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

November 14, 1995

NRC INFORMATION NOTICE 95-52: FIRE ENDURANCE TEST RESULTS FOR ELECTRICAL RACEWAY FIRE BARRIER SYSTEMS CONSTRUCTED FROM 3M COMPANY INTERAM FIRE BARRIER MATERIALS

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 inform addressees of the results of recent fire endurance tests for electrical raceway fire barrier systems constructed from 3M Company Interam fire barrier materials. It is expected that recipients will review the information for applicability to their facilities and consider this information, as appropriate, in their review of Interam fire barriers.

Background

On April 20, May 17, and July 7, 1995, the NRC staff visited Omega Point Laboratories (OPL), San Antonio, Texas, to witness full-scale fire endurance tests for electrical raceway fire barrier systems constructed from 3M Company Interam fire barrier materials. These tests were sponsored by Peak Seals Corporation (Peak Seals). Peak Seals informed the NRC staff that the test specimens included in this test program were intended to represent generic Interam fire barrier systems and that these test programs were conducted in accordance with Generic Letter (GL) 86-10, Supplement 1, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used To Separate Redundant Safe Shutdown Trains Within the Same Fire Area." The following information is based on observations made by the NRC staff who witnessed these fire tests. The NRC staff has not reviewed the test reports.

Description of Circumstances

1-Hour Fire Endurance Tests

The first test assembly included nominal 24-inch and 6-inch-wide steel cable trays; 1-inch, 2-inch, 3-inch, and 5-inch-diameter steel conduits; a 2-inch diameter air drop; each was arranged in a U-shaped configuration; and a 12-inch by 12-inch by 8-inch steel junction box. With regard to the 2-inch-diameter steel conduit, the junction box was installed in one of its vertical runs and the 2-inch diameter air drop was installed in the other. These test specimens did not include cable fill and were supported by a common trapeze

support. They were protected with three layers of Interam E53A fire barrier mat material. Each layer was 7.6 mm [0.3 inch] thick.

On April 20, 1995, OPL subjected the test assembly to the test fire specified in American Society for Testing and Materials (ASTM) Standard E-119, "Fire Test of Building Construction and Materials," for 1 hour. After the fire exposure, the test specimens were subjected to a fog-nozzle hose stream test. The 24-inch-wide cable tray; the 3-inch-, 2-inch-, and 1-inch-diameter conduits; and the air drop exceeded the temperature rise acceptance criteria of GL 86-10, Supplement 1, near the end of the 1-hour fire exposure. None of the barriers burned through during the fire exposure nor were they breached by the hose stream. Table 1 (see Attachment 1) summarizes the test specimen and fire barrier configurations and the results of the April 20, 1995, test.

The second test assembly included a 24-inch-wide steel cable tray, 1-inch- and 5-inch-diameter steel conduits, and a 2-inch-diameter air drop. These test specimens did not contain cables and were protected with three layers of Interam E54A fire barrier mat material. Each layer was 10 mm [0.4 inch] thick.

On May 17, 1995, OPL subjected the test assembly to the test fire specified in ASTM Standard E-119 for 1 hour. After the fire exposure, it subjected the test specimens to a fog-nozzle hose stream test. These 1-hour test specimens met the acceptance criteria of Supplement 1 to GL 86-10. Table 2 (see Attachment 1) summarizes the test specimen and fire barrier configurations and the results of the May 17, 1995, test.

3-Hour Fire Endurance Test

The third test assembly included nominal 24-inch- and 6-inch-wide steel cable trays; nominal 1-inch-, 3-inch-, and 5-inch-diameter steel conduits; a 2-inch-diameter air drop; each was arranged in a U-shaped configuration; and a nominal 12-inch by 12-inch by 8-inch steel junction box. The cable trays were filled with a single layer of mix cables. The cable trays, the 1-inch- and 3-inch-diameter steel conduits, and the air drop were protected with five layers of Interam E54A fire barrier mat material. The 5-inch-diameter conduit and the junction box were protected with six layers of Interam E54A fire barrier mat material. Each layer was 10 mm [0.4 inch] thick.

