

**Response to the Defense Nuclear Facilities Safety Board (DNFSB)
STAFF ISSUE REPORT of June 24, 2003
Review of Electrical and Lightning Protection Systems for K-Area
Material Storage Facility (KAMS), FB-Line, and Building 235-F
At the Savannah River Site**

KAMS

DNFSB ISSUE:

Electrical Distribution System - In general, the staff found the electrical distribution system to be adequate since the system is currently not credited with any safety function. However, in a letter dated June 12, 2003, the Board noted that the ventilation system for KAMS was not designated as safety-class consistent with DOE requirements to preclude unacceptable off-site consequences during certain accidents. Such a designation would require reclassification of the existing electrical system and significant enhancements to the present emergency power capability.

DOE RESPONSE:

The Department of Energy-Savannah River (DOE-SR) directed on 8 September, 2003 that the KAMS facility conditions be established and maintained such that the exhaust ventilation would not required at any time to prevent plutonium release for all Design Basis Accidents. The associated electrical equipment for the exhaust ventilation requires no enhancements to protect against off-site releases. The electrical components supporting the safety related ventilation function would be re-evaluated if the ventilation system is required to perform a safety related function in the future.

DNFSB ISSUE:

Electrical Calculations -The short-circuit analysis for KAMS is based on the short-circuit currents from the original electrical calculations for K-Reactor. Because there have been major equipment modifications, including removal of many of the electrical loads, the short-circuit analysis needs to be reevaluated using short-circuit currents based on the existing configuration of the electrical distribution system. Such an evaluation would verify the capability of the electrical equipment to perform safely without initiating a fire or an explosion.

DOE RESPONSE:

As part of Safe Operations per the contract, work to validate the 105-K 480V electrical drawings is ongoing and scheduled to complete this year. A short circuit analysis calculation is in progress and is scheduled for completion in April 2004. Equipment capability evaluations will be conducted immediately thereafter. The expected calculated fault currents will be lower than historical values due to reduced motor loads,

disconnected generators, and removal of one of the four main transformers. It is not anticipated that this re-analysis will identify significant issues with the safe operation of the electrical distribution system. However, re-design and/or replacement of some small number of electrical components may be warranted. This overall effort will ensure the longer term safe operation of the electrical distribution system. This is considered "best practice" and is being conducted as a level-of-effort activity.

BUILDING 235-F

DNFSB ISSUE:

Lightning Protection System - The current lightning protection system is intended to provide protection via the partial Faraday cage that is established by the building's interconnected structural steel rebar. However, the existing arrangement is rendered ineffective by un-bonded metallic penetrations that breach the cage boundary. By attaching to an un-bonded rooftop or high-elevation penetration, lightning energy (capable of igniting in-situ combustibles) could couple directly into the facility, bypassing the rebar cage altogether. Given the lack of viable fire suppression capabilities in 235-F, it would be prudent to install a lightning protection system compliant with National Fire Protection Association (NFPA) Standard 780, Standard for the Installation of Lightning Protection System.

DOE RESPONSE:

The Building 235-F Fire Hazards Analysis (FHA) is being revised for the planned storage and surveillance project and the extended life of the facility. Upon its completion in the 2nd quarter FY 2004, DOE-SR will review the results of the FHA to determine what action is required concerning lightning protection.

DNFSB ISSUE:

National Electric Code (NEC)-Type Assessments - The electrical distribution system in 235-F was installed in accordance with the 1957 version of the NEC. Facility personnel were unaware of any assessments performed in recent years to ensure compliance with either the current NEC or the code of record. Such assessments are performed routinely for the commercial nuclear industry by NEC-qualified inspectors and have been performed for other facilities at SRS to evaluate electrical systems for compliance with the NEC. The staff believes it would be beneficial to assess the existing electrical system for 235-F against current code requirements to identify potential fire hazards and understand latent system vulnerabilities.

DOE RESPONSE:

The implementation of national codes and standards at SRS is governed by the SRS Engineering Standards Manual, WSRC-TM-95-1, which requires the code of record to

govern the design associated with existing facilities. Specifically, related to the NEC, operating facilities at SRS are required to design and install new equipment in compliance with the current NEC. The NEC does not currently have a requirement to assess existing equipment against the current NEC or to update equipment as the NEC is revised.

