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## DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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October 13, 1995

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

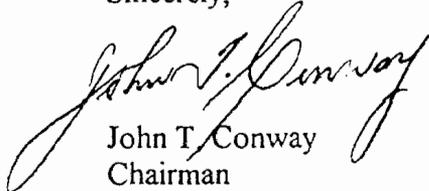
Dear Mr. Grumbly:

The Defense Nuclear Facilities Safety Board (Board) continues to closely monitor the actions of the Department of Energy (DOE) and Westinghouse Savannah River Company to resolve the safety bases of In-Tank Precipitation (ITP) Facility wash cycle operations. Specifically, assumptions in the safety analyses regarding benzene generation and release rates and vapor space mixing in tank 48 remain to be validated. The enclosed report includes observations from the Board's staff review on August 15, 1995, and is provided for your review.

The Board notes the actions taken to fabricate and install poles in tank 48 to monitor vapor concentrations and temperatures during non-wash Cycle 1 operations. However, based on the enclosed report by the Board's staff and a subsequent briefing of the Board by DOE and the Westinghouse Savannah River Company on September 21, 1995, the Board believes it would be prudent to consider using the vapor sample poles through Cycle 1 (including wash cycle operations) and higher activity cycles to ensure that high benzene concentrations do not develop during normal operations.

Please contact me or Mr. David Lowe of the Board's staff if you need any additional information or assistance.

Sincerely,



John T. Conway  
Chairman

c: Mr. Mark Whitaker  
Dr. Mario Fiori

Enclosure

## DEFENSE NUCLEAR FACILITIES SAFETY BOARD

August 23, 1995

**MEMORANDUM FOR:** G. W. Cunningham, Technical Director

**COPIES:** Board Members

**FROM:** David T. Moyle

**SUBJECT:** Savannah River Site In-Tank Precipitation Facility Safety Envelope Review - Trip Report (August 15, 1995)

1. **Purpose:** This report documents a follow-up safety envelope review of the In-Tank Precipitation Facility (ITP) at the Savannah River Site. The review was conducted by the Defense Nuclear Facilities Safety Board (Board) technical staff (D. Lowe, D. Moyle, J. Roarty, and R. Robinson) on August 15, 1995.
2. **Summary:** ITP is scheduled to start up non-wash Cycle 1 operations on August 31, 1995. In parallel with the startup, Westinghouse Savannah River Company (WSRC) is continuing to assess the safety of ITP wash cycle operations where uncertainty exists in benzene release rates and vapor space mixing. In the laboratory, benzene generation rate experiments have produced confounding results and WSRC is no longer planning to modify the conservative rates assumed in the safety basis until full-scale process data are obtained. Two sample poles have been fabricated and are being installed in tank 48 to collect vapor temperature and composition data at various heights from two risers during Cycle 1. Valuable information can be obtained from this testing and it is prudent to continue the acquisition of process test data until benzene generation rates and stratification phenomena are fully understood.
3. **Background:** This review was a follow-up to an ITP safety envelope review conducted on April 26, 1995. The trip report for that review was transmitted to the Department of Energy on June 14, 1995.
4. **Discussion:**
  - a. **Radiolysis Experiments:** Past experiments have determined that some of the benzene formed by radiolysis of tetraphenylborate (TPB) solids is released immediately while the remainder becomes trapped in the crystal lattice. These free and trapped benzene contributions can be assigned separate generation rates (G-values [molecules produced/100 eV]). The trapped benzene will build up until it is released by dissolving the TPB salt crystals during the washing stage of operations. Thus, large benzene releases can be expected during the wash cycle.

Benzene G-values have been determined by several experiments and calculated values vary over a range of three orders of magnitude. Different experiments have shown different transient free benzene release rate behavior--some measured G-values are relatively constant while others increase to a peak before decreasing to a steady state value. Furthermore, Georgia Institute of Technology tests, designed to explore trapped benzene release and mass transfer delay time, failed to measure any trapped benzene formation. While results are generally repeatable for a given experimental technique, conflicting data from different experiments cannot be explained easily. The most conservative generation rates were recorded by Professor Hanrahan, University of Florida, in the mid 1980s. He has recently been contracted as a consultant in the G-value resolution.

In light of the conflicting data, the WSRC G-Value Committee has decided to leave the conservative generation rates in the safety basis documentation until evaluation of in-tank data can be made. The Board's staff agrees with this approach and believes that the benzene formation and release phenomena require much greater understanding before any safety basis assumptions are relaxed. The Board's staff will continue to follow this issue.

- b. Vapor Mixing: All three-dimensional code runs to date have yielded results suggesting that the vapor space of ITP tank 48 will be well mixed during operations. Presently, parametric studies are underway to understand the conditions needed to produce stratification. This information may offer insight into the safety margin. However, there are still inherent problems with benchmarking the code and results must be carefully evaluated to ensure they are valid. Data obtained from sample poles during initial operations may help validate the code, and in the future it may be a useful tool in evaluating process or equipment changes.

A peer review committee of outside experts was formed to assess ITP flammability issues independently. Their final report concludes that benzene should not stratify during the Cycle 1 (including the wash cycle), but the safety margin is not well understood and may be small. The report predicts benzene fluxes required to overpower given thermal gradients that are the same order of magnitude as the maximum expected flux. Furthermore, the report states that if the flux off the liquid surface is spatially uneven, stratification may occur in localized regions and spread horizontally.

- c. Radioactive Operations Commissioning Tests: Savannah River Technology Center has fabricated two sample poles and is installing them into separate risers on opposite sides of tank 48. Each pole has the capability to collect vapor concentration and temperature data from eight vertical locations in the tank vapor space. Three of the eight sample points will be located at six, twelve, and eighteen inches above the liquid surface where higher benzene concentrations are expected. The test apparatus is impressively designed and

includes computer controlled sampling and data collection capabilities. This equipment will be useful in resolving benzene release and mixing uncertainties.

One major question that remains is when it is appropriate to exit the test program. WSRC is moving toward sample pole removal prior to the Cycle 1 wash, but a final decision will be based on the initial data obtained. The Board's staff believes that a more complete data set is needed to determine overall process safety. It would be prudent to use the vapor sampling poles through Cycle 1 and into higher activity cycles to assure that high benzene concentrations do not develop during normal operations.

5. **Future Staff Actions:** The Board's staff will continue to perform follow-up reviews as necessary to ensure that the flammability issues are resolved.