DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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June 29, 1994

The Honorable Victor H. Reis
Assistant Secretary for Defense Programs
Department of Energy
Washington, D.C. 20585

Dear Dr. Reis:

A Defense Nuclear Facilities Safety Board staff review team visited the Savannah River Site on June 6-8, 1994, and focused on the F-Canyon safety envelope. They noted that significant progress has been made in documenting the safety envelope, but there still are major issues that have not been resolved. In particular, the proposed safety envelope management database that will link safety requirements contained in authorization basis documents to implementing procedures is still under development.

The enclosed report is a synopsis of the observations made during the review and is forwarded for your information.

Sincerely,

John T. Conway
Chairman

c: The Honorable Tara O'Toole, EH-1
Mr. Mark Whitaker, Acting EH-6
Dr. Mario Fiori, Manager SR Operations Office

Enclosure

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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

June 14, 1994

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: David C. Lowe

SUBJECT: Savannah River Site (SRS) - F-Canyon Safety Envelope Review Trip Report (June 6-8, 1994)

1. **Purpose:** This trip report documents the Defense Nuclear Facilities Safety Board (DNFSB) technical staff (D. Lowe, J. Roarty, and J. Merwarth) and outside expert (J. Nichols of MPR Associates) June 6-8, 1994, review of the F-Canyon Safety Envelope.

2. **Summary:** Significant progress has been made by the Westinghouse Savannah River Company (WSRC) in developing and documenting the F-Canyon safety envelope since the DNFSB staff review of February 16-18, 1994. There are still, however, several open issues. In particular, the proposed safety envelope management database that will link safety requirements contained in authorization basis documents to implementing procedures is still under development. As currently being developed, it does not appear to the DNFSB staff that the linking database will meet its functional objectives.

3. **Background:** This review was a follow-up to a review conducted February 16-18, 1994. The issues from the February review were forwarded to the Department of Energy (DOE) in a Board letter dated March 25, 1994. The June review was based on the updated F-Canyon authorization basis documentation and their supporting analyses, and discussions with DOE Savannah River Operations Office (DOE-SR) and WSRC personnel.

4. **Discussion:**

   a. Authorization Basis Documentation: Revised Safety Analysis Report (SAR) Addendum 2 and Basis for Interim Operation (BIO) documents were prepared by WSRC and are undergoing DOE-SR and DOE headquarters (DOE-HQ) review. The following "potential positive Unreviewed Safety Questions (USQs)" have been included in the revised BIO and SAR Addendum 2, but resolution has not yet been achieved.

      - Organic-nitrate uncontrolled reactions
      - Hydrogen deflagration (radiolysis)
      - Am-Cm solution source term and potential accidents

- Cooling tower airborne release pathway
- FB-Line ventilation exhaust duct leak

Observations concerning the authorization basis documents are summarized below:

1. DOE-HQ prepared a Preliminary Hazard Analysis (PHA) which raised several accident scenarios that have not been addressed in the BIO, including:

   - Inadvertent puncture wound during sampling.
   - Siphoning of tank contents due to a double ended break in a cooling coil.
   - Suck-back incident in the gang valve corridor.

   WSRC stated that they determined that these scenarios were not credible, but technical justification for not including these scenarios has not been developed. The DNFSB staff believes that these scenarios must be addressed in the BIO or other appropriate document.

2. The Evaporation Technical Standard (DPSTS-221-FC-400) has a hydrogen concentration limit that corresponds to 90% of the lower flammability limit (LFL). ANSI/NFPA 69 (American National Standard Institute/National Fire Protection Association), *Explosion Prevention Systems*, states that flammable gas levels must be maintained below 25 percent of the LFL. WSRC committed to revise this Technical Standard.

3. The BIO identifies several additional safety-related systems and components, including agitation for six process vessels. The proposed method for indicating agitation is by measuring current to the agitator motor. However, this method does not provide positive indication of agitation (e.g., shaft rotating although paddles have fallen off). The Center for Chemical Process Safety (CCPS) *Guidelines for Engineering Design for Process Safety* states that an ammeter is not adequate to detect agitation stoppage and recommends an alternative method for indicating agitation. WSRC stated that they would reevaluate their proposed method.

