DEFENSE NUCLEAR FACILITIES SAFETY BOARD

June 2, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: A. De La Paz

SUBJECT: Report on Review of F-Canyon and FB-Line Safety Envelopes - Savannah River Site

1. Purpose: This report documents a follow-up review of the safety envelopes at the FB-Line facility and of the F-Canyon Phase 2 start-up activities at the Savannah River Site (SRS). This review was conducted by Defense Nuclear Facilities Safety Board (Board) technical staff members A. De La Paz, D. Lowe, D. Moyle, J. Roarty, and R. Robinson on April 27-28, 1995.

2. Summary: Westinghouse Savannah River Company (WSRC) noted that current processing plans support the commitments made by the Department of Energy (DOE) in the implementation plan for Board Recommendation 94-1. These plans include beginning to process targets in F-Canyon in December 1995 and fuel in F-Canyon in November 1996. WSRC personnel believe that it may only be necessary to start up Phase II of HB-Line to process the neptunium and plutonium-239 solutions currently stored in H-Canyon.

3. Background: The review documented in this report is a follow-up to a FB-Line and F-Canyon safety envelope review conducted on February 8-10, 1995. The report of this review was transmitted by the Board to DOE for information on April 12, 1995.

4. Discussion/Observations:

   a. F-Canyon: The following issues were discussed:

      1. Sodium Nitrate Additions During Dissolver Operations: Sodium nitrate is added to the dissolver to minimize the hydrogen generation rate and aid in dissolution of aluminum cladding. If sodium nitrate is not added, the amount of hydrogen generated could be excessive. The presence of sodium nitrate is verified by specific gravity measurement. The operating procedure currently requires that 40% sodium nitrate from Tank 241 be pumped to the dissolver and then water added to bring the nitrate concentration to 23%. The solution is then heated to boiling. WSRC has proposed

storing 23% sodium nitrate in Tank 241, thus eliminating the need for dilution in the dissolver. If this practice is implemented, the Board's staff agrees that the combination of storing 23% sodium nitrate in Tank 241, with periodic verification of contents, and measurement of the ambient density and boiling point of the dissolver contents prior to other chemical additions, constitutes defense in depth against an inadvertent chemical addition to the dissolver.

2. Process Vessel Ventilation: The production of flammable gas in Tank 17.1 requires that adequate ventilation be provided to purge the tank. Tests have indicated that adequate pressure exists to provide ventilation assuming no interruption of flow due to a vent line restriction. The Board's staff noted the feasibility of installing static pressure taps in the vent line jumper to provide direct evidence of flow from Tank 17.1 to the Process Vessel Vent system. WSRC might consider evaluating the need for providing this installation as a defense-in-depth measure. The Board's staff also believes that this type of measurement would be useful for other process vessels where there is significant hydrogen production.

3. In-Service Inspection Program: The Board's staff noted that some progress has been made in planning for process vessel cooling coil inspections. However, it appears that up to this point, only paper studies have been completed and actual baseline inspections are not firmly planned. Also, Tank 17.1 in F-Canyon appears to be the only vessel that is serving as a storage vessel that has its cooling water isolated. The Board's staff believes that WSRC should consider reviewing the storage vessels in H-Canyon to determine if cooling water is needed for the storage mission.

   With the exception of Tank 17.1, the use of a sampling program to determine process vessel corrosion rates as part of an in-service inspection program is not being aggressively pursued by WSRC. WSRC previously outlined such a program, but it appears that many of the baseline samples were not taken. WSRC personnel stated that they were reevaluating the sampling program, but there is no indication that progress has been made. Additionally, H-Canyon is apparently not implementing a sampling program even though there are several tanks (e.g., Np-237, Pu-239, & Pu-242 storage tanks) that will continue to store radioactive material for an extended period of time.

   A sample from the americium-curium solution stored in Tank 17.1

was taken on March 30, 1995. Preliminary analysis results indicate that the masses of iron, nickel, and chromium increased from 5% to 8% since the last sample analysis in September 1993. This rate of increase, which is used to estimate the corrosion rate of the inner surface of the tank, is higher than expected. WSRC personnel are continuing to analyze the sample data.

4. Solids in Tank 9.6: On April 19, 1995, plutonium-bearing solids were reported in Tank 9.6 samples. The immediate actions were to perform an engineering evaluation of the source of the solids, resample, and leave the tank agitator running. WSRC personnel noted that tank chemistry such as pH and nitrate concentration were within Technical Standard limits. Ten samples were taken and analyzed from the tank. The highest sample result showed that there are a total of 193 grams of plutonium in solids in the tank. This is well below the nuclear criticality safety limit of 450 grams. WSRC personnel believe that potential causes for the solids include the polymerization of a small amount of plutonium in the sampler dip tube or a small amount of carry-over of tributyl phosphate (TBP) and dibutyl phosphate (a TBP degradation product) from Tank 9.5. WSRC personnel have back-flushed tank samplers with acid and are evaluating whether to replace the paraffin wash solution in Tank 9.5. Also, WSRC plans to take additional samples from Tank 9.6 to verify that the solids problem has been corrected.

b. FA-Line: The following issues were discussed:

