DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

March 27, 2012

Mr. David Huizenga
Senior Advisor for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Huizenga:

The Defense Nuclear Facilities Safety Board (Board) has reviewed the A- and K-Area fire protection water supplies at the Savannah River Site (SRS). Based on its review the Board questions how Savannah River Nuclear Solutions (SRNS) was able to justify that the systems met the revised functional classification of safety significant. The Board is concerned that in establishing, maintaining, and operating safety-significant fire water systems, neither DOE nor SRNS is applying the level of rigor expected for a system designated to be a nuclear safety control.

The review included discussions with Department of Energy (DOE) and contractor personnel at SRS, as well as subsequent document reviews. The Board has concerns with the process used by SRNS to implement the revised functional classification of portions of the A- and K-Area fire water systems from general-service to safety-significant, including the quality of the backfit analyses used to support reclassification, given multiple deficiencies with the physical condition and reliability of the fire pumps and tanks.

The enclosed report provides further details for your use in improving this situation. The Board notes that DOE and SRNS have already developed and implemented corrective actions to address several of the issues discussed in the report, and that SRNS has self-identified additional deficiencies. Pursuant to 42 U.S.C. § 2286b(d), the Board requests a report within 60 days of receipt of this letter outlining actions already taken or planned by DOE to address the deficiencies discussed in the enclosed report.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

Enclosure

c: Dr. David C. Moody
Mrs. Mari-Jo Campagnone

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

March 13, 2012

MEMORANDUM FOR: T. J. Dwyer, Technical Director

COPIES: Board Members

FROM: W. Futrell

SUBJECT: Review of A- and K-Area Fire Water Supplies, Savannah River Site

This report documents a review by the staff of the Defense Nuclear Facilities Safety Board (Board) of the A- and K-Area fire water supplies at the Savannah River Site (SRS) on September 26, 2011, as well as the staff's review of additional documentation and identification of additional issues following the visit. Staff members W. Futrell, D. Gutowski, D. Burnfield, W. Andrews, M. Sautman, and C. Johnson participated in the review.

Background. The A-Area water supply provides firefighting water to Savannah River National Laboratory's (SRNL) automatic sprinkler system and fire hydrants. It includes a single water storage tank (782-A), two electrically-driven fire pumps and controllers, associated piping and control valves, which are housed in building 784-A, and the fire water distribution system. The K-Area water supply provides firefighting water to sprinkler systems and hydrants at the K-Complex. It consists of a single water storage tank (192-4K), one electrically-driven and one diesel-driven fire pump and controllers, system monitoring equipment, associated piping and control valves, which are housed in building 192-2K, and the fire water distribution system. Savannah River Nuclear Solutions (SRNS) reclassified portions of each system from general-service to safety-significant in 2010 to address nuclear safety concerns. SRNS performed backfit analyses (BFA) to implement the revised functional classification of the systems.

This report identifies issues associated with the process used by SRNS to implement the revised functional classification of portions of the A- and K-Area fire water systems from general-service to safety-significant; the reliability of the fire water supply equipment; and noncompliance with applicable design, inspection, testing, and maintenance standards.

Backfit Analyses. The staff's review of the backfit analyses (BFA) for the A- and K-Area fire water systems, together with verification of actual field conditions and subsequent identification of errors within the analyses, called into question the quality and completeness of

the analyses, as well as the process used to approve the BFA reports. Both BFAs lacked rigor and resulted in conclusions that were not supported by the data. The following examples support this observation:

- Neither BFA included a crosswalk of all applicable requirements from National Fire Protection Association (NFPA) 20, *Standard for the Installation of Stationary Pumps for Fire Protection*; NFPA 22, *Standard for Water Tanks for Private Fire Protection*; or NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. For example, a cross reference to NFPA 22, Section 5.5, which establishes design details for welded steel suction tanks was not provided.

