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

February 15, 2007

NRC INFORMATION NOTICE 2007-07: POTENTIAL FAILURE OF ALL CONTROL ROD GROUPS TO INSERT IN A BOILING WATER REACTOR DUE TO A FIRE

ADDRESSEES

All holders of operating licenses for boiling water reactors (BWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees of an issue discovered at Columbia Generating Station (CGS) regarding the possibility of fire-induced hot shorts preventing all control rod groups from inserting when required due to a postulated fire. The NRC expects 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 an inspection at CGS completed on July 13, 2006, the NRC inspectors identified that two hot shorts, caused by a postulated fire, could prevent one of the four groups of control rods from inserting when the operator places the reactor mode selector switch in the SHUTDOWN position in the control room. The inspection results are summarized in Inspection Report 05000397/200608, dated August 18, 2006 (Agencywide Documents Access Management System, Accession No. ML062300334).

The reactor protection and control rod drive systems are identified as part of the minimum safe shutdown systems necessary to accomplish the reactivity control shutdown function and are credited in the post-fire safe shutdown procedures developed by this licensee. However, the potential for fire to cause a loss of this required shutdown function has not been evaluated. The Final Safety Analysis Report states “Fail safe circuits (electrical divisions 4, 5, 6, and 7) are designed to fail in a safe manner if subjected to fire damage. For example, reactor

scram, once initiated, cannot be overridden as a consequence of fire." The licensee's analysis was "based on the assumption that the operator would initiate and confirm shutdown before control circuiting is damaged;" therefore, evaluation of the effects of fire damage to the reactor protection (RPS) and control rod drive systems was not performed.

Fires can potentially damage circuits prior to the decision to initiate a plant shutdown using alternative shutdown capability and control room evacuation. At CGS, a reactor shutdown would not be initiated unless:

- there are indications that the fire threatens safe operation of the plant,
- the operator observes degraded equipment performance, or
- there is visible damage to vital plant equipment or cabling.

Since a reactor scram would possibly not be initiated until the fire had damaged vital plant equipment, the NRC staff noted the possibility that "hot shorts" could occur prior to making the decision to scram the unit.

At CGS, the licensee revised plant procedures to ensure that the RPS would be de-energized prior to initiating depressurization. This action would ensure that all control rods insert into the reactor prior to opening the safety/relief valves (SRVs) and starting low pressure injection. Due to various power supplies that may be in the cabinet, the response by CGS may not be effective for other BWR designs.

BACKGROUND

Title 10 of the *Code of Federal Regulations* (CFR) Part 50.48(a) requires that each operating nuclear power plant has a fire protection plan that satisfies General Design Criterion (GDC) 3 of Appendix A of Part 50. Criterion 3 specifies that "Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions."

Part 58.48(b) of Title 10 of the *Code of Federal Regulations* identifies some methods to comply with 10 CFR 50.48(a) and imposes a backfit requirement for plants licensed to operate prior to January 1, 1979, to comply with section III.G of Appendix R. For plants licensed to operate after January 1, 1979, similar requirements were incorporated into NUREG-0800, Standard Review Plan, Section 9-5.1, Fire Protection Program, and were incorporated into the licensee programs during the licensing process for these plants. These licensees then had planned implementation as a condition of the Operating License for the facility. To satisfy GDC 3, each licensee must have fire protection features that are capable of limiting fire damage so that:

a. One train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage; and

b. Systems necessary to achieve and maintain cold shutdown from either the control room or emergency control station(s) can be repaired within 72 hours.

DISCUSSION

The control rods are divided into four control rod groups. The scram of each control rod group is controlled by separate circuits within the RPS system. The system design has two trip logic channels functioning in a 1-out-of-2 twice arrangement. This design requires that one trip logic be satisfied in both trip logic channels before the control rod group will scram. The RPS circuits are a fail-safe design in that the circuits are normally energized, and the loss of power will initiate a scram. Also, the RPS scram circuits are routed separately from other circuits to prevent any possibility for interaction.

For CGS, in all fires other than a control room fire, the circuits will be de-energized when the mode switch in the control room is placed in the SHUTDOWN position and circuit damage does not prevent the scram. For fires in the control room, a hot short between conductors to the mode switch could keep the associated trip channel logic energized. Two hot shorts without the occurrence of an open circuit or short to ground have the potential of affecting the scram function. A hot short as described above would have to be present in both of the trip channel logic circuits associated with the same trip channel. This would keep the trip channel energized so that half of the 1-out-of-2 twice logic would not be satisfied. The result would be that the associated rod group would not scram. The other three rod groups would not be affected and would scram as expected.

CGS is a BWR-5 design. This plant design has the Power Generation Control Complex which provides cable separation in the control room subflooring when the wires exit the control cabinets. In part, due to this cable separation, the NRC determined this issue at CGS to be of very low safety significance.

To accomplish alternative safe shutdown, for a fire in the control room, most BWRs rely upon using three to six SRVs to depressurize the reactor vessel. The vessel is then reflooded with a low pressure coolant injection system using a residual heat removal pump in the low pressure coolant injection mode. By design, the negative reactivity, added by all four rod groups during a scram, provides adequate shutdown margin to offset the positive void and temperature reactivity would have been added to the vessel. A typical BWR reactor has about 180 control rods. One of the four rod groups remaining in the fully out position would place the reactor outside of the design basis.

RELEVANT GENERIC COMMUNICATIONS

Regulatory Issue Summary 2004-03, Revision 1, “Risk-Informed Approach for Post-Fire Safe-Shutdown Circuit Inspections” discusses the probability of two hot shorts occurring for a postulated fire.

CONTACTS

This information notice requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/RA/

Michael Case, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Technical Contacts: John M. Mateychick, R IV
817-276-6560
E-mail: JMM3@nrc.gov

Edward McCann, NRR
301-415-1218
E-mail: EVM@nrc.gov

Phillip M. Qualls, NRR
301-415-1849
E-mail: PMQ@nrc.gov

CONTACTS

This information notice requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/RA/

Michael Case, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Technical Contacts: John M. Mateychick, R IV
817-276-6560
E-mail: JMM3@nrc.gov

Edward McCann, NRR
301-415-1218
E-mail: EVM@nrc.gov

Phillip M. Qualls, NRR
301-415-1849
E-mail: PMQ@nrc.gov

Distribution:
IN File

ADAMS Accession No. ML063540138

RIV/SRI	AFPB/FPE	AFPB/FPE	AFPB/BC	TECH EDITOR	PGCB/PM	PGCB/LA	PGCB/BC	DPR/DD
JMateychick	PQualls	EMcCann	SWeerakkody	CClark	QNguyen	CHawes - CMH	CJackson	MCase
12/20/06	2/05/2007	2/02/2007	2/08/2007	02/12/2007	2/01/2007	2/14/2007	02/15/2007	02/15/2007

OFFICIAL RECORD COPY