1. FA-Line Upgrades: The Board's staff reviewed the proposed modifications to minimize depleted uranium oxide contamination in the FA-Line product handling area. Personal protective equipment during normal operations in the area includes anti-C clothing and respirators. The Board's staff believes that barriers could easily be installed in the area to decrease contamination. WSRC performed an engineering walkthrough of the area and identified solutions to the problem areas. The Board's staff believes that WSRC may have missed an opportunity to evaluate commercial methods to contain toxic and radioactive dusts and powders. At commercial facilities, respirators are used only in extraordinary situations and not as a standard practice. Most upgrades identified were maintenance repairs and minor modifications. WSRC personnel stated that the selection of proposed controls and modifications were based on risk and cost benefit. The Board's staff agreed with the steps being taken to control contamination. However, review of commercial designs and lessons learned from the commercial facilities could lead to better containment at possibly lower costs. All upgrades

proposed by WSRC are subject to approval by DOE.

2. Organic-Nitrate Reactions in the 1EU Evaporator: Protection against a Red Oil reaction in the 1EU continuous evaporator is accomplished by preventing organic from being fed to the evaporator and imposing temperature limits on evaporator operation. WSRC has proposed two specific controls on 1EU evaporation in a draft Technical Standard: a maximum evaporator solution temperature of 120
tank liquid level of 52% of the tank's volume. The volume limit allows for a longer solution residence time in the feed tank for decantation (tank is not agitated) and allows for skimming of organic, if needed. WSRC has also proposed a change to the F-Canyon Basis for Interim Operation document to perform weekly inspections of the feed tank for the presence of organic and, if necessary, skim the organic layer that has accumulated. The Board's staff believes that these controls are adequate if implemented as authorization basis requirements.

FB-Line: The following issues were discussed:

1. Ion Exchange Column Explosion: Normal venting capacity for ion exchange columns is provided by a 1/2-inch diameter ever-open vent. These vents are adequate for resin temperatures below 100
generated during runaway thermal reactions. Engineering and administrative controls are in place to assure safety during most process upset conditions. WSRC personnel noted the potential for a facility worker fatality in the event of a resin column explosion and indicated that analyses were underway to better define the explosive response of the columns and the surrounding cabinets. The Board's staff believes that this effort should be continued to establish measures that enhance facility worker protection.

   The Board's staff is continuing to assess the adequacy of ion exchange column ventilation. WSRC report WSRC-RP-95-420, Technical Evaluation of Vent Lines for Ion Exchange Columns in FB-Line, states that a liquid height of five to eight feet in the vent line is expected during anion exchange column dynamic conditions. During static anion exchange column conditions, the column vent may contain several feet of water depending upon the sequence of valve operations. The presence of water in the vent line may also allow the static pressure to be high enough to allow the resin

temperature to react violently. These same conditions may exist for the cation exchange columns. Specifically, the

loaded ion exchange column from having its vent line occupied by several feet of water, as well as the measures to

review the system drawings and operational procedures for the ion exchange columns.

surrounding the cation exchange resin due to a plugged loop seal vent. WSRC has developed a surveillance to verify that

in the FB-Line Authorization Basis Linking Database.

d.

1. Tank 6.8 Leak: On April 10, 1995, WSRC personnel verified a

a girth weld near the bottom of the vessel. The contents of Tank 6.8 were transferred to Tank 8.6. Also, about 970 pounds of

canyon cell that contains Tank 6.8 was last inspected by camera in March 1995. No problems were noted at that time. In addition,

its minimum wall thickness was measured to be 0.36 inches (0.375 inches nominal). WSRC is planning to remove Tank 6.8 for

status of other evaporators, as well as the basis for the frequency of tank wall inspections. As part of this review process, WSRC has

previously documented.

2.

Column: WSRC is evaluating a potential inadequacy in the safety analysis for H-Canyon. The current safety analysis assumes that an

basis earthquake (DBE) and that a column fire takes credit for a release through the sand filter. WSRC has determined that a DBE

have to be loaded at the time of the DBE for there to be a fire. Also, the sand filter may be bypassed due to the loss of canyon

question evaluation, a justification for continued operation, and a seismic evaluation of the system. Preliminary results indicate that,

with minor modifications, flow can be maintained to the column following a DBE.

e. Processing Plans: WSRC plans to start processing the Mark 31 targets in December 1995 utilizing one dissolver. Plutonium recovered from targets is planned to be converted to metal in FB-Line by December 1996. However, WSRC personnel noted that plans proposed to DOE to accelerate the processing of Mark 16 and Mark 22 fuel tubes in F-Canyon in November 1995 were not approved due to limited funding. Fuel processing in F-Canyon is currently planned to begin in November 1996. WSRC is still preparing to restart H-Canyon fuel processing in September 1997. Once H-Canyon fuel processing is begun, all fuel processing will be performed in H-Canyon. WSRC is also exploring the option to start up only HB-Line for the processing of plutonium-239 and neptunium solutions currently stored in H-Canyon. Specifically, WSRC believes that the ion exchange column in Phase II of HB-Line is adequate to purify these solutions. WSRC personnel noted that startup of the FA-Line has been delayed from January 1996 to March 1996.