

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

September 17, 1993

NRC INFORMATION NOTICE 93-75: SPURIOUS TRIPPING OF LOW-VOLTAGE POWER CIRCUIT BREAKERS WITH GE RMS-9 DIGITAL TRIP UNITS

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 the potential for loss of safety-related buses or individual loads because of spurious tripping of low-voltage circuit breakers fitted with General Electric (GE) RMS-9 digital trip units. 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

In October 1992, the Tennessee Valley Authority (TVA) reported to the NRC pursuant to Part 21 of Title 10 of the Code of Federal Regulations (10 CFR Part 21) that the ungrounded, delta-connected, 480-volt distribution system at its Browns Ferry Nuclear Plant (BFN) had experienced short-duration, high-amplitude current transients (possibly high-frequency electrical noise spikes) that caused unwanted tripping of some GE AK-type circuit breakers fitted with GE RMS-9 solid-state digital trip units. These units have a low-pass filter (described by some as a "holdoff circuit") that is supposed to exclude most transients of this sort. However, TVA reported that testing of the trip units revealed that the instantaneous trip function of the trip unit would respond to current transients as short as 100 microseconds and trip the breaker when the peak amplitude of the current pulse or spike was sufficiently above the instantaneous trip setpoint of the RMS-9 unit.

On August 4, 1993, the NRC was informed that the Maine Yankee Nuclear Power Plant had a similar situation that the licensee described as sympathetic tripping of two safety-related, RMS-9-equipped breakers, one of which was a load breaker (with longtime and instantaneous trip functions) and the other a motor control center (MCC) feeder breaker (with longtime-shorttime trips). Both of the affected breakers were fed from the plant's delta-connected, 480-volt, engineered safeguards buses which are of an ungrounded design like

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those at Browns Ferry. The trips may have been initiated by current spikes caused by an intermittent ground fault on the boric acid makeup tank startup heaters, a nonsafety-related load on that bus; although their breaker did not trip. Also, the trips occurred during the process of ground isolation which may have created or contributed to transients on the busses. However, the transients were not sufficient to trip other RMS-9-equipped breakers, some of which, acting as Class 1E isolation devices, are meant to protect the safety-related busses from faults and overloads on nonsafety-related circuits, which are also not environmentally qualified.

Discussion

In both these cases, the digital RMS-9 units were installed in GE AK-type low-voltage power circuit breakers as conversion kits to replace either earlier versions of solid state units or the electromechanical EC-type series overload trip units previously used. According to the manufacturer, GE Electrical Distribution and Control (ED&C) in Plainville, Connecticut, the RMS-9 digital electronic units were first available in October 1986 and the last of the previous models, the analog electronic "MicroVersatrip" MVT-9 units, were supplied in about January 1987.

GE Nuclear Energy (GE NE) in San Jose, California, has informed the NRC that it is developing a modification specifically for the affected RMS-9 units at Browns Ferry to make them less susceptible to unwanted tripping due to these transients. In addition, ED&C is undertaking a systems study in cooperation with GE NE and Maine Yankee to determine the conditions conducive to these transients and to develop long-term or permanent solutions. These may be software and/or hardware modifications to the trip units and/or recommended modifications to the plant systems to prevent the unwanted tripping. Once fully developed and tested, any trip unit updates would be included in new RMS-9 units and GE switchgear service shops would install them in existing units. Trip units could then be interchanged in breakers in the field or purchased with new or replacement breakers.

Neither GE NE nor GE ED&C has issued any Service Information Letters (SILs) or Service Advice Letters (SALs), respectively, on this subject as yet. However, GE product literature indicates that the units can be set up with their instantaneous trip functions disabled. This may be more appropriate for certain applications (typically, feeder breakers) which, for purposes of breaker coordination, would rely on a short time trip function for fault protection, keeping the instantaneous trip functions only on load breakers.

