ITP process testing. If the benzene releases from the waste are not adequately controlled, a serious flammability hazard could result.

The Department of Energy (DOE) Savannah River Operations Office and Westinghouse Savannah River Company (WSRC) believe that the benzene that was retained in the waste has been released through agitation of the tank's contents using slurry pumps. The pump operations have shown that the amount of benzene retained was much larger than previously estimated, and that benzene release rates were also higher than predicted.

WSRC is developing plans to add a catalyst to Tank 49 to chemically decompose the remaining benzene-generating compounds in the waste. This proposed activity poses flammability hazards similar to the process testing addressed in Recommendation 96-1, *In-Tank Precipitation System at the Savannah River Site*, which remains applicable to the ITP facility. In order to perform this operation safely, a bounding hazards analysis must be performed based on an improved characterization of the contents of Tank 49, as well as a thorough understanding of the mechanisms and rates of benzene generation that may result from adding a catalyst to the ITP byproducts, the mechanisms for benzene retention and release in the Tank 49 slurry, the benzene retention capacity of the slurry, and the potential benzene release rates. The unforeseen results of the ongoing pump operations in Tank 49 stand as evidence that an improved understanding of these phenomena is needed before actions are taken to induce more rapid benzene generation in the tank.

The Board urges you to examine the proposed path forward for Tank 49 and ensure that the risks and uncertainties associated with the proposed operations are sufficiently understood, so that a bounding analysis of the hazards can be performed. The Board believes that, with an adequate control strategy based on clearly understood benzene generation, retention, and release phenomena, the operation can be performed safely.

The enclosed issue report summarizes the observations of our staff on these issues.

Sincerely,

John T. Conway
Chairman

c: Mr. Greg Rudy
Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

April 19, 2000

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: L. M. Jellett

SUBJECT: High-Level Waste Tank Space Management and Selection of Alternative Salt Treatment Process, Savannah River Site

This report documents issues reviewed by the staff of the Defense Nuclear Facilities Safety Board (Board) regarding the high-level waste (HLW) system at the Department of Energy's (DOE) Savannah River Site (SRS). The staff reviewed tank space management efforts and the selection of an alternative salt treatment process. The review was conducted on March 20–22, 2000.

The issues of tank space management in the HLW tank farms at SRS and the selection of an alternative to In-Tank Precipitation (ITP) for cesium removal from radioactive salt solutions are intimately connected. Only operation of a salt processing facility will alleviate the strain on the tank farms and eliminate the need for rigorous tank space management. Further delay in selecting a technology for cesium removal will continue to impact tank farm operations negatively.

Tank Space Management. Available space in the tank farms is currently below the desired minimum working space defined by the HLW program at SRS. Only the 2F evaporator is currently operating, because of a Potential Inadequacy in Safety Analysis (part of the SRS Unreviewed Safety Question process) regarding uranium-bearing solids in the 2H evaporator and operational problems with the 3H evaporator (Replacement High-Level Waste Evaporator). Receipts into the tank farms are being scheduled daily, based on available space. Recycle waste from the Defense Waste Processing Facility (DWPF) is currently being stored in Type IV (single-shell) tanks because of a lack of space in the Type III (double-shell) tanks. Only four Type IV tanks are available, and they are quickly filling up. If the evaporators are not running before the Type IV tanks are full, DWPF may be forced to slow or even stop operations, and sludge mobilization and washing activities could be delayed.

Resolution of two near-term issues would temporarily alleviate the strain on the tank farms: operation of the 3H evaporator, and the return of Tank 49—currently part of the ITP facility—to HLW service.

- *3H Evaporator*—Westinghouse Savannah River Company (WSRC) originally planned to start the 3H evaporator in October 1999. However, DOE did not authorize radioactive operations until December 1999, and operational difficulties have precluded

operation to date. The flush valve that flushes the gravity drain line from the evaporator bottoms tank back to the evaporator pot has been sticking and not functioning as designed. Testing and design modifications are under way to fix the problem; however, it is not known when the evaporator will be operational.

- *Tank 49*—Tank 49 currently contains wash water from the 1983 ITP process demonstration. It is being maintained in a nitrogen inerted atmosphere because of benzene generation and release from decomposition of dissolved tetraphenylborate (TPB). To return the tank to an HLW storage mission, the benzene hazard must be eliminated. WSRC plans to mix the tank using slurry pumps until the benzene stored in the tank has been depleted and the generation rate is minimal. At that point, WSRC plans to add copper catalyst, either directly or as copper-containing waste. Doing so will catalyze the decomposition of the remaining TPB daughter products (e.g., phenylboronic acid) to benzene.

  The slurry pump runs conducted to date have resulted in much higher benzene evolution rates than anticipated. WSRC expected evolution rates of 100 g/min; however, rates up to 650 g/min have been encountered. Prior to the slurry pump runs, WSRC believed that little or no benzene above the aqueous solubility limit of the waste was being retained in the tank. However, the pump runs indicate that significantly more benzene is being retained, and that the generation rates in the tank are potentially higher than indicated by laboratory experiments. The total benzene inventory in Tank 49 is still uncertain. The Board's staff believes it would be inadvisable to add catalyst to Tank 49 and generate potentially large quantities of benzene without a better understanding of the benzene inventory, generation, and retention mechanisms in the tank. Understanding of retention mechanisms also has implications for one of the proposed alternatives to ITP—small-tank TPB precipitation.

Recent SRS accomplishments have reduced the burden on the tank farms. The most notable of these accomplishments is a reduction in the DWPF recycle waste stream by approximately 800,000 gallons to date in fiscal year 2000. This reduction has been accomplished by increasing the efficiency of DWPF and isolating the melter off-gas steam atomized scrubbers. The scrubbers are designed for use during salt operations to remove cesium from the off-gas, and are not needed for the current sludge batch, which has a low cesium content. Future sludge batches may require scrubber operation. Further efforts to reduce the recycle waste stream are being pursued by DWPF. If successful, these efforts may eliminate the need to install a new evaporator in DWPF for the recycle stream.

Alternative Salt Treatment Process. The long-term solution to the tank space management problem is operation of a salt solution processing facility. However, progress towards choosing a technology to replace ITP for cesium removal from salt solutions at SRS remains slow. Research and development is ongoing, but no agency is coordinating the effort. The DOE Office of Environmental Management has recognized this problem and is forming a technical working group to provide oversight and direction for the technology selection effort. The team will consist of both DOE-Headquarters personnel and Savannah River Operations Office

representatives. It will be headed by the director of the headquarters Savannah River Office (EM-42), and will report to the Deputy Assistant Secretary for Project Completion (EM-40). The group's charter will include coordinating research and development, determining technology selection criteria, and finally choosing a technology in fiscal year 2001. DOE believes this schedule will allow the SRS salt processing facility to be designed, constructed, and operated in time to support the site's material stabilization and waste immobilization missions. The staff believes accomplishing this will prove to be a challenge.