

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

August 13, 1993

INFORMATION NOTICE 93-65: REACTOR TRIPS CAUSED BY BREAKER TESTING WITH
FAULT PROTECTION BYPASSED

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 to problems caused by high-voltage breaker testing with inadequate fault protection. 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 December 31, 1992, Tennessee Valley Authority workers were conducting differential relay phasing checks on a newly installed circuit breaker in the Sequoyah Nuclear Plant 500-kV switchyard when a 20,000 ampere phase-to-ground fault occurred in the breaker. Because all of the primary fault protection relays had been bypassed for the duration of these checks, the fault continued for about 1.5 seconds (90 cycles) before it was cleared by backup fault protection. The faulted breaker connected the 500-kV switchyard through inter-tie transformers to a 161-kV switchyard which provided power to both of the Sequoyah units through station service transformers. The fault caused a 61-kV drop in the 161-kV switchyard, which cascaded through the on-site power systems of both units, and affected the power to the reactor coolant pumps. The resulting pump undervoltage signals caused reactor trips for both units. The low voltage also affected the 6.9-kV shutdown boards, where it was sensed by the under voltage relays. These actuated, causing the safety-related buses to separate from the grid, and starting up and loading the emergency diesel generators.

The new breaker is an ASEA Brown Boveri power circuit breaker which contains sulfurhexafluoride (SF6) dielectric gas. This breaker is normally provided with a 20-cycle time delay between opening and closing by a closing delay relay. However, this delay relay was bypassed during the timing tests of the breaker to improve the accuracy of the timing checks. Consequently this allowed the breaker to rapidly cycle open and close, thus mechanically damaging the breaker and ejecting particulate contamination into the

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dielectric gas. The electrical fault in the breaker is believed to have resulted from breakdown of the dielectric gas due to contamination in the breaker.

Discussion

The Sequoyah customer group personnel performed most of the vendor recommended post-installation tests on the new breaker with the breaker de-energized. However, the differential relay phasing checks had to be made with the breaker energized. The switching orders, which had been developed by the licensee for these checks, called for all primary protective relays to be disabled during the phasing checks by opening their trip cutouts. This was done because the licensee was concerned that operating the primary fault protection relays before they could properly verify the phasing of the differential relays would increase the chance of spurious trips. Had any of the primary protective relays remained in service, the fault would have cleared in about 3.5 cycles (instead of 90) and would most likely not have caused either unit to trip. The licensee assumed that the necessary fault protection would be provided by the backup protective relays. The operations personnel performing the tests did not question the switching orders, since the practice of disabling the protective relays was described as common practice by the licensee customer group and they were not aware that an electrical fault under these conditions could lead to the reactor trips.

The licensee strengthened its controls over customer group work activities that could have a significant effect on safety. These included:

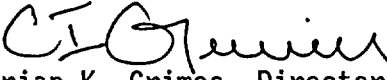
- (1) Requiring evaluation and approval of non-routine work in the switchyard to minimize the removal of protective devices and minimize the length of time that these devices are out of service.
- (2) Requiring approval by operations and maintenance managers in order to energize switchyard equipment with any protective relay trips disabled.
- (3) Requiring consultation with the manufacturer for testing beyond the manufacturer recommended tests.
- (4) Increasing the sensitivity of backup relay protection so as to maximize protection while phasing is in progress.

In order to complete the testing of the new breaker, the licensee changed the test procedures to prevent a recurrence of the initial problems. Changes included:

1. Leaving the anti-pump relay in its normal configuration. The delay induced by this relay was determined and subtracted from the total times measured during the timing checks.
2. Leaving at least one of the primary fault protection relays in its normal configuration. These relays were sequentially bypassed as necessary.
3. Reducing the time delay of the backup fault protection.

The testing problems discussed in this notice resulted in challenges to safety systems. Both the NRC and the industry have recognized the need to minimize such challenges.

