

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

November 15, 2007

NRC INFORMATION NOTICE 2007-36: EMERGENCY DIESEL GENERATOR VOLTAGE
REGULATOR PROBLEMS

ADDRESSEES

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of recent operating experiences involving the emergency diesel generator (EDG) voltage regulator problems. The NRC expects that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. Suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

There have been recent operating experiences with EDG voltage regulator problems at the following nuclear stations:

Seabrook Generating Station

On August 30, 2006, during a fast start test of the "A" EDG, the EDG voltage regulator diode failure warning light illuminated. Data obtained at test points within the EDG voltage regulator indicated that there were anomalies with the gate firing circuit output pulses to the silicon controlled rectifiers (SCRs) on the rectifier assembly. On September 27, 2006, the "A" EDG experienced an additional diode failure light illumination. The subsequent troubleshooting determined that the K1 contactor was defective with one phase not making ideal contact.

During surveillance testing of the "B" EDG on August 31, 2006, the EDG voltage regulator diode failure light illuminated and the EDG output voltage failed high and could not be controlled in the automatic mode. Initial troubleshooting of the "B" EDG voltage regulator failure identified degradation in one of the seven capacitors in the power chassis. The licensee's root cause evaluation for this event discussed that the "B" EDG at Seabrook Station had a history of intermittent overvoltage problems, including two overvoltage events in 2005. The evaluation

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attributed the root cause of the intermittent overvoltage problem to a higher than expected impedance in the flyback diode portion of the rectifier chassis circuitry. The high impedance caused one of the SCRs to become latched on during the transient conditions experienced during a fast start of the EDG. The mock-up testing demonstrated that the rectifier chassis installed during the August 31, 2006, event exhibited an SCR lock-up when exposed to conditions that simulate an excitation system during the fast start. (NRC Special Inspection Report 05000443/2006016 dated February 16, 2007, Agencywide Documents Access and Management System (ADAMS) Accession No. ML070510065)

Palo Verde Generating Station

On September 22, 2006, the "A" EDG at Palo Verde Unit 3 failed to attain its required voltage during post maintenance surveillance testing. This occurred because the field shorting K1 contactor (also referred to as the K1 relay) did not fully reset, preventing field excitation. (The field flashing relay and the shut-down relay/contacter (K1) are interlocked to prevent field flashing unless the shut-down relay/contacter is reset.) The root cause was determined to be insufficient compression on the auxiliary contacts of the K1 contactor due to a bent metal actuator arm in the K1 contactor assembly.

A similar prior event had occurred on July 25, 2006, at Palo Verde Unit 3 when the "A" EDG failed to attain its required voltage. At that time the licensee's investigation into that occurrence determined that an auxiliary contact of the K1 contactor had an erratic resistance reading in the closed state. The licensee determined that the most probable cause was contamination on the contact surfaces. Investigation of the September 22, 2006, failure concluded that the K1 contactor that initially failed on July 25, 2006, and was replaced, was vulnerable to the same inadequate DC auxiliary contact compression as the September 22, 2006, failure, in addition to the debris and oxidation buildup inside the auxiliary contact. (Licensee Event Report 2006-006-01 dated March 9, 2007, ADAMS Accession No. ML070820085 and NRC Special Inspection Report 05000528/2006012; 05000529/2006012; 05000530/2006012 dated December 6, 2006, ADAMS Accession No. ML063400561)

Cooper Generating Station

On January 18, 2007, approximately three hours into a loaded surveillance run of EDG 2 at Cooper Station, the EDG output breaker tripped on an overcurrent condition, followed immediately by an overvoltage trip of EDG 2. The root cause was determined to be failure of the voltage regulator printed circuit board due to a failed zener diode on the printed circuit. The board had been installed in EDG 2 on November 11, 2006, as corrective maintenance to repair a failed potentiometer on the previously installed circuit board. (NRC Special Inspection Report 05000298/2007007 dated May 22, 2007, ADAMS Accession No. ML071430289)

Part 21 Notification

On September 21, 2007, MPR Associates Inc. issued a Part 21 report on the analog electronic circuit card used in the automatic voltage regulator (AVR) assembly of Basler SBSR voltage regulators (ADAMS Accession No. ML072750470). The report identified that, over a period of many years, cracks can form in the solder joint connections between the electronic circuit card and the L1 magnetic amplifier module of the AVR. When electrical continuity is lost at the

solder connections, the voltage regulator does not perform as intended, and the EDG could fail to deliver emergency AC power as intended.

DISCUSSION

Licenseses rely on EDGs to provide emergency alternating current power in response to loss of offsite power events. EDGs are required to be operable as specified in plant technical specifications. Although the first two events above are recent examples, operating experience over the last ten years shows eight additional examples where EDGs at other plants have been rendered inoperable due to K1 relays or contactor problems. In addition, the voltage regulator systems of EDGs have experienced approximately fifty malfunctions of other kinds at various plants during the last ten years. EDG voltage regulators, typically of 1950-1960 vintage, have recently experienced aging and obsolescence issues that have created a heightened awareness among nuclear utilities because of the threat to overall EDG performance. The industry's situation is complicated by parts shortages and limited or nonexistent manufacturer support. The problems are of various types and are not limited to a typical single component or model of the voltage regulator. In general, the performance of a voltage regulator is very sensitive to any minor defects in any component of the voltage regulation system.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below.

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