

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

August 21, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director**COPIES:** Board Members**FROM:** R. N. Robinson**SUBJECT:** Savannah River Site, F-Canyon Safety Envelope and Americium/Curium (Am/Cm) Processing

1. **Purpose:** This report documents a follow-up review by Defense Nuclear Facilities Safety Board (Board) staff (D. Lowe, D. Moyle, J. Roarty, and R. Robinson) of the safety envelope for the F-Canyon and Am/Cm processing program status on August 16, 1995.
2. **Summary:** The Department of Energy Savannah River Operations Office (DOE-SR) and Westinghouse Savannah River Company (WSRC) are preparing F-Canyon and FB-Line for restart. In previous reviews a number of safety issues were raised by the staff and most have been addressed. Two issues (cooling water system upgrades, and ion exchange column explosion mitigation analysis and upgrades) are still open, but with an acceptable path forward.
3. **Background:** The review documented in this report is a follow-up to the FB-Line and F-Canyon safety envelope review conducted on April 27-28, 1995, and the Am/Cm processing program status review on January 25, 1995.
4. **Discussion:**
 - a. **Am/Cm Vitrification:** By overlapping the research and development, design, and construction activities, the Am/Cm project should meet the Recommendation 94-1 Implementation Plan (IP) schedule. Development work has included a bench-scale demonstration of Am/Cm glass production. The design and procurement systems for the TNX pilot plant are being completed while the design of the full scale Multi Purpose Processing Facility (MPPF) Vitrification module is underway. The demonstration Bushing melter has been ordered and delivery is expected in September 1995 with frit-only testing beginning that same month. Demonstration runs will begin in January 1996. National Environmental Policy Act (NEPA) and safety documentation are under development and scheduled for completion by March 1997. The detailed design will begin January 1996 but is dependent on the Interim Management of Nuclear Material EIS Record of Decision.

The glass formulation has been developed using surrogate materials. The glass to be used is more of an aluminosilicate formulation than a borosilicate, allowing higher loading while maintaining homogeneity in the product glass. Am/Cm loading of 5-45 percent is anticipated resulting in approximately 40 glass-filled canisters (approximately 3 inches

diameter and twelve inches long) after processing the entire contents of Tank 17.1. Process control will be based on specific gravity of the nitric acid feed to the melter. A process hazard review is complete and the Board staff will review it to assure adequate safety.

- b. Fuel Processing Plans: Mark 31 targets are to be processed first with a normal F-Canyon flowsheet. Next, the K-14 Mark 22 fuel with very low burnup, will be processed in F-Canyon using a modified PUREX process to recover the uranium. Since F-Canyon process vessels are not geometrically favorable, uranium from the processing of Mark 31 targets will be blended with the high enriched uranium from Mark 22's for criticality control. When Mark 22 uranium solution is exhausted, dissolved depleted uranium will be blended for criticality control. From this process, a small amount of plutonium and neptunium with the fission products will be rejected to the tank farm. The K-14 batch should provide feed one year of fuel processing. WSRC plans to process all remaining fuel in H-Canyon when it restarts, thus freeing up F-Canyon to process residues.

If F-Canyon is used to process spent fuel beyond the K-14 charge, higher quantities of neptunium will have to be recovered. Otherwise, the neptunium levels may exceed the saltstone acceptance criteria for low level waste stabilization. The neptunium will then be transferred to H-Canyon for processing or to MPPF for vitrification.

- c. FB-Line Ion Exchange Column High Energy Reaction Prevention: WSRC considers an ion exchange column explosion to be unlikely, but credible, with the potential for worker fatalities. WSRC has adopted a number of administrative controls to reduce the potential for this accident, but the Board staff stressed the need to also consider engineered safety measures to mitigate the accident consequences (i.e., prevent injury to facility workers). WSRC indicated that a structural evaluation is in progress to assess this safety concern.
- d. Sodium Nitrate Presence in Dissolvers: WSRC has changed their operating procedures to store 25 percent instead of 40 percent NaNO_3 in chemical storage tanks. This change mitigates the concern for inadvertent chemical addition to the dissolvers when specific gravity is the only method for detection of the presence of NaNO_3 . Without the presence of NaNO_3 in the dissolvers, excess hydrogen generation would occur during the dissolution of aluminum clad fuel.
- e. Inadvertent Process Transfer Using Flexible Jumpers. WSRC identified the potential for inadvertent transfers of process vessel contents to circulated cooling water outlet nozzles improperly installed flexible jumpers as an Unreviewed Safety Question (USQ) in both F-Canyon and H-Canyon. The USQ is resolved by the addition of the following measures: (1) limiting the number of flexible jumpers in the canyon, (2) adding independent verification of the flexible jumper connection before use, (3) installing blanks on all unused cooling water nozzles, and (4) improving the alarm response procedure to cooling water contamination. WSRC stated that the addition of these measures makes the event incredible (frequency less than 1×10^{-6} /year).

- f. Cooling Water Automatic Diversion Upgrades: Installation of an automatic diversion system for cooling water has been delayed to November 1995. The Board staff noted that there have been repeated delays of these upgrades. In view of the recent USQ involving inadvertent transfer of vessel contents to the circulated cooling water system using flexible jumpers, the staff reinforced the need to complete this modification by the current scheduled date.

- g. Process Vessel Leaks: Evaporator 6.8E in H-Canyon developed a leak in the sidewall of the vessel below a trunnion support ring in April 1995. The evaporator was flushed, removed from service and replaced. The defective evaporator was placed in the warm truckwell for inspection where three through wall failures were found below the weld line. An in-depth historical review revealed a total of four wall failures in batch evaporator vessels since Savannah River Site (SRS) startup (one failure per decade). There have been no failures of storage vessels. WSRC stated that they will continue to operate batch evaporators to failure because: (1) only leaks occur (no catastrophic failure), (2) the sump level alarms are reliable detection systems for leaks, and (3) program is cost effective and minimizes radiation exposure to personnel.

- h. Upgrading FA-Line Powder Handling: Several contamination control improvements are planned for the FA-Line powder (UO_3) handling facility. These improvements are contingent upon a decision to "privatize" this operation.

- i. FB-Line Indeterminate Valve Position Issue: In March 1995, WSRC declared inadequate configuration control for 577 ball valves in the facility, 400 of which are required for restart. Since most inadvertent transfers are due to valve position errors, startup will be held up until configuration control over the valves is obtained. The valves in question have extension handles with indeterminate positions penetrating Lexan panels having incorrect panel maps. This lack of configuration control has evolved throughout the years of operation where some extension handle positions or panel maps were changed, making it impossible to know if a valve was closed or open. True valve positions have been tested systematically by vacuum tests, solution transfer, or physical inspection. To date, 267 of the required 400 valves have been brought under configuration control. Configuration control will be maintained via standing orders, maintenance directives, and archival panel mapping.