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

September 16, 1988

NRC INFORMATION NOTICE NO. 88-75: DISABLING OF DIESEL GENERATOR OUTPUT CIRCUIT BREAKERS BY ANTI-PUMP CIRCUITRY

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to potential problems where the capability to either automatically or manually close diesel generator circuit breakers from the control room may be lost. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On June 5, 1988, operators at Browns Ferry Unit 3 were unable to reclose the diesel generator output breakers to the 4-kV shutdown boards from the control room during a loss-of-power/loss-of-coolant-accident (LOP/LOCA) test. During the test, the output breakers connected the diesel generators to their respective 4-kV shutdown boards after the LOP signal was generated; however, the breakers tripped and remained open after receiving the LOCA signal. Operators diagnosed the output breaker lockout problem using system electrical configuration drawings. An operator was sent to the 4-kV shutdown board to manually transfer output breaker control power to its alternate source. This momentarily removed power, enabling the breaker to close when the power was restored.

On October 14, 1987, an operator at Wolf Creek Generating Station manually tripped the output circuit breaker of the emergency diesel generator (EDG) from the control room. At the time, the EDG was supplying a vital bus. When the operators tried to reenergize the vital bus from the still-operating EDG, they found that they could not close the EDG output breaker from the control room. The vital bus was finally reenergized from the offsite power supply. Through examination of the breaker control schematics the licensee later found that the EDG circuit breaker could be closed by cycling the EDG mode switch at the EDG local control station.

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Discussion:

The anti-pump circuit configuration will protect large breakers from rapid cycling and, under certain circumstances, will prevent breaker closure. At Browns Ferry Unit 3, a unique sequence of events, a LOP signal followed within 6 seconds by a LOCA signal, led to the discovery of a design deficiency of this circuit configuration. Contacts from the undervoltage relay will seal in the breaker anti-pump relay until the undervoltage condition on the 4-kV boards clears.

The circuit is designed such that following a LOP, the undervoltage condition must exist for at least 5 seconds and the diesel must reach rated speed before the diesel generator output breaker will close on the bus. Once the breaker has closed, the closure spring recharge motor and the breaker anti-pump relay will be energized. A fully discharged closure spring requires 2 seconds for the spring to be fully recharged. During this 2 second window the anti-pump coil will remain energized via contacts sensing spring position, and if an undervoltage condition exists on the 4-kV bus it will seal in and lock open the breaker.

During the Browns Ferry event, the EDG output breaker closed 5 seconds after the LOP signal, the undervoltage condition was eliminated, and the undervoltage relay began its 5 second cycle to reset from the undervoltage condition. About 1.5 seconds later, the LOCA signal retripped the breaker and created another undervoltage condition on the 4-kV bus. At this point, because the undervoltage relay had not completed its reset cycle, the undervoltage relay remained in its undervoltage state. Therefore, the undervoltage relay sealed in the still-energized anti-pump relay because the undervoltage condition occurred before the breaker charging spring was fully charged. Thus, the breaker could not be closed from the control room either manually or automatically until control power was removed, which deenergized the anti-pump relay.

The Browns Ferry licensee modified the breaker control logic to prevent the anti-pump relay from sealing in during a LOCA condition by adding a time-delay relay in the breaker trip coil circuitry. This relay will be energized by a LOCA signal and its contact in the anti-pump coil seal-in path will open after a 2-to 5-second delay to prevent anti-pump coil seal-in and breaker lockout.

The Wolf Creek EDG output circuit breaker has automatic closing logic to close the circuit breaker when the following five permissives are satisfied:

(1) Both offsite circuit breakers are open.
(2) The EDG mode switch is in the automatic mode.
(3) Lockout relays are deenergized.
(4) A 3-second time delay has elapsed.
(5) The EDG has reached operating speed and voltage.

This logic sends a constant close signal to the circuit breaker that keeps the breaker's internal anti-pump relay energized as long as the logic permissives are satisfied. The anti-pump relay prevents the circuit breaker from cycling if attempts are made to hold the breaker closed against a valid trip signal.

When the Wolf Creek operator manually tripped the EDG output breaker, the automatic closing logic permissives remained satisfied. Therefore, the anti-pump relay remained energized, preventing reclosure of the circuit breaker. Cycling the EDG mode control switch at the local control station allowed the circuit breaker to reclose by momentarily interrupting the automatic close signal, thereby resetting the anti-pump logic. When the mode switch contact was reclosed by returning the switch to the "auto" position, the circuit breaker's automatic closing logic closed the breaker.

The Wolf Creek licensee modified the EDG breaker control switch located in the control room to enable the operator to reclose the EDG circuit breaker from the control room. This switch was originally intended only as a means of paralleling the EDG with the offsite power supply. With the current modification, the switch can be used to reset the anti-pump logic and allow the automatic circuit to reclose the breaker. The modification added a contact that is closed in the "normal" position and open in the "trip" and "pull to lock" positions of the control switch. When operators manually trip the EDG circuit breaker from this control switch, the contacts open to interrupt the close circuit and reset the circuit breaker anti-pump relay. If the operator wishes to keep the breaker open, he must put the switch in the "pull to lock" position. Returning the switch to the "normal" position completes the automatic close circuit and the breaker recloses.

It should be noted that although the above discussion has dealt only with EDG output circuit breakers, anti-pump circuit problems could also apply to other breakers that use automatic closing logic, such as load-sequencing breakers and offsite supply breakers to the emergency buses.

The information herein is being provided as an early notification of a potentially significant matter that is still under consideration by the NRC staff. If NRC evaluation so indicates, specific licensee actions may be requested.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: James Lazevnick, NRR
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Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-74	Potentially Inadequate Performance of ECCS in PWRs During Recirculation Operation Following a LOCA	9/14/88	All holders of OLs or CPs for W and B&W-designed nuclear power reactors.
88-73	Direction-Dependent Leak Characteristics of Containment Purge Valves	9/8/88	All holders of OLs or CPs for nuclear power reactors.
88-72	Inadequacies in the Design of dc Motor-Operated Valves	9/2/88	All holders of OLs or CPs for nuclear power reactors.
88-71	Possible Environmental Effect of the Reentry of COSMOS 1900 and Request for Collection of Licensee Radioactivity Measurements Attributed to That Event	9/1/88	All holders of OLs or CPs for nuclear power reactors, fuel cycle licensees, and Priority 1 material licensees.
88-70	Check Valve Inservice Testing Program Deficiencies	8/29/88	All holders of OLs or CPs for nuclear power reactors.
88-69	Movable Contact Finger Binding in HFA Relays Manufactured by General Electric (GE)	8/19/88	All holders of OLs or CPs for nuclear power reactors.
88-48, Supplement 1	Licensee Report of Defective Refurbished Valves	8/24/88	All holders of OLs or CPs for nuclear power reactors.
88-68	Setpoint Testing of Pressurizer Safety Valves with Filled Loop Seals Using Hydraulic Assist Devices	8/22/88	All holders of OLs or CPs for nuclear power reactors.
88-67	PWR Auxiliary Feedwater Pump Turbine Overspeed Trip Failure	8/22/88	All holders of OLs or CPs for nuclear power reactors.

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OFC	*OEAB	*Tech Ed	*SL:OEAB	*C:OEAB	*D:DEST	*C:OGCB	D:DOEA
NAME	CSchulten	BCalure	PBaranowsky	WLanning	LShao	CBerlinger	CERossi
DATE	9/7/88	7/28/88	9/7/88	9/7/88	8/24/88	9/8/88	9/13/88

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