UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

November 24, 2008

NRC INFORMATION NOTICE 2008-21: IMPACT OF NON-SAFETY ELECTRICAL SUPPORT SYSTEM VULNERABILITIES ON SAFETY SYSTEMS

ADDRESSES

All holders of operating licenses for nuclear fuel facilities.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees about potential impacts of non-safety support system failures or vulnerabilities on safety systems. This IN references operating experience regarding low-, medium-, and high-voltage circuit breakers as described in IN 2007-34 and adds similar operating experience of non-safety related breakers at fuel facilities. Information Notice 2007-34 is attached.

Licensees rely on non-safety electrical systems to satisfy many items relied on for safety (IROFS), technical safety requirements (TSR), or plant features (PF). For IROFS/TSRs/PFs to be considered available and reliable, they must have necessary instrumentation, controls, and normal or emergency electrical power available.

It is expected 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 Region II Division of Fuel Facility Inspection reviewed operating experience for the past five years at both power reactors and fuel facilities related to electrical circuit breakers and found that breaker problems were often caused by the following:

Deficient fit-up with cubicles
Worn or misadjusted linkages
Inadequate or inappropriate maintenance practices
Configuration control errors
Deficiencies from original design and refurbishment
Design changes
Foreign material entry

ML082730593

The following are examples of circuit breaker problems at fuel facilities:

BWX Technologies

On November 17, 2007, heavy smoke was emanating from the vicinity of an electrical transformer. The fire, which emanated from a shorted 480 volt fuse panel, had melted nearby plastic material and caused nearby wooden material to ignite and smolder.

Immediate event review by the licensee determined that an electrical surge was halted when the 12.4 kilovolt gang-operated switch disconnected the power supply transformer from the utility sub-station. The licensee's root causes for the fire were human performance such that the preventative maintenance on the failed breakers was not performed due to production schedules and equipment failure. (Inspection Report No. 70-27/2007008, ADAMS Accession No. ML0802503450) The licensee stated in their root cause analysis that the fire was the result of an electrical fault. The branch circuit and the main breaker feeding the transformer failed to open as designed allowing a sustained fault condition resulting in the fire.

Paducah Gaseous Diffusion Plant

On May 20, 2003, the plant staff identified a fire in a non-safety related 480 volt circuit breaker located in the Building C-633 Pump House. The circuit breaker provided power to a motor associated with a recirculating water cooling tower fan. Due to problems within the circuit breaker, the breaker did not immediately de-energize after the fault occurred. Instead, after approximately 8 seconds, the breaker was de-energized after the setpoints associated with a back-up current limiting device were exceeded. As a result of the delayed de-energizing of the electrical breaker, other nearby breakers were damaged during the resultant fire. No personnel injuries occurred as a result of the fire and no safety-related equipment was affected. (Inspection Report No. 70-7001/2003005, ADAMS Accession No. ML032020568)

Paducah Gaseous Diffusion Plant

On November 23, 2004, the 480 volt Transformer Service Breaker 2PPA1 was being returned to service when a fault occurred resulting in a fire. Non-safety plant equipment that should have operated to isolate the fault failed to function and, as a result, the fault remained energized for approximately 11 minutes. After the fault was isolated, the plant fire brigade used water to extinguish the fire. No release of radioactive material occurred and no plant personnel were injured; however, a significant plant transient resulted. The certificate holder's root cause analysis determined that foreign material had caused the fault, and that the failure of other breakers to properly operate caused additional damage to the switchgear. Short term and long term corrective actions were initiated (Inspection Report No. 70-7001/2005001, ADAMS Accession No. ML050620142)

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 into the connect position - preventing the circuit breaker from closing 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 within the panel or cubicle. 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 inadequate 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 non-safety electrical circuit breakers to power many IROFS, TSRs, or PFs related to electrical power. For IROFS/TSRs/PFs to be considered available and reliable, they must have all necessary instrumentation, controls, and normal or emergency electrical power available. Circuit breakers are relied upon to provide electrical power to equipment credited in the integrated safety analysis or safety analysis report. Licensees should incorporate the industry experience highlighted in this, and the above information notices, in electrical circuit breaker maintenance programs. Maintenance programs should identify and emphasize the importance of electrical systems which support important safety systems. Because licensees often use breakers of the same type and manufacture in various electrical support systems throughout the plant, common mode failure possibilities should be evaluated when performing modifications or other maintenance. When failures do occur, the extent of condition should be thoroughly evaluated for the potential for poor maintenance practices or design issues to impact other important site electrical systems.

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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Enclosure: IN 2007-34, Operating Experience Regarding Electrical Circuit Breakers

- IN 2005-15, "Three-Unit Trip and Loss of Offsite Power at Palo Verde Nuclear Generating Station" (ADAMS Accession No. ML050490364)
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DISTRIBUTION:
*see previous concurence

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