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

February 10, 2005

NRC INFORMATION NOTICE 2005-03: INADEQUATE DESIGN AND INSTALLATION OF SEISMIC-GAP FIRE BARRIERS

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 of recently identified deficiencies in the design and installation of seismic-gap fire barriers. 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 in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

During a quarterly fire protection inspection at the Wolf Creek Generating Station, the resident inspectors discovered that a portion of the fire barrier in the seismic gap between the auxiliary building main steam enclosure floor and the containment building was incomplete. Approximately 20 inches of fire barrier material in the four-inch-wide gap was missing. This resulted in a degradation of the fire barrier between the main steam enclosure and all the auxiliary feedwater system's steam generator water level control valve rooms. The licensee determined that the fire barrier material had been missing since initial plant construction. The licensee performed a walkdown of all seismic gaps and identified two additional incomplete fire barriers. The inadequate design and installation condition also existed at the Callaway Plant.

The licensee also found, during the course of resolving the missing fire barrier segment issue, that the original seismic-gap fire barrier design was deficient. The design only included the gaps between a single floor or wall of one building and a wall or floor of an adjacent building or fire area. The design did not include the fire barrier configuration where floors, walls, and/or ceilings of one building joined together, such as a corner of a room, at the seismic gap with an adjacent building or fire area. Since the design was deficient, the licensee implemented compensatory measures for all potentially affected fire areas. The licensee inspected 25 suspect configurations and determined that 14 were inadequate. The attached diagram represents a typical as-found deficient seal and the associated restoration configuration where multiple fire boundary seismic-gap seals interface.

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Through intrusive inspection, it was determined that the original fire barriers were not installed per the design at many single-interface locations. Instead of installing fire barrier material on just one side of a gap, the installers placed barrier material in the gaps at both sides of a wall or floor and did not use the polyethylene backing. The polyethylene is provided for support of the caulking material. With fire barrier material on both sides, the polyethylene backing is not needed. Installing barrier material on both sides of the gap actually mitigated the potential consequences of the inadequate installations at some of the room corners. The licensee immediately corrected the deficiencies at the corner interfaces by adding fire barrier material.

Additionally, the resident inspectors asked whether the caulking compound and polyethylene backing material used in the seismic gaps were included in the fire loading calculations for each fire area. The caulking material was used as a pressure and/or flooding boundary. The licensee had stated that these materials were combustible and were consumed during the fire barrier qualification tests.

The licensee reviewed the calculations and found that these materials had not been included in the fire loading calculations. The licensee performed further analysis to determine if the fire areas' ratings were affected. The licensee concluded that the caulking and backing material in the seismic gaps did not significantly increase the fire area loadings. The licensee also concluded that only the caulking and backing material on the exposed fire barrier side would be affected. On the unexposed barrier side, combustible elements of the seal would not reach a high enough temperature to sustain combustion. This determination was based on a review of relevant fire testing for the design.

Using Manual Chapter 0609, Appendix F, Attachment 2, "Additional Guidance for the Assessment of Findings Using Significance Determination Process Entry," the inspectors made two determinations:

- There was no credible fire scenario that would affect more than one safe shutdown area. This was based on a lack of combustible material, lack of ignition sources, location of the seal with respect to safe shutdown equipment, the presence of detection and suppression systems, the amount of seal degradation, or the distance from the seal to any combustible material. In addition, the inspectors determined that the fire barriers did not leave significant gaps between fire areas. In some cases, the fire seal materials were butted up against each other at a right angle.

- These as-found conditions did not provide the required 3-hour fire rating, but would hamper the propagation of smoke and hot gases between fire areas for some untested amount of time. The inspectors concluded that the degraded fire barriers would provide a minimum of 20 minutes fire endurance protection, and that the fixed and in situ fire ignition sources and combustible or flammable materials were positioned such that, even if the fire spread to secondary combustibles, the degraded fire barriers would not be subjected to direct flame impingement.

On this basis, this finding was greater than minor because it was similar to the example in Inspection Manual Chapter 0612, Appendix E, Section 2.e. In the as-found condition, the 15 fire penetration seals at the seismic gaps would not have performed their function as a 3-hour rated fire barrier. This finding is of very low safety significance because, overall, the fire barriers would have provided the protection needed for credible fire scenarios. The issue was processed in the NRC's significance determination process and determined to be Green. Please refer to NRC Inspection Report 05000482/2004002, Section 4OA5, for additional information.

BACKGROUND

The NRC has issued other generic communications that have discussed requirements, guidance, and potential problems with fire-barriers, especially penetration seals. For example

(1) On February 5, 1988, the NRC issued Information Notice (IN) 88-04, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals," to alert addressees that some installed fire-barrier penetration seal designs may not be adequately qualified for the design rating of the penetrated fire barrier. This IN discussed an NRC staff review which identified some instances where installed fire-barrier penetration seal configurations were not qualified by adequate testing or were not supported by adequate qualification documentation.

(2) On August 9, 1988, the NRC issued IN 88-04, Supplement 1, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals," to alert addressees to problems caused by potential misapplication of silicone foam material used in penetration openings at nuclear power plants.

(3) In July 1996, the NRC issued NUREG-1552 "Fire Barrier Penetration Seals in Nuclear Power Plants." This was followed up by NUREG-1552, Supplement 1 in January 1999.