On July 7, 1995, OPL subjected the test assembly to the test fire specified in ASTM Standard E-119 for 3 hours. After the fire exposure, it subjected the test specimens to a fog-nozzle hose stream test. The barriers did not burn through during the fire exposure, nor were they breached by the hose stream. There was no visible damage to the test specimen cables. However, all of the test specimens exceeded the temperature rise acceptance criteria of GL 86-10, Supplement 1. Table 3 (see Attachment 1) summarizes the test specimen and fire barrier configurations and the results of the July 7, 1995 test.

Discussion

Section 50.48 of Title 10 of the *Code of Federal Regulations* requires that each operating nuclear power plant must have a fire protection plan that

satisfies General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50. Fire protection features required to satisfy GDC 3 include features to ensure that one train of systems necessary to achieve and maintain shutdown conditions is free of fire damage. One means of satisfying this requirement is to separate one safe shutdown train from its redundant train with a fire-rated barrier. The level of fire resistance required of the barrier, 1 hour or 3 hours, depends on the other fire protection features in the fire area.

The NRC issued guidance on acceptable methods of satisfying the regulatory requirements of GDC 3 in Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants"; Appendix A to BTP APCSB 9.5-1; BTP Chemical Engineering Branch (CMEB) 9.5-1, "Fire Protection for Nuclear Power Plants"; and GL 86-10, "Implementation of Fire Protection Requirements." These guidance documents state that the fire resistance ratings of fire barriers should be established in accordance with National Fire Protection Association (NFPA) Standard 251, "Standard Methods of Fire Tests of Building Construction and Materials" (1975), by subjecting a representative test specimen to a standard fire exposure.[1]

On March 25, 1994, the NRC issued Supplement 1 to GL 86-10 to (1) clarify the applicability of the test acceptance criteria in GL 86-10 to raceway fire barrier systems, (2) specify a set of fire endurance test acceptance criteria that are acceptable for demonstrating that fire barrier systems can perform the required fire-resistive function and maintain the protected safe shutdown train free of fire damage, (3) specify acceptable options for hose stream testing, and (4) specify criteria for cable functionality testing when a deviation is necessary, such as when the fire barrier temperature rise criteria are exceeded or the test specimen cables sustain visible damage. These positions are incorporated by the NRC staff in its review and evaluation of the adequacy of fire endurance tests and fire barrier systems proposed by licensees or applicants to satisfy existing NRC fire protection rules and regulations.

Some temperatures observed during the tests exceeded the maximum allowable temperature acceptance criteria of Supplement 1 to GL 86-10. In accordance with this supplement, an engineering evaluation could be performed to determine the acceptability of an in-plant Interam fire barrier that was bounded by a deviating test specimen configuration. Information about such evaluations can be found in Enclosure 2 of Supplement 1 to GL 86-10. By letter dated August 7, 1995 [accession number 9509050173], Peak Seals submitted to the NRC staff additional documentation relating to the thermal performance of the 3-hour fire barrier test specimens for information.

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[1] NFPA adopted ASTM Standard E-119 as NFPA Standard 251.

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 Regulation (NRR) project manager.

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Attachments:
1. Tables 1, 2, and 3, Summaries of Endurance Tests
2. List of Recently Issued NRC Information Notices

Table 1. Summary of April 20, 1995 Fire Endurance Test

Peak Seals - 3M Company 1-Hour Interam Fire Barriers
Allowable single point unexposed-side temperature criterion = 399 °F[1]
Allowable average unexposed-side temperature criterion = 324 °F
(Shading shows temperatures that exceeded, acceptance criteria of GL 86-10 Supplement 1)

TEST SPECIMEN	THERMOCOUPLE LOCATIONS	AVERAGE (°F)	MAXIMUM (°F)	REMARKS
6" Cable tray	Front side rail	262	338	Protected with three layers of Interam E53A.
	Rear side rail	262	337	Met acceptance criteria.
	Copper conductor	228	282	
24" Cable tray	Front side rail	369	470	Protected with four layers of Interam E53A.
	Rear side rail	387	482	Exceeded the maximum single point temperature criterion at 50½ minutes and the average temperature rise criterion at 54½ minutes.
	Copper conductor	342	382	
5" Conduit	Conduit surface	277	370	Protected with three layers of Interam E53A.
	Copper conductor	217	275	Met acceptance criteria.
3" Conduit	Conduit surface	366	402	Protected with three layers of Interam E53A.
	Copper conductor	329	374	Exceeded the maximum single point temperature criterion at 59½ minutes and the average temperature rise criterion at 53½ minutes.
2" Conduit	Conduit surface	357	428	Protected with three layers of Interam E54A.
	Copper conductor	321	400	Exceeded the maximum single point temperature criterion at 55½ minutes and the average temperature rise criterion at 55 minutes.
1" Conduit	Conduit surface	361	417	Protected with two layers of Interam E53A and an outer layer of Interam E54A.
	Copper conductor	332	397	Exceeded maximum single point temperature criterion at 49½ minutes and the average temperature rise criterion at 52 minutes.
2" air drop	Copper conductor	326	393	Protected with three layers of Interam E54A. Exceeded average temperature rise criterion at 59 minutes.
Junction box	Metal surface	257	311	Protected with three layers of Interam E54A. Met acceptance criteria.

