

June 27, 1997

Mr. Jon S. Rennie  
Total Quality Manager  
Distribution Systems Division  
ABB Power T&T Company, Incorporated  
201 Hickman Drive  
Sanford, FL 32771

SUBJECT: REQUEST FOR A TECHNICAL REVIEW OF A DRAFT INFORMATION NOTICE  
REGARDING INCORRECTLY WIRED CURRENT SENSORS IN ABB K-LINE CIRCUIT  
BREAKERS

Dear Mr. Rennie:

The U.S. Nuclear Regulatory Commission (NRC) is planning to issue an information notice on the miswiring of the current sensors in ABB K-line circuit breakers. We ask that you review the enclosed draft of that information notice to ensure the technical information is accurate. Your cooperation in this matter is appreciated. Please return any comments you may have as soon as possible. A copy of this request and your response will be placed in the Public Document Room for review by the public. Your response should be mailed to:

U.S. Nuclear Regulatory Commission  
ATTN: David Skeen, NRR/PECB  
Mail Stop: O-11-E4  
Washington, DC 20555-0001

Please address any questions you may have on this matter to David Skeen of my staff. Mr. Skeen may be reached by phone (301) 415-1174 or e-mail at DLS@NRC.GOV. If no comments are received by close of business on July 11, 1997, we will assume the technical information in the notice is correct.

Sincerely,

for [Original signed by Edward F. Goodwin]  
Alfred E. Chaffee, Chief  
Events Assessment and  
Generic Communications Branch  
Division of Reactor Program Management  
Office of Nuclear Reactor Regulation

300005

cc: J.J. Connolly

Enclosure:  
Draft Information Notice

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

June xx, 1997

NRC INFORMATION NOTICE 97-XX: POTENTIAL FOR INCORRECTLY WIRED OR ASSEMBLED ABB  
K-LINE METAL-CLAD LOW-VOLTAGE 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 that the potential exists for ASEA Brown Boveri (ABB) K-Line metal-clad low-voltage circuit breakers to be incorrectly wired or assembled, and these errors may not have been identified due to ineffective verification of the operation of the solid state trip device, and ineffective verification of the secondary wiring. As a result, loss of multiple safety functions may occur. 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 September 16, 1996, while operating at full power, an ABB type K600S 480-Vac circuit breaker prematurely tripped on overcurrent at Centerior Energy Company's Perry Nuclear Power Plant (Perry) and de-energized a safety-related motor control center (MCC). The circuit breaker's SS-5 solid state trip device (Power Shield), sensed an overcurrent condition even though actual MCC current at the time of the trip was well below the Power Shield's expected trip set point. Subsequent inspection of the circuit breaker determined that phase C current transformer (CT) sensor wires were reversed, resulting in the polarity of the sensor being reversed. Three-phase testing of the breaker at ABB's circuit breaker manufacturing facility test laboratory in Florence, SC, showed that the breaker consistently tripped between 350-360 amps, much below the Power Shield's expected overcurrent trip set point of 660 amrs.

Discussion

Other ABB K-Line low voltage circuit breakers equipped with solid state trip units have also tripped unexpectedly after being placed into service, due to incorrectly wired or installed CTs. The unexpected trips were due to the polarity sensitivity of ABB's 3-phase solid state trip units. Incorrectly wired or installed CTs have a 180 degree phase shift in their output currents which may cause the trip units to actuate at a primary current level significantly below the expected level. Because single-phase primary current

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calibration or testing does not detect phase shift or CT secondary output current, other testing or inspections are necessary to verify proper operation of ABB's solid state trip units and verification of the secondary wiring should also be consistently and effectively implemented.

The K600S breaker that tripped due to reversed CT wires at Perry was a new breaker manufactured at ABB Power Transmission & Distribution (T&D) Company, Incorporated, Distribution Systems Division (ABB Power T&D), facility in Florence, S.C. On March 26, 1997, ABB Power T&D informed the NRC of a potential defect in the K-line circuit breakers, equipped with the "Power Shield" solid state trip device. The report indicated that the trip device could trip below the trip setting if the circuit breaker's overcurrent sensing CTs are incorrectly connected to the Power Shield trip device. Although the circuit breaker which tripped prematurely at Perry was a new circuit breaker, K600S breakers that have been refurbished by ABB Service Incorporated facilities have also been found to contain similar CT or wiring problems. Therefore, the wiring defect identified at Perry could potentially be found in refurbished, as well as new circuit breakers.

A typical ABB K-Line metal-clad low voltage circuit breaker has six CTs, three of which are referred to as phase sensors, and are used to detect fault currents (see attached wiring diagram). The remaining three CTs are referred to as power sensors, and are used to develop a trip reference signal within the trip unit. Two CTs are installed on each phase of the circuit breaker; one phase sensor and one power sensor. The leads from all six CTs are terminated on three terminal blocks attached to the lower molding of the circuit breaker. These three terminal blocks are connected to the trip unit by a multiconductor cable. Typical wiring and assembly errors that have been discovered in new and refurbished ABB K-line circuit breakers include:

- CT leads terminated on the wrong terminals of the lower terminal blocks;
- Multiconductor cable conductors terminated on the wrong terminals of the lower terminal blocks, or on the wrong terminals of the Power Shield Trip Unit;
- CTs installed upside down, but correctly terminated on the lower terminal blocks (same effect as reversing the leads).

Additionally, ABB Power T&D has found that the potential of miswiring can occur during different operations. For example, when the wires on terminals 6, 7, and 8 of the Power Shield trip unit are lifted to perform continuity checks of the phase sensors, or the wires on terminals 11, 12, 13, and 14 are lifted to conduct calibration tests, the wires can be relanded incorrectly.

Circuit breaker wiring or assembly errors can be introduced by the original equipment manufacturer, companies performing circuit breaker refurbishment services, or utilities during testing. Incorrectly wired or assembled circuit breakers might be presently in service or stored in a warehouse for service at a later date. Because single phase calibration testing, similar to that performed at the ABB manufacturing facility, does not adequately verify the overcurrent trip set points of some circuit breakers equipped with three phase

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solid state trip units, the potential exists for incorrectly wired or assembled circuit breakers to pass calibration testing, but trip during a design basis accident, resulting in a loss of safety functions.

ABB Power T&D informed its customers of record of the potential defect. However, because some licensees may have purchased breakers through a third party supplier, or may have had breakers refurbished by a third party contractor, this notice is being issued to ensure that all potentially affected licensees receive the information.

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.

Marylee M. Slosson, Acting Director  
Division of Reactor Program Management  
Office of Nuclear Reactor Regulation

Technical contacts: Donald Kosloff, R-III  
216-259-3610  
E-mail: dck@nrc.gov

Virgil Beaston, NRR  
301-415-5774  
E-mail: vlb@nrc.gov

J.J. Petrosino, NRR  
301-415-2979  
E-mail: jjpl@nrc.gov

David Skeen, NRR  
301-415-1174  
E-mail: dls@nrc.gov

Attachment: ABB K-Line Power Shield Wiring Diagram - Drawing 709551, Rev 16

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