4. WSRC stated that the BIO would be revised to include a limit on the Am-Cm activity concentration in Tank 17.1. This will ensure that assumptions used in the accident analysis are maintained.

b. Safety Envelope Management: WSRC reported that they are developing a computer-based database that will link the requirements contained in the authorization basis documents and the safety related systems procedure to the implementing procedures, surveillances, calibrations, and functional tests. This database will be used by the appropriate operations and engineering personnel to ensure that requirements contained in the authorization basis are met. As currently being developed, the DNFSB staff believes this database will not

meet its functional objectives. For example, Operational Safety Requirement (OSR) or Technical Standard requirements are not linked to the applicable surveillance requirements. Additionally, there currently appears to be insufficient resources or time available to complete development, to properly validate the information, and to train the appropriate users to meet the current startup schedule.

c. Cooling Water System: WSRC has made some modifications to the cooling water activity monitoring system. These enhancements should result in greater availability of the monitoring system.

- Alpha monitor mylar windows replaced with new material.
- Additional manual sampling if one detector fails.
- Changed position of beta-gamma detector - reduced false alarms by about a third.
- Plan to replace beta-gamma detectors by January 1995.

Additionally, WSRC committed to implement automatic diversion of cooling water which will incorporate an appropriate time delay that will allow confirmatory manual sampling of the cooling water stream and operator intervention to prevent diversion if it is not necessary.

In response to the DNFSB staff concerns, WSRC isolated Tank 17.1 (Am-Cm solution) which included securing cooling water. WSRC will also determine if the cooling water to other tanks can be secured. These actions will reduce the potential for releases to the environment.

d. Process Vessel Integrity: The Savannah River Technology Center (SRTC) completed a statistical analysis of the remaining useful life of process vessels. The analysis indicated that most process vessels have a low probability of failure (i.e., <50%) for the anticipated five-year mission. For three evaporator cooling/heating coils (installed between 1990-1992), however, the analysis concludes that there is a 70% probability that the bundle will fail during the five-year mission. WSRC is reevaluating the approach and assumptions of the statistical analysis.

The vulnerability of cooling/heating coil failure due to corrosion is recognized as a key safety issue because of the potential for a release to the environment. Cooling/heating coil failure is similar to steam generator tube failure at pressurized water reactor power plants. A remote inspection system has been developed to allow periodic inspection of steam generator tubes. Application of a similar system may be feasible and worthwhile for inspection of canyon process vessel cooling/heating coils.

e. Process Hazard Reviews (PHRs): WSRC has instituted a Process Safety Management (PSM) program. As part of this program, PHRs are prepared to identify, control, and mitigate process-related hazards. As discussed in the trip report forwarded by the March 25th Board letter, the DNFSB staff is concerned that the PHR acceptance criteria are too

high, such that actions to reduce the potential for lower consequence events are not considered. The PHR criteria have not changed since this observation.

The DNFSB staff is concerned that uncontrolled chemical reactions (e.g., eructations) are not adequately addressed in the appropriate PHRs because the event does not exceed the PHR acceptance criteria. For example, the Low Activity Waste PHR identifies an eructation as a potential hazard, but does not identify any process controls because the event does not exceed the acceptance criteria. In this particular case, WSRC stated that process controls are in place to prevent this event from occurring, but there appears to be a lack of sensitivity toward preventing such process upsets.

WSRC has reviewed the status of F-Canyon PHRs and prioritized their near-term efforts to support planned operations. WSRC recently updated the Cooling Water PHR, and committed to update four additional PHRs. The 1st Cycle and 2nd Uranium Cycle PHRs will be updated before operation of these processes; and the Electrical Power Distribution and Chemical Handling/Storage PHRs will be updated by November 1994.

f. Criticality Control: WSRC has initiated an analysis to assess the effectiveness of adding boric acid to process tanks containing fissile materials. This analysis is based on recognition of the potential for localized concentration of fissile material due to precipitation. WSRC plans to add boric acid to tanks where it will be effective in providing an increase in the criticality margin, not as a compensatory measure in order to modify mass or concentration limits.

g. Reaction Modeling Effort: WSRC is developing a calculational model to predict the chemical reaction kinetics associated with uncontrolled organic-nitrate reactions (i.e., Tomsk "red oil" events). This model will also contain experimentally derived models of the effectiveness of process vessel venting to dampen the effects of the reaction. The potential exists to use these analytical tools, or a version thereof, to better understand and predict other uncontrolled reactions (e.g., eructations).

5. **Future Actions:** The staff will perform follow-up reviews when DOE/WSRC actions are complete.