

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, DC 20555-0001

October 22, 2007

NRC INFORMATION NOTICE 2007-34: OPERATING EXPERIENCE REGARDING  
ELECTRICAL CIRCUIT BREAKERS

**ADDRESSEES**

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

**PURPOSE**

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees about operating experience regarding low-, medium-, and high-voltage circuit breakers. The NRC expects that recipients will review the information for applicability to their facilities and consider appropriate actions to avoid similar problems. Suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

**DESCRIPTION OF CIRCUMSTANCES**

The Office of Nuclear Reactor Regulation (NRR) reviewed recent operating experience related to electrical circuit breakers and found that breaker problems were often caused by the following:

- Deficient fit-up with cubicles
- Inadequate or excessive tolerances and gaps
- Worn or misadjusted operating linkages
- Inadequate or inappropriate maintenance practices
- Configuration control errors
- Deficiencies from original design and refurbishment
- Design changes

The following are examples of recent circuit breaker problems:

River Bend Station Unit 1

On May 27, 2006, while the unit was operating at 100 percent power, the licensee determined that one of the required offsite power supplies to the Division 3 standby switchgear had been inoperable because a 4160-volt circuit breaker was not functional. The licensee found that the

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breaker was not fully racked in and the racking mechanism was unusually difficult to operate. The licensee had an outstanding maintenance work order to address that the control power light for the breaker in the main control room was not illuminated, which it turned out was due to the breaker not being fully racked in. The licensee also found that one of the permissive signals necessary to close the breaker was not present – the next breaker upstream was not closed. The licensee found that the surveillance test procedures for verifying the alignment of offsite power supplies did not verify the supplies to Division 3. Corrective actions included (1) revising the operations procedure for breaker racking to verify indication of control power, and to perform a functional test of breakers that support a safety function; and (2) revising the technical specification bases and surveillance test procedure to verify the alignment of breakers to the Division 3 switchgear. (LER 50-458/2006-006, ADAMS Accession No. [ML062130074](#))

### Crystal River Unit 3

In November 2006, the licensee found that the 1A emergency diesel generator was inoperable because the breaker charging motor direct current power control switch was found in the off position and the breaker closing spring was not charged. Since the breaker performed as expected during post-maintenance testing, operations and maintenance personnel did not recheck or verify the position of the toggle switch, which is located in the closed breaker cubicle. The problem was subsequently revealed during the next periodic surveillance test. (LER 50-302/2006-002, ADAMS Accession No. [ML070030513](#))

### Indian Point Unit 2

On January 2, 2007, during quarterly surveillance testing, a residual heat removal pump failed to start on demand. A control power fuse had blown in the pump 480-volt alternating current electrical supply breaker, a Westinghouse type DB-50 breaker. The licensee found that the inertia latch (which is designed to prevent a breaker re-closure due to contact bounce following a breaker trip) was binding and did not reset following the last breaker trip operation causing the closing coil to remain energized until the protective fuses opened. Foreign material was found imbedded on the surface of the inertia latch bushing creating a rough and uneven surface. As corrective actions, the licensee cleaned and lubricated the inertia latch and changed the breaker preventive maintenance procedure to emphasize the importance of assuring freedom of movement and smooth operation of the inertia latch. (LER 50-247/2007-001, ADAMS Accession No. [ML070650407](#))

### Fort Calhoun

On January 25, 2007, the 4160-volt circuit breaker for the train 'B' raw water pump closed on demand which started the pump but the mechanical-operated contact (MOC) switch did not actuate the auxiliary contacts that provide breaker position indication and provide a signal to open the discharge valve from the pump when the circuit breaker is closed. The MOC switch failure was the result of a broken MOC offset rod, a metal rod that transfers the motion of the circuit breaker to operate the auxiliary contacts. One month earlier, the 'C' raw pump had also been rendered inoperable due to a broken MOC offset rod. In 1995, all of the station's 4160-volt General Electric (GE) Magna-Blast circuit breakers were replaced with breakers from Asea Brown Boveri Services Company that were designed to fit in the GE switchgear. The licensee's root cause analysis determined that design processes failed to recognize and

properly evaluate the additional stresses placed on MOC offset rod by a metal “test flag” device, an accessory used during circuit breaker testing. As corrective actions, the licensee replaced the MOC offset rod in the ‘A’ and ‘D’ raw water pumps circuit breakers and other 4160-volt safety-related circuit breakers having more than 1000 cycles of operation were rebuilt with rods having fewer than 1000 cycles of operation. (LER 50-285/2007-002, ADAMS Accession No. [ML071070290](#))

