NUCLEAR ENERGY INSTITUTE

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December 3, 2009

Mr. Michael T. Lesar
Chief, Rulemaking and Directives Branch (RDB)
Division of Administrative Services
Office of Administration
Mail Stop TWB–05–B01M
U.S. Nuclear Regulatory Commission
Washington, DC 20555–0001

Subject: Industry Comments on Draft NUREG 1924, "Electric Raceway Fire Barrier Systems in U.S. Nuclear Power Plants," Docket ID NRC–2009–0442

Project Number: 689

The Nuclear Energy Institute (NEI),[1] on behalf of the nuclear energy industry, is pleased to provide comments on Draft NUREG 1924, "Electric Raceway Fire Barrier Systems in U.S. Nuclear Power Plants," Docket ID NRC–2009–0442, 74FRN51621.

The attachment to this letter provides comments and recommended changes to the text of the NUREG. The following are key comments that are further discussed in the attachment:

- Minor corrections to site-specific information have been included as comments. Additional site-specific comments are expected to be submitted separately by affected licensees.

- Section 3 of the NUREG intermixes contemporary NRC staff positions and information with historical positions and information without a clear reference to the timeframe of interest. It is important to note in the NUREG that licensees installed their fire barriers in conformance with NRC guidance in effect at that time. That NRC guidance was subsequently changed to reflect new information that is not clearly articulated in the draft NUREG.

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

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E-RIDS = ADM-03

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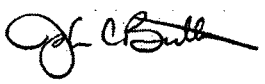
Template = ADM-013
Add = G. Taylor (GST)

- Paragraph 5.1.2 contains both events that occurred in 1981 and events that occurred in 1992. While the NRC received the referenced test reports in 1981, problems with the test reports were first documented in 1992. An NRC staff position calling for full-scale tests did not come into effect until GL 86-10 Supplement 1 was issued in 1994. It is recommended that a time line be used to clarify the time sequence of events and how they impacted the industry and the NRC.

- Prior to NRC issuance of Info Notice 84-09, there was no specific NRC guidance indicating that fire barriers (walls, floor, ceilings, wraps) were to be subject to testing by UL or nationally recognized testing laboratories. BTP APCSB 9.5-1 required this for doors, but not fire barriers. In each edition of the BTP, the NRC said that E-119 should apply to penetration seals, not cable-tray fire wraps.

If you have any questions or need clarification on our comments, please do not hesitate to contact me or Steven Hutchins (202.739.8025, sph@nei.org).

Sincerely,



John C. Butler

Attachment

c: Dr. Sunil D. Weerakkody, U.S. Nuclear Regulatory Commission
Mr. Mark H. Salley, U.S. Nuclear Regulatory Commission
Mr. Gabriel Taylor, U.S. Nuclear Regulatory Commission
Mr. Alex Klein, NRR, U.S. Nuclear Regulatory Commission
NRC Document Control Desk

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1924

Electric Raceway Fire Barrier Systems in U.S. Nuclear Power Plants

Draft Report for Comment

Office of Nuclear Regulatory Research

Summary of Comments on Microsoft Word - c-1924 - Draft Report for Comment _NEW_ _2_.doc

This page contains no comments

Page: 2

Author: Subject: Highlight Date: 11/30/2009 8:32:47 AM
typo - "protecting cables and/or equipment"

Author: Subject: Highlight Date: 11/30/2009 8:34:36 AM
We are not aware of anything in the rule making record of Appendix R that suggests that classical fire-rated walls were the only option being considered by the staff in 1980. This would need to be substantiated.

1. INTRODUCTION

On March 22, 1975, the Tennessee Valley Authority (TVA) Browns Ferry Nuclear Plant (BFN) experienced a serious fire in its cable spreading room (CSR) and Unit 1 reactor building. The fire burnt for over 7 hours and damaged over 1,600 electrical cables, rendering all Unit 1 and many of Unit 2 Emergency Core Cooling Systems (ECCS) inoperable. This near-miss accident illustrated the vulnerability of essential electric cables to fire damage. In response to this fire, the U.S. Nuclear Regulatory Commission (NRC) issued Appendix R to Title 10 of the *Code of Federal Regulations* Part 50 (10 CFR 50) as a backfit to operating reactors and similar requirements implemented on reactors under construction.