(4) On June 25, 2003, the NRC issued Information Notice 2003-08 "Potential Flooding Through Unsealed Concrete Floor Cracks."

DISCUSSION

NRC requirements and guidelines for fire barriers are contained in various documents, including Appendix R to 10 CFR Part 50, Appendix A to Branch Technical Position (BTP) APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," and NUREG-0800, Standard Review Plan. The extent to which these requirements or guidelines are applicable to a specific plant depends on plant age, commitments made by the licensee in developing the fire protection plan, the staff safety evaluation reports (SERs) and supplements, and the license conditions pertaining to fire protection.

The goal is to provide a fire barrier that will remain in place and retain its integrity when subjected to an exposure fire, and subsequently, a fire suppressing agent. This will provide reasonable assurance that the effects of a fire are limited to discrete fire areas and that one division of safe-shutdown-related systems will remain free of fire damage.

Seismic gaps (commonly referred to as “shake space,” “rattle space,” “construction joint systems,” or “building joint systems”) are a part of the overall seismic design of the structure. Their principal function is to allow different parts of the nuclear power plant (NPP) to move independently during an operating-basis earthquake (OBE) or a design-basis earthquake (DBE). To fulfill other design functions, the gaps (openings) have seals similar to penetration seals in rated fire barriers. Other NPP-specific design functions can include fire barrier, flood barrier, pressure boundary, and radiation shielding. The seismic gap penetration seal often has multiple design functions and is tested, installed, and maintained accordingly.

The fire resistance rating of the seismic-gap penetration seal is equal to or greater than the fire barrier in which it is installed. The fire resistance rating is determined by testing a representative sample to the requirements of American Society of Testing and Materials (ASTM) Standard E-119, “Standard Methods of Fire Tests of Building Construction and Materials”[1] including the hose stream test. The existing staff guidance on fire barrier penetration seals is also applicable to seismic-gap penetration seals.[2] There are also specific test methods for building joints such as the ASTM E1966 “Standard Test Method for Fire Resistance of Building Joint Systems” and the method in Underwriters Laboratories Inc (UL) Standard UL 2079 “Tests for Fire Resistance of Building Joint Systems.”

[1]American Society for Testing and Materials Standard E-119 was adopted by the National Fire Protection Association (NFPA) as NFPA Standard 251

[2]See Information Notice 88-04 “Inadequate Qualification and Documentation of Fire Barrier Penetration Seals”

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.

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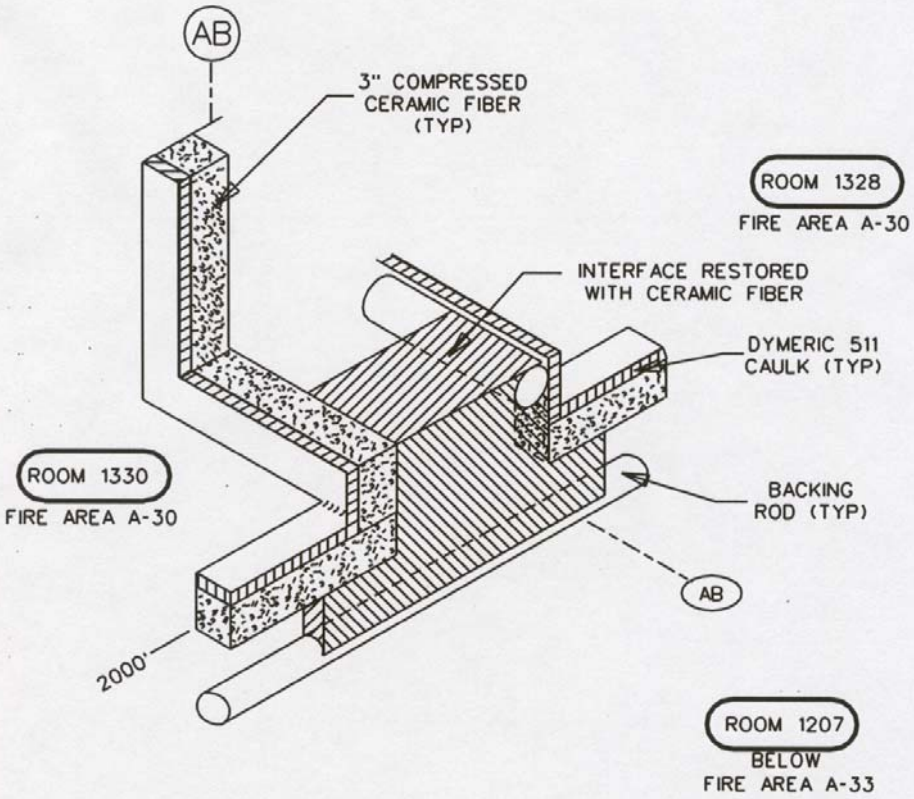
Attachment: Diagram

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



NOTES:

1. CERAMIC FIBER INSTALLED TO CNT-MC-680 WITHIN CAVITY TO SATISFY 3-HR FIRE RESISTANCE AND OVERLAP REQUIREMENTS.
2. WALL AND FLOOR/CEILING NOT SHOWN FOR CLARITY.