[1]Temperatures measured during testing and the acceptance temperatures are presented in °F in all Tables of this attachment to minimize error and confusion.

Table 2. Summary of May 17, 1995 Fire Endurance Test

Peak Seals - 3M Company 1-Hour Interam Fire Barrier Allowable single point unexposed-side temperature criterion = 405 °F Allowable average unexposed-side temperature criterion = 330 °F				
TEST SPECIMEN	THERMOCOUPLE LOCATIONS	AVERAGE (°F)	MAXIMUM (°F)	REMARKS
24" Cable tray	Front side rail	290	389	Protected with three layers of 3M Interam E54A Met acceptance criteria.
	Rear side rail	301	354	
	Copper conductor	226	265	
5" Conduit	Conduit surface	224	251	Protected with three layers of E54A. Met acceptance criteria.
	Copper conductor	217	244	
1" Conduit	Conduit surface	308	374	Protected with three layers of E54A. Met acceptance criteria.
	Copper conductor	286	346	
2" Air drop	Copper conductor	242	279	Protected with three layers of Interam E54A. Met acceptance criteria.

Table 3. Summary of July 7, 1995 Fire Endurance Test

Peak Seals - 3M Company 3-Hour Interam Fire Barrier
Allowable single point unexposed-side temperature criterion = 407 °F
Allowable average unexposed-side temperature criterioon = 332 °F
(Shading shows temperatures that exceeded acceptance criteria of GL 86-10, Supplement 1)

TEST SPECIMEN	THERMOCOUPLE LOCATIONS	AVERAGE (°F)	MAXIMUM (°F)	REMARKS
6" Cable tray	Front side rail	381	436	Protected with five layers of Interam E54A. Exceeded the maximum single point temperature criterion at 158 minutes and the average temperature rise criterion at 166 minutes.
	Rear side rail	357	454	
	Copper conductor	301	343	
24" Cable tray	Front side rail	357	417	Protected with five layers of Interam E54A. Exceeded the maximum single point temperature criterion at 176 minutes and the average temperature rise criterion at 167 minutes.
	Rear side rail	344	406	
	Copper conductor	243	334	
5" Conduit	Conduit surface	336	451	Protected with five layers of Interam E54A. Exceeded the maximum single point temperature criterion at 161 minutes and the average temperature rise criterion at 178 minutes.
	Copper conductor	310	411	
3" Conduit	Conduit surface	399	485	Protected with five layers of Interam E54A. Exceeded the maximum single point temperature criterion at 148 minutes and the average temperature rise criterion at 152 minutes.
	Copper conductor	344	462	
1" Conduit	Conduit surface	366	530	Protected with six layers of Interam E54A. Exceeded the maximum single point temperature criterion at 126 minutes and the average temperature rise criterion at 167 minutes.
	Copper conductor	345	465	
2" Air drop	Copper conductor	349	426	Protected with five layers of Interam E54A. Exceeded the maximum single point temperature criterion and the average temperature rise criterion at 152 minutes.
Junction box	Metal surface	370	391	Protected with six layers of Interam E54A. Exceeded the average temperature rise criterion at 165 minutes.

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Information Notice No.	Subject	Date of Issuance	Issued to
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95-12, Supp. 1	Potentially Nonconforming Fasteners Supplied by A&G Engineering II, Inc.	10/05/95	All holders of OLs or CPs for nuclear power reactors.
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OL = Operating License
CP = Construction Permit

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Attachments:
1. Tables 1, 2, and 3, Summaries of Endurance Tests
2. List of Recently Issued NRC Information Notices

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