SRS does look at the electrical equipment for unsafe conditions on an ongoing basis. Training of the electrical mechanics, electrical Quality Assurance inspectors, and electrical engineers working on the facilities on the National Electrical Code is ongoing. Corrective maintenance and/or Non-Conformance Reports are issued to correct any discrepancies found. In addition, a Configuration Management program has been completed on the 480V portion of the 235-F facility. The electrical personnel who do the inspections on the equipment are experienced electrical workers with a good knowledge of the National Electrical Code. The DOE-SR 235-F Electrical Safety System Specialist has also been trained on the NEC Code.

In addition, the site uses its lessons learned program to proactively investigate any electrical safety issue identified, look at the current NEC for compliance and follow up in all other site facilities.

Equipment designed and installed under the 235-F storage and surveillance project, will be compliant with current codes and standards, including the current NEC. Any equipment categorized as Safety Significant (SS) or Safety Class (SC) will be either installed new to the current NEC or will have a backfit analysis, including a NEC assessment that will verify that the safety functions of the safety related systems can be performed.

DNFSB ISSUE:

Calibration of Protective Devices - To ensure reliable operation, Institute of Electrical and Electronics Engineers (IEEE) Standard 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, recommends that electrical protective devices be maintained and calibrated in accordance with manufacturer's recommendations. The 235-F circuit breakers and relays are maintained on a 5-year calibration frequency. Representatives of 235-F could not verify whether this calibration frequency is consistent with the manufacturer's recommendation. The Board's staff believes the calibration tests on the breakers and relays should be in accordance with the manufacturer's recommendation to ensure that the equipment will operate as designed.

DOE RESPONSE:

Preventative maintenance (PM) and calibration frequencies for new equipment are established based on manufacturer's recommendations. Based on equipment performance and maintenance history, an engineering evaluation is performed to adjust

the frequency of the preventive maintenance. Using this process, the SRS Site Circuit Breaker committee allows the Design Authority to increase the frequency of the circuit breaker PM's up to 5 years.

There are three types of circuit breakers in 235-F. The General Electric (GE), Model AK breakers are 1970's vintage, have had good reliability and the frequency has been increased from 3 to 5 years. The Nelson Electric ITE breakers are 1950's vintage. However, the PM on these breakers is a complete re-work, the breaker completely disassembled, cleaned, lubricated, and reassembled per Manual Y17, Procedure 7-22003. These breakers are heavy duty and contain more conducting surface area than newer breakers. Combining the heavy duty design, the complete rework, and the long history of reliability and familiarity with this breaker, the frequency has been changed from 3 to 5 years. The frequency of Brown-Boveri Model LK, LKD, & K-DON breakers will be changed to 3 years in accordance with the manufacturer's recommendations. A schedule will be established within several months with the details to implement this change. Relay frequencies have undergone similar engineering evaluations and are currently on a 3-year frequency.

Additionally, the facility will be performing a review of Electrical Power Research Institute (EPRI) guidelines concerning life extension of electrical equipment. If, during these reviews, additional guidance is found on breaker PM frequencies, it will be applied to the facility. The review will start in January 2004 and take approximately 12 months to complete. This is considered "best practice" and is being conducted as a level-of-effort activity.

DNFSB ISSUE:

Electrical Cables-The majority of the electrical cables in 235-F are approximately 50 years old and have exceeded their estimated design life. Power, instrumentation, and control cables can deteriorate during service. When cable jackets and insulating materials age, they become brittle and may crack. Because a number of facility safety systems rely on the working condition of these cables, continued monitoring of their condition is an essential part of effective preventive maintenance. Such monitoring of the condition of the cables improves the service life and reliability of electrical equipment by detecting damaged and deteriorating power and instrumentation and control cables prior to equipment failure. Several techniques for this type of monitoring exist; for example, the Defense Waste Processing Facility at SRS uses an Electronic Characterization and Diagnostics (ECAD) system for monitoring the condition of cables. The types of degradation and problems that can be detected by the ECAD system are changes to dielectric materials, deterioration of circuit insulation, high-resistance connections, short circuits, open circuits, moisture intrusion, circuit noise, and development of conducting paths. The condition of safety-related cables needs to be determined using a suitable system for monitoring the condition of the cables to support a long-term storage mission in this building.

