

## DEFENSE NUCLEAR FACILITIES SAFETY BOARD

January 9, 1995

**MEMORANDUM FOR:** G. W. Cunningham, Technical Director

**COPIES:** Board Members

**FROM:** Ajit Gwal

**SUBJECT:** Backup Power Supply Systems, Rocky Flats Environmental  
Technology Site, Report of Site Visit, September 27-29, 1994

1. **Purpose:** This memorandum provides a report of a visit by Defense Nuclear Facilities Safety Board (DNFSB) Staff members, Ajit Gwal and Todd Davis, to the Rocky Flats Environmental Technology Site (RFETS), Buildings 371, 771, 707 and 779, on September 27-29, 1994. The review focused on backup power supplies (i.e., Emergency Diesel Generators (EDGs) and Uninterruptible Power Supplies (UPSs)).
2. **Summary:** The review identified the following major issues and observations:
  - a. For the RFETS facilities reviewed, significant improvements and upgrades in system design, maintenance and testing are required to achieve a high confidence level for reliable emergency power availability.
  - b. The EDG in Building 779 is loaded to approximately 250% of the generator power capacity. RFETS has administrative controls in place to prevent overloading the generator until the excess loading is removed.
  - c. The Department of Energy (DOE) has taken steps toward improving the reliability of backup power systems with reports issued by an augmented evaluation team and a recently issued backup power supply standard. However, cognizant personnel at RFETS were not aware of this information and have no direction to implement the improvements.
  - d. Lead-acid battery ventilation in most facilities at RFETS is inadequate. Ventilation is necessary to prevent hazardous build-up of hydrogen gas. There is currently no plan to upgrade the battery ventilation systems to meet the requirements of American National Standards Institute (ANSI) C2, National Electric Safety Code.

3. **Background:** Emergency power systems at RFETS provide power to ventilation exhaust, instrumentation and control and other vital safety systems during a failure of offsite power. EDGs are required to accommodate emergency loads after approximately 10 to 50 seconds following a power failure. EDGs supply power for an extended period. UPSs use batteries to provide a continuous stable power supply during a power interruption; they are required where the 10 to 50 second power interruption is unacceptable. UPS only provides power for a short period, usually less than two hours.
  
4. **Discussion:**
  - a. Generator Overloading: The EDG in Building 779 is currently connected to loads that require approximately 250% of the generator power capacity. A work order is in place to reduce these loads. Except for informal hand calculations performed in 1978, loading calculations were not available for the EDG in Building 371. For the EDG in Building 771, there is no load sequence, interlock or procedural requirement to prevent two exhaust fans from starting simultaneously which could exceed the generator capacity and result in a loss of emergency power. Accurate emergency bus loading and sequencing information for all facilities should be available and utilized to prevent overloading and loss of emergency power.
  
  - b. Battery Ventilation: ANSI C2, National Electric Safety Code, requires adequate ventilation and ventilation alarms for rooms with lead-acid batteries to ensure hydrogen does not build-up and result in an explosion. All RFETS facilities reviewed do not have an alarm to detect a ventilation failure and do not conform to the requirements of ANSI C2. In addition to having inadequate battery ventilation, Building 771 has a space heater located in the overhead above the batteries that provides an ignition source.
  
  - c. DOE Standard: Based on a large number of incidents where EDGs failed to provide a backup power supply, DOE formed an Augmented Evaluation Team (AET) to review the reliability and availability of EDGs. The AET published its results in a November 1993 final report. As a part of the AET review, a DOE standard, issued by Office of Defense Programs-DOE (DP) facilities (DOE-DP-STD-3003), which incorporates the knowledge gained during the AET review. While the AET review included RFETS backup power systems, most personnel at RFETS were unfamiliar with the AET conclusions and the DOE-DP standard. The AET review and DOE-DP standard contain important guidelines for ensuring that backup power supplies are available when needed (e.g., design, preventive maintenance and surveillance requirements and reference to applicable commercial standards). This standard has recently been issued to establish fundamental requirements for backup power sources at all DOE facilities.

- d. Drawing Control: A one-line diagram of the Building 371 backup power system is posted in the utility control room and is used by operating personnel. However, the diagram is not a controlled drawing. RFETS personnel agreed the diagram should be a controlled drawing and are taking actions to correct the situation.
- e. Starting System: National Fire Protection Association (NFPA) 110, Emergency and Standby Power Systems, requires that the starting system be capable of three start cycles. Most of the EDGs at RFETS are not tested to demonstrate this capability.
- f. Load Test: Both the U.S. Nuclear Regulatory Commission Regulatory Guide 1.9, Selection, Design, and Qualification of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants; and DOE-STD-3003 require a 24-hour full load test every 18 months. The EDGs at RFETS are typically exercised twice monthly (once fully loaded and once unloaded) for one hour. Periodic demonstration of extended EDG operation is necessary to identify problems not observed during the one-hour tests.
- g. Control System: The control system for the EDG in Building 371 was manufactured before 1978 and uses mechanical relay devices to provide control signals to start the EDG during a power failure. Failure of the control system has prevented the EDG from starting on several occasions in the last two years. RFETS is considering a control system upgrade; however, a schedule has not been established.
- h. Electrical Calculations: Protective device coordination analysis has not been performed, except for Building 771. Lack of coordination increases the number of components affected by a short circuit. In addition, a review of the emergency breaker ratings compared with the available short circuit currents has not been done. Both reviews are necessary to demonstrate an adequate emergency power system.
- i. Redundant Systems: A redundant and independent backup power supply provides increased emergency power system reliability. RFETS facilities were not originally designed to provide redundant backup power supplies. Two EDGs in Building 771 can each supply all emergency loads; however, because the #2 EDG is located in a building which is not insulated or heated, the generator does not meet starting requirements during cold temperatures. For the Building 707 emergency power supply system, two separate EDGs are required to supply the emergency loads. Because the #2 EDG supplies emergency power for the #1 EDG control system, operator action is required to prevent failure of the #2 EDG from effecting the #1 EDG. EG&G is currently in the process of upgrades in Building 707 needed to achieve a reliable redundant and independent emergency power system.

- j. Preventive Maintenance: The staff was told that there is no preventive maintenance performed on the EDG in Building 707. A routine preventive maintenance program in accordance with NFPA 110, Standard for Emergency and Standby Power Systems, is essential to ensuring reliable emergency power to vital safety systems.
5. **Future Staff Actions**: The DNFSB Staff intends to perform the following reviews to assess the progress of RFETS personnel in resolving the issues identified in this memorandum:
- a. Progress of emergency power system upgrades. Including implementation of recommendations contained in the DOE backup power review and the DOE backup power standard regarding design, preventive maintenance and testing.
  - b. Progress of reducing the generator loading for the EDG in Building 779 and the load sequencing control for Building 771.
  - c. Resolution of lead-acid ventilation system inadequacies.
  - d. Progress of improvements in the EDG starting and control systems.
  - e. Protective device coordination and short circuit calculations for the emergency supply system.