DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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February 6, 2009

Dr. Inés R. Triay
Acting Assistant Secretary for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Dr. Triay:

The Defense Nuclear Facilities Safety Board (Board) continues to follow closely operations at the H-Canyon facility at the Savannah River Site as it continues its mission of stabilizing inactive and surplus nuclear materials from around the nuclear weapons complex. The Board's staff recently assessed the condition of the electrical distribution systems that provide power to safety-related equipment at H-Canyon. This electrical equipment is essential to support safe, reliable operations at the facility. Enclosed is a report prepared by the Board's staff that provides the details of the review and highlights several areas that require attention:

- As a result of electrical system modifications made in the past 10 years, the backup diesel generators for H-Canyon are now connected to the safety-class canyon exhaust fans through as many as five circuit breakers. Additionally, the associated automatic transfer switches (ATSs) do not function as originally intended when normal power is restored after an interruption of power. The excessive number of circuit breakers between the diesel generators and the safety-class canyon exhaust fans degrades the reliability of the system. This issue could be resolved by (1) reconfiguring the electrical system to reduce the number of circuit breakers and (2) replacing the four existing ATSs with four new standard-type ATSs.

- Safety-class exhaust fans are located in the Fan House building which is not located fully within the lightning protection zone. The contractor should provide an adequate lightning protection system for the Fan House building in accordance with National Fire Protection Association Standard 780, *Standard for the Installation of Lightning Protection Systems*.

- The contractor has not evaluated the ampacity derating effect (reduction in rated current of the cable) for several penetration seals containing safety-related electrical power and control cables in the HB-Line electrical room. Improperly sized cables could fail and be unable to perform their intended safety function.

Pursuant to 42 U.S.C. § 2286b(d), the Board requests a briefing within 90 days of receipt of this letter on actions to be taken to resolve the electrical design deficiencies discussed above and in the enclosed report.

Sincerely,

A. J. Eggenberger
Chairman

Enclosure

c: Mr. Jeffrey M. Allison
Mr. Mark B. Whitaker, Jr.

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

December 14, 2008

MEMORANDUM FOR: T. J. Dwyer, Technical Director

COPIES: Board Members

FROM: A. Gwal

SUBJECT: Electrical Safety Systems at the H-Canyon/HB-Line, Savannah River Site

This report documents a review by the staff of the Defense Nuclear Facilities Safety Board (Board) of the electrical distribution system for the H-Canyon/HB-Line at the Savannah River Site (SRS). Staff members A. Gwal, P. Foster, and B. Sharpless and Site Representative M. Duncan met with representatives from the Department of Energy (DOE) and its contractor and assessed the design and installation of the electrical system on September 9, 2008. The staff also reviewed documents received in September, October, and November 2008 from SRS related to the electrical system.

Background. H-Canyon was constructed in the early 1950s to reprocess spent nuclear fuel and reactor targets. Nuclear materials recovered from H-Canyon operations, including neptunium, plutonium, and uranium, were used in nuclear weapons and national security programs. Following the end of the Cold War, H-Canyon treated unstable nuclear materials that posed potential environmental, public safety, and health risks. Several studies, including the Board's Recommendation 94-1, *Improved Schedule for Remediation in the Defense Nuclear Facilities Complex*, argued that continued operation of canyon facilities would be necessary for future treatment of surplus nuclear materials and waste products. In 2006, DOE began to implement a new plan for H-Canyon, proposing its continued operation until 2019. H-Canyon's extended mission is to process spent nuclear fuel from research reactors, surplus plutonium, enriched uranium, and other materials from across DOE's nuclear weapons complex. To ensure this mission can be fulfilled, H-Canyon's management and engineers are developing a facility aging management program.

Safety-Class Electrical System. The safety-class electrical system at H-Canyon provides reliable backup power to the canyon exhaust fans during a loss of normal/off-site power. In a letter dated July 10, 1997, the Board raised issues regarding the safety-class electrical system at H-Canyon. These issues were resolved in 1999 as part of the completion of project S-4404, which significantly upgraded the safety-class electrical system. The upgrade provided redundant electrical power trains, including new diesel generators, switchgear, motor

control centers, battery stations, panel boards, and raceways located in separate redundant rooms in a new Building 254-19H. The new upgraded safety-class electrical system at H-Canyon was designed to comply with the requirements of DOE Order 420.1B, *Facility Safety*, and related Institute of Electrical and Electronics Engineers (IEEE) standards, such as IEEE Standard 308-2001, *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*, and IEEE Standard 384-1992, *IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits*.