DOE RESPONSE:

The 235-F facility is similar in age and design to many other facilities on site. ECAD testing was not implemented in 235-F since ECAD testing within other facilities of similar age and design had not detected any discernable pattern of cable degradation.

The 292-2F Sandfilter Fan house was installed with new electrical equipment in the 1980's. This encompasses more than 90% of the SS/SC electrical cables for the facility. A representative sample of the remaining SS/SC cables within the 235-F building will be megger tested to verify acceptable electrical cable condition.

Predictive maintenance is currently performed on electrical equipment in 235-F. Thermography has been initiated on the terminations of cables in cubicles, switches, and lighting panels and has been useful in showing possible problems with the equipment before failure. Corrective actions and follow-up thermography are performed as needed. Thermography is currently performed on a two year frequency and will be revised to annually.

The use of thermography is based on the requirements in DOE Order 433.1 Maintenance Management Program for DOE Nuclear Facilities and DOE Order 5480.4 Environmental Protection, Safety, and Health Protection Standards. Electrical equipment inspections are performed on approximately 255 electrical components in the 235-F facility using the guidelines and or standards for thermography scans found in:

- ASTM E 1934-99a, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
- National Electric Testing Association (NETA) Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems, Section 9, "Thermographic Survey".
- National Electric Testing Association (NETA) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, Section 9, "Thermographic Survey".
- NFPA-70B Recommended Practice for Electrical Equipment Maintenance

The facility will be performing a review of EPRI guidelines concerning life extension of electrical equipment. If, during these reviews, additional guidance is found on cable preventive maintenance, it will be applied to the facility. The review will start in January 2004 and take approximately 12 months. This is considered "best practice" and is being conducted as a level-of-effort activity.

FB-LINE

DNFSB ISSUE:

Ampacity Derating of Fire-Protected Cables – In one of the stairwells, the power, instrumentation, and control cables routed through the cable trays are coated with a protective material (Flammastik) to prevent the initiation and rapid propagation of fire. Such protective coatings may reduce the heat transfer characteristics associated with the ampacities codified in industry standards. Hence, ampacity testing to determine whether the coating has affected the rating of fire-protected cable systems is necessary. The Board's staff believes IEEE Standard 848- 1996, IEEE Standard Procedure for the Determination of the Ampacity Derating of Fire-Protected Cables, should be used to evaluate the adequacy of the coated cables in the stairwell, as well as in other locations where such coated cables exist.

DOE RESPONSE:

An engineering evaluation of these cables is in progress. These cables were coated with the fire retardant material to correct deficiencies called out in 96-NCR-03-0132. This NCR (Non-Conformance Report) was written as a result of installation of a Fiber Optic Data Highway for the FB-Line Digital Control System. While the cables identified in the NCR are for instrumentation/communication (which would not be a concern), some power cables may have also been included when the coating was applied in 1997. The application of this material was limited to the north interior personnel stairwell between fifth and sixth level of FB-Line. Before a final evaluation can be completed, further definition of the electrical loads supplied by these cables is necessary. (Note: there are no safety-related electrical power supplies or cables within the 221-PB-Line facility structure.) It is believed from a preliminary review that:

- the number of power cables is limited,
- several of the power cables are presently de-energized due to the wet chemistry processes being placed in a suspended state, and
- the remaining cables are likely operating at a reduced load.

Two other positives are the Flammastik was applied as a single-layer coating (versus a thick casing around the cables) and the cable trays are located in a climate-controlled location. A final evaluation should be completed by the 2nd quarter FY 2004.

DNFSB ISSUE:

NEC-Type Assessments - As discussed above for Building 235-F, it would be beneficial to assess the existing electrical system against current code requirements to identify potential fire hazards and understand latent system vulnerabilities.

DOE RESPONSE:

The final FB-Line facility production mission centers on the completion of thermally stabilizing and packaging various plutonium and uranium oxide materials. This production mission results in the de-inventorying of FB-Line and concludes around May 2005. By early calendar year 2006 the FB-Line facility is scheduled to be deactivated which includes all electrical distribution systems in the facility being de-energized and placed in a safe state.

With the anticipated short production life of the facility, the current systems in place to address and correct electrical deficiencies/issues are deemed adequate.