The NRC is attempting to obtain sufficient information to better define the range of applications of these units, envelop the conditions likely to make the equipment susceptible to the problem, and identify any common-mode initiators that may exist. GE has confirmed that its evidence suggests that ungrounded systems (particularly if delta-connected) are apparently the most susceptible to the kind of transients to which the RMS-9s can respond. RMS-9 units, used only on low-voltage switchgear, are used in certain models of GE

molded-case circuit breakers, and "Power Break" circuit breakers in addition to the metalclad breakers. Although, none except those on metalclad air circuit breakers have reportedly experienced this problem, other RMS-9s may not have been exposed to the transients of concern. Meanwhile, GE NE and the GE Switchgear Apparatus Service Shop in Atlanta, Georgia, are currently assisting Maine Yankee in exchanging (at least temporarily) several critical RMS-9-equipped breakers for ones fitted with EC-type series trip units.

In terms of safety significance, these incidents of spurious tripping, although somewhat isolated, raise the concern that a common-mode initiator of intermittent ground faults on nonsafety-related and unqualified circuits, such as a loss-of-coolant accident or high-energy line break, could conceivably cause propagation of current spikes to multiple portions of an electrical distribution system. They may not trip Class 1E isolation breakers not fitted with RMS-9s, and may not trip some with RMS-9s, but could result in unwanted tripping of other RMS-9-equipped breakers and the attendant loss of vital loads, possibly in more than one train.

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

Technical contacts: Stephen D. Alexander, NRR
(301) 504-2995

Kamalakar R. Naidu, NRR
(301) 504-2981

Attachment:
List of Recently Issued NRC Information Notices

Attachment
IN 93-75
September 17, 1993
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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-74	High Temperatures Reduce Limitorque AC Motor Operator Torque	09/16/93	All holders of Ols or CPs for nuclear power reactors.
93-73	Criminal Prosecution of Nuclear Suppliers for Wrongdoing	09/15/93	All NRC licensees.
93-72	Observations from Recent Shutdown Risk and Outage Management Pilot Team Inspections	09/14/93	All holders of Ols or CPs for nuclear power reactors.
93-71	Fire at Chernobyl Unit 2	09/13/93	All holders of Ols or CPs for nuclear power reactors.
93-70	Degradation of Boraflex Neutron Absorber Coupons	09/10/93	All holders of Ols or CPs for nuclear power reactors.
93-69	Radiography Events at Operating Power Reactors	09/02/93	All holders of Ols or CPs for nuclear power reactors and all radiography licensees.
93-68	Failure of Pump Shaft Coupling Caused by Temper Embrittlement during Manufacture	09/01/93	All holders of Ols or CPs for nuclear power reactors.
92-16, Supp. 2	Loss of Flow from the Residual Heat Removal Pump during Refueling Cavity Draindown	08/23/93	All holders of Ols or CPs for nuclear power reactors.
93-67	Bursting of High Pressure Coolant Injection Steam Line Rupture Discs Injures Plant Personnel	08/16/93	All holders of Ols or CPs for nuclear power reactors.

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OFFICE	VIB/DRIL	VIB/DRIL	SC/VIB/DRIL	BC/VIB/DRIL	TECHED
NAME	SALEXANDER*	KNAIDU*	GCWALINA*	LNORRHOLM*	DGABLE*
DATE	8/05/93	8/05/93	8/11/93	8/11/93	8/06/93
COPY	YES	YES	YES	YES	NO
OFFICE	D/DRIL/NRR	BC/SELB/DEST	BC/OGCB/DORS	D/DORS	
NAME	CEROSI*	CBERLINGER*	GMARCUS*	BKGRIMES	
DATE	8/13/93	8/13/93	8/23/93	9/16/93	/ /93
COPY	YES	YES	YES NO	YES NO	YES NO

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DATE	8/13/93	8/13/93	8/23/93	9/ /93	/ /93
COPY	YES	YES	YES (NO)	YES NO	YES NO

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In terms of safety significance, these incidents of spurious tripping, although somewhat isolated, raise the concern that a common-mode initiator of ground faults on nonsafety-related and unqualified circuits, such as a loss-of-coolant accident or high-energy line break, could conceivably cause propagation of current spikes to multiple portions of an electrical distribution system. They may not trip Class 1E isolation breakers not fitted with RMS-9s, but could result in unwanted tripping of RMS-9-equipped breakers and the attendant loss of vital loads, possibly in more than one train.