### Farley Unit 1

While performing an EDG operability test on April 26, 2007, the licensee determined that the MOC switch of the 1C EDG output breaker was not being fully activated when the breaker was closed. Operators declared the EDG inoperable. The licensee determined that the MOC switch, which is used to provide auxiliary contacts for breaker status indication and other control functions, was not rotating sufficiently to fully engage the normally open contacts. The event was the result of a fit-up discrepancy during replacement of the existing Allis Chalmers breakers with new Cutler Hammer breakers within the Allis Chalmers switchgear. The fit-up discrepancy went unrecognized because of inadequate procedural guidance on how the replacement breakers were to be set up during initial installation and testing. (LER 50-348/2007-001, ADAMS Accession No. [ML071760334](#))

### Other Circuit Breaker Issues

The NRC review of operating experience also revealed the following circuit breaker issues involving inadequate maintenance practices:

- Inadequate maintenance practices have resulted in gaps/clearances in the breaker mechanism becoming out of specification and preventing proper operation of the circuit breaker.
- Inadequate maintenance practices have resulted in not properly clearing and resetting the trip mechanism once the circuit breaker is fully racked in the connect position. This would prevent the circuit breaker to close on demand.
- Inadequate maintenance practices have resulted in main stabs with excessive wear leading to misalignment while racking the circuit breaker into the cubicle. This has led to the failure of the high-resistance stab connection, which caused an electrical fault.
- Inadequate maintenance practices have resulted in misalignment of the circuit breaker to the cubicle for circuit breaker racking operation. Misalignment has led to control power contacts not connecting when the circuit breaker is racked in. Also, instances of inadequate assessment, cleaning, and testing of contacts (relay, switch, contacts, etc.) have led to the circuit breaker not operating in accordance with its design.
- Inadequate maintenance practices have involved crimping of control power lead lugs. Faulty crimps have caused control power losses. There are also instances of loose connections not being identified and/or corrected.

- Inadequate maintenance practices have involved cleaning (including hardened greases) and greasing of the circuit breaker mechanism. This can result in the circuit breaker mechanism and auxiliary switch not operating in accordance with their design.
- Inadequate maintenance practices have caused inadvertent actuation of relays mounted on circuit breaker cubicle doors during circuit breaker maintenance.

## BACKGROUND

Previous Related Generic Communications:

- [IN 1999-13](#), “Insights from NRC Inspections of Low- and Medium-Voltage Circuit Breaker Maintenance Programs” (ADAMS Accession No. [ML031040447](#))
- [IN 2005-21](#), “Plant Trip and Loss of Preferred AC Power From Inadequate Switchyard Maintenance” (ADAMS Accession No. [ML051740051](#))
- [IN 2005-15](#), “Three-Unit Trip and Loss of Offsite Power at Palo Verde Nuclear Generating Station” (ADAMS Accession No. [ML050490364](#))
- [IN 2006-18](#), Supplement 1, “Significant Loss of Safety-Related Electrical Power at Forsmark Unit 1 in Sweden” (ADAMS Accession No. [ML071900368](#))
- [IN 2006-31](#), “Inadequate Fault Interrupting Rating of Breakers” (ADAMS Accession No. [ML063000104](#))
- [IN 2007-14](#), “Loss of Offsite Power and Dual-Unit Trip at Catawba Nuclear Generating Station” (ADAMS Accession No. [ML070610424](#))

## DISCUSSION

Licensees rely on electrical circuit breakers being operable to satisfy many technical specification (TS) requirements which includes TSs related to electrical power, as well as, many other TSs because for a system to be considered operable, it must have all necessary attendant instrumentation, controls, normal or emergency electrical power. Circuit breakers are relied upon to provide electrical power to equipment credited in accident analysis. Because licensees often use the breakers of the same type and manufacturers in redundant trains of several safety systems, certain breaker problems raise the possibility of a common mode failure. In particular, several licensees have experienced problems following a modification that installs replacement breakers of a different manufacturer into the existing switchgear.

## CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contact listed below.

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Note: NRC generic communications may be found on the NRC public Web site, <http://www.nrc.gov>, under Electronic Reading Room/Document Collections.

