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

July 9, 1992

NRC INFORMATION NOTICE 92-51: MISAPPLICATION AND INADEQUATE TESTING OF MOLDED-CASE CIRCUIT BREAKERS

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 that were recently observed concerning the application and testing of molded-case circuit breakers (MCCBs). 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

During research and inspection activities, the NRC staff has found that licensees, when determining the MCCB parameters for motor loads, occasionally underestimate or neglect to consider the inrush transient (starting) current (ITC) occurring during the first few cycles after a motor is started. Often only the locked rotor current (LRC) is considered in selecting the appropriate MCCB.

If no special starting methodology is used to specifically limit the ITC, the magnitude of the ITC can be as much as approximately three times the LRC. Also, depending on the electrical characteristics of the power supply and the impedance of the motor when started, the ITC can increase to as much as approximately six times the value of the LRC. A current of this magnitude is greater than the maximum instantaneous trip setting for circuit protection recommended by the National Electric Code (NEC). Therefore, the NEC recommended level of protection may be insufficient to prevent an unwanted trip. Proper application of MCCBs depends strongly upon the use of accurate design assumptions.

Another application problem involves the use of MCCBs equipped with both thermal overload trip elements and instantaneous magnetic trip elements. A newly purchased replacement Westinghouse Type HFB3125 ambient compensating MCCB tripped when a hydrogen skimmer fan motor at the Catawba Nuclear Station

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was started during testing after installation. Duke Power Company personnel did not expect the MCCB to trip since the peak value of the ITC for the fan motor was thought to be well below the instantaneous trip band of that MCCB (NRC Inspection Report 99900404/90-01). A similar Westinghouse MCCB used as a turbine room sump pump breaker tripped in a similar manner at the Donald C. Cook Nuclear Power Plant. (NRC Inspection Report 99900404/90-21).

Westinghouse determined that most of its thermal-magnetic MCCBs with the nonadjustable instantaneous magnetic trip function could trip inadvertently. Westinghouse attributed this behavior to interaction between the thermal overload trip function and the instantaneous magnetic trip function under overload conditions. Under nonfault conditions, these functions may interact when the circuit current causes the thermal trip element to deflect until it presses on the MCCB's tripper bar at the same time that the instantaneous magnetic armature is vibrating against the tripper bar. This interaction causes the MCCB to trip.

Westinghouse notified nuclear licensees of this problem and recommended that they test these MCCBs in their intended circuits before releasing them for plant operation. Westinghouse also stated this recommendation on certificates of conformance provided with its dedicated MCCBs sold as safety-related items.

Potential interactions between thermal overload and instantaneous trip functions can be avoided by using a special class of MCCBs that are designed specifically for motor loads. These MCCBs include only instantaneous magnetic trip functions for protecting against faults or short circuits. The trip setpoints are normally adjustable and more accurate than those in thermal-magnetic MCCBs. These MCCBs, commonly referred to by the Westinghouse term "motor circuit protectors," are intended for use in combination with motor contactors or starters. Thermal overload relays contained in the contactors or starters provide the coordinated protection against overloads and fault currents which are below the magnitude necessary to actuate an instantaneous trip of the MCCB.

Instances of premature tripping have occurred with MCCBs manufactured by ITE-Siemens Company. The Carolina Power and Light Company, licensee for the Shearon Harris Nuclear Power Plant, found that some of the 480 volt MCCBs manufactured by ITE-Siemens, and purchased as commercial-grade, tripped prematurely when tested (NRC Inspection Report 99901177/90-01). The licensee had purchased these MCCBs as replacements for some older 600 volt ITE-Siemens MCCBs. The ITE-Siemens Company tested the 480 volt MCCBs and found that these trips were initiated by the MCCBs' instantaneous magnetic trip function, when induction motor loads were started. The manufacturer tested the older 600 volt MCCBs and found no premature trips. Rather, the older 600 volt MCCBs tripped at currents significantly above the levels at which an instantaneous trip should have occurred.