- The BFAs did not identify deficiencies related to (1) the lack of a recent tank inspection report for the A-Area 782-A water supply tank, or (2) the failure to act to remove sediment from the bottom of the K-Area 192-4K water supply tank, which was identified in a 2007 tank inspection report. The contractor performed this 2007 inspection to meet the five-year inspection as required by NFPA 25. On November 3, 2011, SRNS issued a Nonconformance Report for failing to follow NFPA 25 during the inspection of tank 192-4K.

- The assumptions in the A-Area BFA regarding the amount of water to be reserved for fire protection and the condition of the 782-A tank were not in accordance with the requirements of the applicable standards. A subsequent engineering analysis by SRNS determined that the original calculation was in error. As a result, SRNS declared a Potential Inadequacy of the Safety Analysis (PISA).

- Assumptions without technical justification were used to validate conclusions in the A-Area BFA. For example, the BFA states that fire protection features for the 784-A pump house are not required because the potential for simultaneous fires within the laboratory and the pump house is excluded. NFPA 20 does not permit such an exception.

In addition, the BFA for the A-Area fire water supply did not address a number of known deficiencies (portions of the system that did not meet applicable codes and standards) and failed to consider the cumulative effect of those deficiencies. SRNS provided no technical justification for noncompliance's with codes and standards.

A-Area Fire Water Supply. The staff identified issues associated with the supply tank, pumps, and pump house for the A-Area fire water supply. The staff concluded that the A-Area fire water supply does not meet the expectations for a safety-significant system. Details on specific issues are discussed below.

782-A Water Storage Tank—

- SRNS did not inspect the tank in calendar year (CY) 2010 as part of the process of implementing the revised functional classification of the system. SRNS inspected the tank's interior using divers in CY 2011, following the reclassification, and found sediment on the tank bottom. SRNS also discovered foreign objects including rocks, remnants of a ladder, a sphere, and other objects. The outer tank had an average sediment (sand and lime) depth of 11.9 inches, and the inner tank had an average sediment depth of 49 inches. Sediment, especially sand (because of its abrasive qualities), can damage the pump and thus affect its performance. The sediment and debris were removed by the divers as a part of the tank inspection process. SRNS has not taken action to prevent the future buildup of sediment in the tank.

- An inspection of the tank's exterior conducted by SRNS during the week of October 17, 2011, and previous measurements of pit depth revealed the following issues:

  — at "rusty" areas at the bottom course to base plate attachment, the lowest shell bottom course thickness is approximately 0.180 inches, which is less than that required by the design standard, and

  — at "rusty" areas, the tank shell base to plate outboard weld is missing (approximately 13 percent of the exterior weld) and the outboard portion of the base plate is missing (rusted away) in numerous areas.

- In the BFA, SRNS credited automatic refill of the 782-A tank from wells as the means to ensure that the required 2-hour fire water supply would be maintained. For this to be acceptable, the automatic refill system (wells, pumps, power supply, etc.) must be considered a required support system and classified at a level no lower than that of the fire water system that it supports. However, the automatic refill system is classified as general service, not safety significant.

A-Area Fire Pumps—

- Tank 782-A supplies water directly to the two electrically-driven fire pumps, which are housed in Building 784-A. Loss of electrical power would render both pumps inoperative.

- Both pumps are located in a structure that is partially open to the effects of weather, is not secured from unauthorized entry, and has neither automatic fire suppression nor a fire rated barrier separating the pumps from the remainder of the facility. These conditions do not meet the requirements of NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.

- The pumps and controllers are obsolete, resulting in the need to scavenge parts or obtain parts from sources other than the original manufacturer. Such an approach to maintenance is not sustainable in the long term; it also calls into question the pumps' Underwriters Laboratories (UL) listing.

- The A-Area pumps, controllers, isolation valves, and other equipment lack supervisory monitoring features (electronic or mechanical) required by current standards.

- SRNS failed to perform the required annual NFPA 25 test of the A-Area fire pumps in CY 2009.

