DEFENSE NUCLEAR FACILITIES SAFETY BOARD

December 29, 1993

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: David C. Lowe
Dominic S. Napolitano

SUBJECT: Savannah River Site (SRS) - High-Level Waste (HLW) System Review Trip Report (December 6-8, 1993)

1. Purpose: This trip report documents the Defense Nuclear Facilities Safety Board (DNFSB) technical staff's (David Low and Dominic Napolitano) December 6-8, 1993 review of the Savannah River Site (SRS) HLW system activities and plans.

2. Summary: The application of a systems approach to the SRS HLW system is still in its infancy. It appears that Department of Energy Savannah River Site Operations Office (DOE-SR) and Westinghouse Savannah River Company (WSRC) are focused on individual facility startups. This focus is clearly important, but clear communication of lessons-learned and performance expectations as well as technical exchanges between facilities are necessary. Additionally, peripheral, but nevertheless critical, components of the overall HLW system may not be getting the appropriate management attention.

3. Background: SRS has recently instituted a systems approach to the HLW system. The major processing facilities comprising the HLW system are Extended Sludge Processing (ESP), In-Tank Precipitation (ITP) (radioactive startup scheduled for December 1994), Defense Waste Processing Facility (DWPF) (radioactive startup scheduled for December 1995), F-Area and H-Area tank farms, and the evaporators (1-H started operations on December 27, 1993, and startups are scheduled for 2-F in March 1994 and 2-H in April 1994).

4. Discussion:

   a. Startup Testing: Several facilities of the HLW system are in various stages of their startup test programs. The DWPF, ITP, and ESP startup test programs, and testing results and problems were discussed. WSRC instituted a new senior-level Joint Test Group (JTG) to support the DWPF startup program which appears to be getting a handle on the problems identified in the startup program. Some of the more significant startup problems are briefly discussed below.

      (1) Analyzers: DWPF flammable gas and oxygen analyzers have a history of high failure rates and require large expenditures of labor to ensure

reliability. WSRC has instituted an engineering review of all their DWPF analyzers. This will include possible replacement of certain types of analyzers with more reliable ones, and potentially eliminating some analyzers. The DNFSB staff is concerned that the WSRC justification for eliminating the analyzers is primarily based on a probabilistic analysis instead of good engineering practice and the principles of defense-in-depth.

As an example, the proposed elimination of the flammable gas analyzer in the annular space of the Organic Waste Storage Tank (OWST) is based on the safety analysis report (SAR) fault tree analysis which assumes that a flammable condition exists and that it cannot be mitigated. The fault tree concludes that an OWST explosion will not occur because it is incredible for an ignition source to be present (i.e., 8x10 9/year). Therefore, WSRC concludes that the analyzer is not required. This is in conflict with the National Fire Protection Association Standard 69 (NFPA 69), Explosion Prevention Systems, which does not recognize lack of a known ignition source as an acceptable method for preventing an explosion.

ITP also utilizes flammable gas and oxygen analyzers similar in design and function to DWPFs analyzers. ITP has been experiencing some of the same difficulties as DWPF, but there has been only a limited attempt to transfer lessons-learned and engineering expertise between these two facilities. The WSRC systems engineer responsible for the ITP analyzers stated that he has informal contact with the DWPF analyzer lead engineer, but that he was not aware of the monthly reports of the DWPR Analyzer Improvement Plan.

(2) Material Transfer Systems: These systems provide frit to the process and transfer frit/waste slurries to other processes. The frit system is vulnerable to frequent clogging in the feed tank. The frit is pumped from ground level to an elevated feed tank. At the entrance to this tank is a nozzle which increases the frit velocity in order to compensate for the loss of static pressure. This nozzle causes clogging in the feed tank. WSRC believes that increasing the air pressure and replacing the line's rubber valves should solve the problem. Additionally, WSRC is considering the installation of a new agitator in the feed tank.

WSRC stated that a major concern is the clogging of the slurry mix evaporator (SME) transfer pump J-priming line. This is a potential "show-stopper" and system modifications are required.

(3) Sampling Systems: The DWPF Organic Evaporator Collection Tank (OECT) has more water than expected during the precipitate hydrolysis process. During sample recirculation, water, vice benzene, is being recirculated via the sample line. Since Cs-137 is soluble in the water, high

radiation levels could exist in the sampling area. Additionally, sampling system modifications have been identified to ensure remote operability of the sampling system. The sampling system will require extensive modification in order to meet DWPF production requirements.

(4) Slurry Pumps: The ITP/ESP tanks are equipped with quadraloop slurry pumps. The bearing seals on these pumps are prone to water leakage. This leakage adds significant quantities of water to the HLW system which may have a substantial impact on the HLW processing system.

b. H/F Inter-Area Line (IAL): The H/F IAL is a two mile long pipeline which connects the F-Area and H-Area tank farms. The initial need for the IAL is for liquid waste transfer from H to F area to support continued operation of the 2-F evaporator in mid-1955. Sludge transfer from F- to H-Tank farms is required around 2001. Construction on the IAL was completed in 1969 and has been used infrequently. During its limited operation there were a number of occurrences that were directly related to inadequate training, procedures, and conduct of operations.

WSRC stated that there are no plan to qualify the IAL with the exception of a biennially 15 psig leak test. There is no in-service inspection program or engineering analysis to determine if the IAL will be able to perform its function. Additionally, the facility lacks a finished set of standard operating procedures and operators are not trained regularly for IAL use. This may be expected since IAL is not required for approximately 18 months based on WSRCs plans, but there was little evidence of any program or effort that will ensure that the IAL will be able to meet the requirements of the HLW system.

c. Waste Tank Deflagration: WSRC declared that an unreviewed safety question (USQ) existed because a non-conservative analysis of a postulated waste tank deflagration event existed in the SAR. The SAR source term was determined to be low because the dominant release mechanism (liquid entrainment) was not properly considered. WSRC stated that the event frequency had been reanalyzed and that the event is now considered incredible (i.e., <1x10- 6/year). WSRC has issued a justification for continued operation is that the probability of a deflagration in a waste tank is unchanged whether the tank farm is operational or shutdown, since normal evaporator and batch transfer operations do not significantly affect the hydrogen production rate. Additionally, WSRC stated that the overall risk will be the same or lower than the risk identified in the SAR because the frequency of the event is greatly reduced.

The major reason for the frequency reduction is that WSRC is now taking credit for the long time (greater than nine days) required for hydrogen buildup and the capability to use backup ventilation measures. However, the use of backup ventilation measures are not documented in emergency response plans/procedures,

emergency response personnel are not trained or exercised in this evolution, and the necessary equipment is not designated and may not be available when required. WSRC stated that this is a normal tank farm evolution and that the required actions could be undertaken in the required timeframes in all situations. The DNFSB staff does not agree with these conclusions and believes that additional effort is required to ensure that backup ventilation measures are available in an emergency situation.

5. Future Staff Actions: The staff will perform follow-up reviews until DOE/WSRC actions are complete and the outstanding issues are resolved to our satisfaction.