The licensee's testing of the 480 volt MCCBs was judicious. ITE-Siemens stated that the instantaneous trip setpoints of commercial grade MCCBs with nonadjustable magnetic trips are not normally verified at the factory. However, ITE-Siemens and possibly other manufacturers of MCCBs will, upon request, verify that the instantaneous magnetic trip points of their commercial grade MCCBs with nonadjustable magnetic trips supplied to nuclear utilities fall within the appropriate design band. Nevertheless, field testing of other MCCBs may be needed to verify that their magnetic trip points occur within the design band (but not below the band) because other manufacturers may not routinely provide this verification for commercial grade MCCBs. For this type of MCCB, most manufacturers check only that the MCCB will trip instantaneously, without determining the current level at which the trip occurs.

Discussion

An MCCB can render safety-related equipment inoperable if it trips prematurely. Premature trips can result if the incorrect MCCB is selected (and/or incorrectly adjusted) as a result of inadequate analysis of the load circuit including dynamic analysis of expected transients when determining ratings, settings and coordination requirements. Premature trips can also occur with properly applied and set MCCBs that are operating out of tolerance when incorrect bench testing methods and/or inadequate post-installation testing fail to detect the out of tolerance performance.

Acceptable testing methods and specifications are provided in some MCCB manufacturers' technical publications. Industry and professional organizations also provide guidance on MCCB testing methods, including generic acceptance criteria, in documents such as the National Electrical Manufacturers Association (NEMA) Standard AB4-1991, "Guidelines for the Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications." It should be noted that the application of generic field test tolerances to the instantaneous trip band on manufacturers' time-current characteristic curves may not always ensure that the MCCBs meet plant-specific breaker coordination, circuit protection or technical specification requirements.

Testing of properly applied and set MCCBs in accordance with industry recommended practices should provide reasonable assurance that the MCCBs' instantaneous trip performance is acceptable for safety-related applications.

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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Office of Nuclear Reactor Regulation

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Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
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Information Notice No.	Subject	Date of Issuance	Issued to
92-50	Cracking of Valves in the Condensate Return Lines of A BWR Emergency Condenser System	07/02/92	All holders of OLs or CPs for BWRs.
92-49	Recent Loss or Severe Degradation of Service Water Systems	07/02/92	All holders of OLs or CPs for nuclear power reactors.
92-48	Failure of Exide Batteries	07/02/92	All holders of OLs or CPs for nuclear power reactors.
92-47	Intentional Bypassing of Automatic Actuation of Plant Protective Features	06/29/92	All holders of OLs or CPs for nuclear power reactors.
92-46	Thermo-Lag Fire Barrier Material Special Review Team Final Report Findings, Current Fire Endurance Tests, and Ampacity Calculation Errors	06/23/92	All holders of OLs or CPs for nuclear power reactors.
92-45	Incorrect Relay Used in Emergency Diesel Generator Output Breaker Control Circuitry	06/22/92	All holders of OLs or CPs for nuclear power reactors.
92-44	Problems with Westinghouse DS-206 and DSL-206 Type Circuit Breakers	06/18/92	All holders of OLs or CPs for nuclear power reactors.
92-43	Defective Molded Phenolic Armature Carriers Found on Elmwood Contactors	06/09/92	All holders of OLs or CPs for nuclear power reactors.
92-42	Fraudulent Bolts in Seismically Designed Walls	06/01/92	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Original Signed by
Charles E. Rossi

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Brian K. Grimes, Director, Division of Reactor Inspection and Safeguards and Ashok C. Thadani, Director, Division of Systems Technology concurred in a previous version of this information notice. Notice was significantly revised to remove "regulatory guide" portions of original draft after above concurrences were obtained. I determined it was unnecessary to have re-concurrence at the Division Director level. C. E. Rossi

*SEE PREVIOUS CONCURRENCE

OEAB:DOEA:NRR NFields* 05/21/92	SC/OEAB:DOEA:NRR DFischer* 05/22/92	RPB:ADM TechEd* 05/22/92	C/OEAB:DOEA:NRR AChaffee* 06/04/92
EMEB:DE:RES SKAggarwal* 06/08/92	C/EMEB:DE:RES MVagins* 06/08/92	D/DE:RES LCShao* 06/08/92	RVIB:NRR SAlexander* 06/30/92
SELB:NRR ASGill* 06/29/92	C/OGCB:DOEA:NRR CHBerlinger* 06/10/92	D/DOEA:NRR CERossi 7/6/92	

Document Name: 92-51.IN

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