- NFPA 25, section 8.3.5.3, states that a fire pump is to be considered acceptable if the test results are at least 95 percent of the pump's original performance characteristics. The annual fire pump test conducted in CY 2010 showed a 7.16 percent degradation for the 1,000 gpm electric fire pump and a 9.95 percent degradation for the 2,000 gpm electric fire pump when operating at 150 percent of capacity. SRNS has not declared the pumps deficient. NFPA 25 also requires an investigation to reveal the cause of the degraded performance; SRNS has not conducted an investigation.

Redundant Fire Water Supply—A-Area lacks a credited redundant fire water supply, although DOE Standard 1066-1999, *Fire Protection Design Criteria*, recommends such a redundant supply. SRNS has no plan to provide a credited redundant water supply for A-Area. SRNS did not consider or evaluate available alternatives such as partially crediting the M-Area diesel fire pump and associated tank (tank and pump are undersized for the maximum fire water demand), or using the existing elevated domestic water tank as a water source for either new fire pumps or the two existing fire pumps in Building 784-A.

Where only a single fire water supply system (single tank and single pumping arrangement) is provided for nuclear safety, loss of that system, as in the case of A-Area, might result in the following negative consequences:

- Nuclear safety vulnerability between the time operation of the fire water system is lost and when the facility can be placed in a safe status. In the case of the SRNL, placing facility operations in a safe status would take considerable time and effort.

- While normal operations are being halted, the available compensatory measures might provide little or no safety benefit.

- Depending upon the nature of fire water system deficiency, repair time could range from hours to weeks/months should the single tank or pumps be severely damaged.

K-Area Fire Water Supply. The water supply for K-Area has numerous deficiencies; as a result, it also fails to meet the expectations for a safety-significant water supply, as discussed below.

K-Area Water Supply Tank—

- SRNS did not inspect the tank in CY 2010 as part of the process of implementing the revised functional classification of the system.

- A review of documents detailing results of the robotic camera inspection of the tank performed on June 13, 2007, revealed the following:

  — A layer of sediment of undefined depth is present in the tank. Although NFPA 25 requires that the sediment be removed before the inspection continues, SRNS failed to take this action. The sediment was subsequently removed during a CY 2012 inspection of the tank.

  — SRNS has not taken action to prevent the future buildup of sediment in the tank.

K-Area Fire Pumps—Both the diesel-driven and, especially, the electrically-driven fire pumps have shown degradation during the past 13 years. In CY 2009, results of the annual fire pump flow test conducted by SRNS revealed that the performance of the electric fire pump had degraded 13.11 percent for the capacity test and 21.61 percent for the 150 percent of capacity test. A subsequent test in CY 2010 used a new method that implied improved results, but the change in test method does not account for what appears to be continued pump degradation over the past ten years. The CY 2010 test revealed that the performance of the electric fire pump had degraded 6.59 percent for the capacity test and 5.69 percent for the 150 percent of capacity test. None of these results meet 95 percent of the pump's original performance characteristics as required by NFPA 25. In November 2011 SRNS issued a Nonconformance Report for the K-Area degraded fire pumps, but the associated Unresolved Safety Question was determined to be negative in early February 2012. SRNS has recently declared the pumps deficient, but must investigate the cause of their degraded performance as required by NFPA 25.

Conclusions. Considering the number of issues discovered by the Board's staff and SRNS personnel during and following the review of the A- and K-Area fire water supplies at SRS, it is not clear how SRNS was able to justify that the A- and K-Area fire water supply systems met the revised functional classification in CY 2010. Neither system meets safety significant performance expectations.

SRNS has initiated actions to address some of these issues. The questions provided to DOE and SRNS by the staff prior to the review resulted in SRNS declaring a PISA for the 782-A fire water supply tank. SRNS has also identified additional issues associated with the 782-A tank related to the required tank wall thickness, exterior corrosion of the tank shell at grade, and the potential for tank failure with little or no warning. While SRNS has begun developing a

project to replace the A-Area fire water tank and pumps, funding for this project has not been identified or secured. SRNS has not identified the need to provide a redundant fire water supply for the A-Area fire water distribution system. SRNS has taken action to address some but not all of the K-Area fire water system deficiencies that have been identified to date.