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 contact listed below or the appropriate project manager in the Office of Nuclear Reactor Regulation.


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

Technical contacts: George MacDonald, RII
(404) 331-5576

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Attachment:
List of Recently Issued NRC Information Notices

Attachment
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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-64	Periodic Testing and Preventive Maintenance of Molded Case Circuit Breakers	08/12/93	All holders of OLs or CPs for nuclear power reactors.
93-63	Improper Use of Soluble Weld Purge Dam Material	08/11/93	All holders of OLs or CPs for nuclear power reactors.
93-62	Thermal Stratification of Water in BWR Reactor Vessels	08/10/93	All holders of OLs or CPs for boiling water reactors.
93-61	Excessive Reactor Coolant Leakage Following A Seal Failure in A Reactor Coolant Pump or Reactor Recirculation Pump	08/09/93	All holders of OLs or CPs for nuclear power reactors.
93-60	Reporting Fuel Cycle and Materials Events to the NRC Operations Center	08/04/93	All fuel cycle and materials licensees.
93-59	Unexpected Opening of Both Doors in An Airlock	07/26/93	All holders of OLs or CPs for nuclear power reactors.
93-58	Nonconservatism in Low-Temperature Overpressure Protection for Pressurized-Water Reactors	07/26/93	All holders of OLs or CPs for pressurized-water reactors.
93-57	Software Problems Involving Digital Control Console Systems at Non-Power Reactors	07/23/93	All holders of OLs or CPs for test and research reactors and nuclear power reactors.
93-56	Weakness in Emergency Operating Procedures Found as Result of Steam Generator Tube Rupture	07/22/93	All holders of OLs or CPs for pressurized water reactors.

OL = Operating License
CP = Construction Permit

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1. Leaving the anti-pump relay in its normal configuration. The delay induced by this relay was determined and subtracted from the total times measured during the timing checks.
2. Leaving at least one of the primary fault protection relays in its normal configuration. These relays were sequentially bypassed as necessary.
3. Reducing the time delay of the backup fault protection.

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orig /s/'d by CIGrimes
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*See previous concurrence.

OGCB:DORS	BC:EELB:NRR	RII	RII
*DKirkpatrick	*CBerlinger	*AGibson	*GMacDonald
04/29/93	05/19/93	07/01/93	07/01/93

RII	Tech Ed.	BC:OGCB:DORS	D:DORS:NRR
*MShymlock	*RSanders	GHMarcus	BKGrimes
07/01/93	04/29/93	08/05/93	08/9/93

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for

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In order to complete the testing of the new breaker, the licensee changed the test procedures to prevent a recurrence of the initial problems. These included:

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2. Leaving at least one of the primary fault protection relays in its normal configuration. These relays were sequentially bypassed as necessary.
3. Reducing the time delay of the backup fault protection.

With these changes in place, the licensee did not experience any problems during the retesting.

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*SEE PREVIOUS CONCURRENCE

OFFICE	OGCB:DORS	BC:EELB:NRR	RII	RII	RII
NAME	*DKirkpatrick/vsb	*CBerlinger	*AGibson	*GMacDonald	*MShymlock
DATE	04/29/93	05/19/93	07/1/93	07/1/93	07/1/93

Tech Ed.	BC:OGCB:DORS	D:DORS:NRR
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NAME	*DKirkpatrick/vsb	*CBerlinger	<i>DK for</i> AGibson	<i>DK for</i> GMacDonald	<i>DK for</i> MShymlock
DATE	04/29/93	05/19/93	<i>by phone</i> 07/1/93	<i>by phone</i> 07/1/93	<i>by phone</i> 07/1/93

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NAME	DKirkpatrick/vsb <i>DCK</i>	CBerlinger	AGibson	GMacDonald <i>(d)</i>	MShymlock
DATE	<i>4/29/93</i> 05/29/93	05/ /93	05/ /93	05/ /93	05/ /93

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