During this review, the Board's staff discussed with the contractor and DOE the operational sequence of the connection of the safety-class diesel generators to the designated safety-class canyon exhaust fans during a loss of normal/off-site power. The contractor stated that in the original configuration of the safety-class electrical distribution system, one diesel generator operated continuously to avoid any problems with the startup of a diesel generator during loss of power. Following a 2002 study, however, this design was modified so that the diesel generators would be used only during a loss of normal/off-site power. During this design modification, an effort was made to use most of the original equipment of the electrical distribution system. The result was substantial savings due to the minimal implementation costs and the reduced consumption of diesel fuel. In recent years, DOE has approved extended operation of H-Canyon, prompting the Board to review life extension efforts. The Board's staff identified the following issues regarding the modified electrical system design and its capability to supply power to the safety-class canyon exhaust fans:

- The Board's staff is concerned that the excessive number of circuit breakers between the diesel generators and the safety-class canyon exhaust fans degrades the reliability of the fans. During a loss of normal power, the diesel generators will automatically start up and supply the safety-class canyon exhaust fans through a series of electrical devices (e.g., fan MO-001 is supplied through the 480-volt switchgear-A2, circuit breakers CB-52A2-1 and CB-52A1-2, 480-volt switchgear-A1, circuit breaker CB-52A1-3, and the automatic transfer switch [ATS] F1). The failure modes of circuit breakers are presented in IEEE Standard 493-1997, *IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*. Of primary concern is the large percentage of failures in which circuit breakers "opened when they should not." This type of circuit breaker failure can significantly affect the reliability of safety-class electrical systems when many circuit breakers are connected in series.

- In the present configuration, the connection from the diesel generators to the canyon exhaust fans during a loss of normal/off-site power is automatic. After recovery of normal/off-site power the ATSs do not automatically switch to normal/offsite power as is typical. Instead, the fans must be connected back to normal/off-site power manually.

The Board's staff believes the above issues could be resolved by reconfiguring the electrical circuit to reduce the number of circuit breakers and using four new standard-type ATSs in place of the four existing ATSs—F1, F2, F3, and F4. The new ATSs would switch

automatically from diesel power to normal/offsite power upon the return of normal/offsite power. Additionally, in the new configuration, during a loss of normal/off-site power, the diesel generators would supply the fans through a substantially reduced number of electrical circuit breakers (e.g., fan M-001 would be supplied through 480-volt switchgear-A2, a single circuit breaker, and ATS-F1).

Unprotected 480-Volt Switchgear. Safety-class 480-volt switchgear A and B in the electrical rooms of Building 254-19H are relied upon to provide power for safety-class loads. The switchgear have openings in the hoods located on the top of the cabinets for heat release purposes. These openings are located under the sprinkler heads of the fire suppression system. Water spray from activation of the sprinkler system would likely enter the switchgear and could initiate a short circuit that could damage the switchgear, create a hazardous condition, and leave safety-class loads without power. Contractor personnel agreed to evaluate this issue.

Lightning Protection System. Safety-class exhaust fans are located in the Fan House building which is not located fully within the lightning protection zone. The Board's staff believes it would be prudent for the contractor to provide an adequate lightning protection system as discussed by DOE Guide 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide*, and National Fire Protection Association Standard 780, *Standard for the Installation of Lightning Protection Systems*.

Penetration Seals. During a walkdown of the HB-Line electrical room, the Board's staff observed several penetration seals containing safety-related electrical power and control cables. The staff inquired whether any ampacity derating factor had been applied during the sizing of these cables. The contractor reported having a list of the penetration seals and the respective cable routing through the seals. However, an evaluation of the ampacity derating effect (reduction in the rated current of the cable) of the penetration seals had not been performed. The staff suggested that the contractor obtain this information from the penetration seal vendors, who typically would determine the derating factor in accordance with IEEE Standard 848, *IEEE Standard Procedure for the Determination of the Ampacity Derating of Fire-Protected Cables.* Improperly sized cables could fail and be unable to perform their intended safety function. Project personnel stated that they will evaluate this issue.

Fast Reclosing of Electrical Power. The staff suggested performing an evaluation of the transient torque for the 300 hp safety-class canyon exhaust fan during a fast reclosing after a loss of power. Section 20.85 of National Electrical Manufacturers Association MG-1-1993, Revision 2, *Motors and Generators*, states: "Induction machines are inherently capable of developing transient current and torque when exposed to an out-of-phase bus transfer or momentary voltage interruption and reclosing on the same power supply." The magnitude of the transient torque may range from 2 to 20 times the rated torque and is a function of machine parameters and switching time. Suitable protective devices should be provided, if required, for protection of the exhaust fan motor. Project personnel agreed to evaluate this issue.