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COPY	YES	YES	YES	YES	NO
OFFICE	D/DRIL/NRR	BC/SELB/DEST	BC/OGCB/DORS	D/DORS	
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DATE	8/13/93	8/13/93	8/ /93	8/ /93	/ /93
COPY	YES NO	YES NO	YES NO	YES NO	YES NO

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addition, the NRC has learned that certain early versions of the RMS-9 units had instantaneous trip functions that could not be bypassed or the time delay adjusted, indicating a possible misapplication problem.

The NRC is attempting to obtain sufficient information to better define the range of applications of these units, envelope the conditions likely to make the equipment susceptible to the problem, and identify any common-mode initiators that may exist. GE Nuclear Energy personnel, associated with GE's Switchgear Apparatus Service Shop in Atlanta, Georgia, have informed the NRC that GE is developing a modification for the RMS-9 circuitry to correct the problem. GE also explained that its evidence suggests that ungrounded and/or delta-connected (grounded or ungrounded) systems are most susceptible to the kind of transients to which the RMS-9s can spuriously respond. GE is currently assisting Maine Yankee in exchanging (at least temporarily) RMS-9-equipped breakers for ones fitted with EC-type series overloads.

Meanwhile, the incidents of spurious tripping, although isolated, raise the concern that a common-mode initiator of ground faults such as a loss-of-coolant accident or high-energy line break could conceivably cause propagation of short-duration, high-current transients to multiple portions of an electrical distribution system which could result in spurious tripping of RMS-9-equipped breakers and the attendant loss of vital loads, possibly in more than one train. 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.

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COPY	YES NO	YES NO	YES NO	YES NO	YES NO

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and Control in Plainville, Connecticut) providing trip units that are less sensitive to high-amplitude, short-duration current transients. However, the NRC has learned that certain early versions of the RMS-9 units had instantaneous trip functions that could not be bypassed or the time delay adjusted indicating also a potential misapplication problem.

The NRC is attempting to obtain sufficient information to better define the range of applications of these units, envelope the conditions likely to make the equipment susceptible to the problem, and identify any common mode initiators that may exist. GE Nuclear Energy personnel associated with GE's Atlanta, Georgia, Switchgear Apparatus Service Shop have informed the NRC that GE is developing a modification for the RMS-9 circuitry to correct the problem. GE also explained that its evidence suggests that ungrounded and/or delta-connected (grounded or ungrounded) systems are most susceptible to the kind of transients to which the RMS-9s can spuriously respond. GE is also currently assisting Maine Yankee in exchanging (at least temporarily) RMS-9-equipped breakers for ones fitted with EC type series overloads.

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OFFICE	D/DRIL/NRR	BC/SELB/DEST	BC/OGCB/DORS	D/DORS	
NAME	CEROSI	CBERLINGER	GMARCUS	BKGRIMES	
DATE	8/ /93	8/ /93	8/ /93	8/ /93	/ /93
COPY	YES NO	YES NO	YES NO	YES NO	YES NO

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DATE	8/5/93	8/5/93	8/ /93	8/ /93	8/ /93
COPY	YES	YES	YES	YES NO	NO
OFFICE	D/DRIL/NRR	BC/SELB/DEST	BC/OGCB/DORS	D/DORS	
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DATE	8/ /93	8/ /93	8/ /93	8/ /93	/ /93
COPY	YES NO	YES NO	YES NO	YES NO	YES NO