UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

November 17, 1994

NRC INFORMATION NOTICE 94-77: MALFUNCTION IN MAIN GENERATOR VOLTAGE REGULATOR CAUSING OVERVOLTAGE AT SAFETY-RELATED ELECTRICAL EQUIPMENT

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees that a malfunction in the main generator voltage regulator could increase generator output voltage, which could cause an overvoltage condition at the Class 1E buses powering safety-related electrical equipment. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On March 1, 1993, a steam extraction line to a feedwater heater ruptured at Sequoyah Nuclear Plant, Unit 2. The steam from the ruptured pipe engulfed the nearby main generator voltage regulator cabinet. The heat and moisture caused the voltage regulator to malfunction, increasing the excitation to the main generator (overexcitation). The overexcitation caused the main generator voltage to rise about 19 percent above the normal output voltage. Main generator alarms annunciated in the main control room. After approximately 3 to 3½ minutes, the operators tripped the main generator manually because they could not control the generator output voltage. The turbine and reactor tripped in response to the generator trip. Although the overvoltage transient caused the voltage at the Class 1E buses to rise, the licensee determined that, in this instance, the voltages were within the design limits of the equipment involved.

On April 16, 1993, North Anna Power Station, Unit 2, automatically tripped while at 100-percent power in response to a main generator exciter field breaker trip because of overexcitation (overvoltage). The overexcitation was caused by a malfunction in the voltage regulator circuitry.

Discussion

The Class 1E buses that supply power to Class 1E electric equipment in a nuclear power plant are powered either from the startup transformers or from the main generator through the station service transformers. Regardless of the power source, the Class 1E buses can be exposed to overvoltage conditions if the main generator voltage regulator fails in the high field (overexcitation) position. Overexcitation of the generator field can produce overvoltage throughout the electrical system, including the switchyard.

Volts/hertz relays are usually supplied to protect generators and transformers from overexcitation of the generator field. When the ratio of volts to hertz exceeds a preset value, the volts/hertz relay initiates an alarm and, after a time delay, trips the main generator exciter field breaker. When the exciter field breaker opens, it interrupts excitation to the main generator field, causing the generator to trip. Although a volts/hertz relay was installed at Sequoyah Unit 2, it was used only to initiate an alarm in the control room. In contrast, a similar relay installed at North Anna Unit 2 initiates an alarm and also trips the main generator exciter field breaker. In addition, the transformers that supply power to the Class 1E buses from the grid at North Anna are equipped with automatic load tap changers. The load tap changers automatically switch taps in response to changes in switchyard voltage to maintain the proper voltage at the Class 1E buses.

After the event on March 1, 1993, the licensee for Sequoyah Unit 2 installed a second volts/hertz relay. This relay automatically trips the main generator exciter field breaker to end generator overexcitation conditions that could damage the generator, transformers, and Class 1E electrical equipment. A similar relay was already installed at Sequoyah Unit 1.

Main generator protective relays designed only to activate an alarm and not to trip the field breaker in response to overexcitation may not protect the associated Class 1E electrical equipment from voltages beyond the design limits of the equipment.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts: Peter J. Kang, NRR
(301) 504-2779

Om P. Chopra, NRR
(301) 504-3265

Attachment:
List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-76	Recent Failures of Charging/ Safety Injection Pump Shafts	10/26/94	All holders of OLs or CPs for pressurized water reactors.
93-60, Supp. 1	Reporting Fuel Cycle and Materials Events to the NRC Operations Center	10/20/94	All 10 CFR Part 70 fuel cycle licensees.
94-75	Minimum Temperature for Criticality	10/14/94	All holders of OLs or CPs pressurized-water reactors (PWRs).
94-74	Facility Management Responsibilities for Purchased or Contracted Services for Radiation Therapy Programs	10/13/94	All U.S. Nuclear Regulatory Commission Medical Licensees.
94-73	Clarification of Criticality Reporting Criteria	10/12/94	All fuel fabrication facilities.
94-72	Increased Control Rod Drop Time from Crud Buildup	10/05/94	All holders of OLs or CPs for pressurized water reactors.
94-71	Degradation of Scram Solenoid Pilot Valve Pressure and Exhaust Diaphragms	10/04/94	All holders of OLs or CPs for boiling water reactors (BWRs).
94-70	Issues Associated with Use of Strontium-89 and Other Beta Emitting Radiopharmaceuticals	09/29/94	All U.S. Nuclear Regulatory Commission Medical Licensees.
94-69	Potential Inadequacies in the Prediction of Torque Requirements for and Torque Output of Motor-Operated Butterfly Valves	09/28/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

Discussion

The Class 1E buses that supply power to Class 1E electric equipment in a nuclear power plant are powered either from the startup transformers or from the main generator through the station service transformers. Regardless of the power source, the Class 1E buses can be exposed to overvoltage conditions if the main generator voltage regulator fails in the high field (overexcitation) position. Overexcitation of the generator field can produce overvoltage throughout the electrical system, including the switchyard.

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Main generator protective relays designed only to activate an alarm and not to trip the field breaker in response to overexcitation may not protect the associated Class 1E electrical equipment from voltages beyond the design limits of the equipment.

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Original signed by
Brian K. Grimes

Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

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Attachment: List of Recently Issued NRC Information Notices

OFFICE	*RPB:ADM by Email	*OGCB:DORS	*EELB:DE	*EELB:DE
NAME	JMain	AJKugler	PKang	OChopra
DATE	09/14/94	09/26/94	09/26/94	09/26/94
OFFICE	*C/EELB:DE	*D/DE	*C/OECB:DORS	D/DORS
NAME	CHBerlinger	BWSheron	AEChaffee	BKGrimes
DATE	09/27/94	09/28/94	10/31/94	11/10/94

DOCUMENT NAME: 94-77.IN

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residents + PM's for both units soon