For compliance via Appendix R III.G.2, two of the three options for lack of separation of cables within a single fire area involve protective cables that are needed for post fire safe shutdown or could cause maloperation of post-fire safe shutdown equipment. The authors of Appendix R envisioned classical fire-rated walls being installed to separate or protect these cables. In actual application of the regulation, often times, classical fire walls could not be installed and the need was to protect just a train / division of equipment located in the electrical raceway. This is the origin of the Electrical Raceway Fire Barrier System (ERFBS).

ERFBSs are used in nuclear power plants (NPPs) to provide fire area separation between redundant safety-related components and safe shutdown functions. They provide fire resistance protection, as required by Appendix R Section III.G.2, to one safe shutdown train in those fire areas that contain both trains. The objective of the safe-shutdown-related Appendix R fire barrier is to ensure that a safe-shutdown train is conservatively protected from fire-related thermal insult. The necessity for these fire barriers has been verified by multiple probabilistic risk assessments (PRAs). These PRAs indicated that, even with fire barriers installed, fires are still major contributors to core melt probabilities.

In June 2008, the U.S. General Accountability Office (GAO) issued its report titled, "NRC's Oversight of Fire Protection at U.S. Commercial Nuclear Reactor Units Could Be Strengthened, GAO-08-747." One conclusion identified the need for NRC to test and resolve the effectiveness of fire wraps[1] at NPPs. This report provides the history, effectiveness, and plant resolution of ERFBS (i.e., fire wraps).

Fire barriers are one level of protection used in fire protection programs to ensure the safety of the public and to protect the environment. Fire barriers are often employed to ensure that the plant can safely shut down in the event of a fire. ERFBSs are non-structural fire-rated assemblies that protect the electrical cables they enclose. In NPP applications, ERFBS are required to have a fire-resistance rating of either 1- or 3-hours, based on the specific application. 1-hour ERFBSs require detection and automatic suppression to be installed within the same fire area. For some areas, licensees have requested exemptions to these requirements based on the specific area configuration and low combustible loading. Exemptions are reviewed by the Nuclear Regulatory Commission (NRC) staff under the agency's normal exemption process and the staff approves or disapproves the exemptions, as appropriate. A variety of ERFBSs in use at NPPs include Thermo-Lag, Darmatt, Hemyc, MT, Versa Wrap, Mecatiss, Pyrocrete, FP-60, Pabco, Promat, Cerablanket, Kaowool, and 3M Interam.

[1] Fire wrap is synonymous with ERFBS

Page: 3

Author: u999gp Subject: Highlight Date: 11/25/2009 8:00:20 AM
Table 1-1, pg. 1-2 incorrectly indicates that Braidwood currently uses Darmatt. Darmatt installations have been abandoned as described in sect. 6.3, pg. 6-2. Braidwood currently only credits 3M Interam installations. Table should be revised to indicate that Braidwood uses 3M Interam.

Table 1-1, provides a summary of the ERFBS use at individual NPP sites. The table is ordered by plant name alphabetically in left column and by barrier popularity along the top header row with the most popular to least popular barriers arranged from left to right. As is shown in the table, many plants use more than one type of ERFBS. Although the choice to use multiple ERFBS is site specific, some factors that may have influence the use of multiple barriers are costs, ease of installation, new product, technical problems with other barriers, better performance, etc. Section 5 provides the specific details and history of each ERFBS.

Table 1-1. ERFBS Currently Used in U.S. NPPs

Plant Name	Thermo-Lag	3M Interam	Darmatt	Kaowool & FP-60	Hemyc & MT	VersaWrap	Mecatiss	Promat	Pyrocrete	Pabco	Concrete
Arkansas Nuclear 1 and 2	X				X	X					
Beaver Valley 1 and 2	X	X	X								
Braidwood 1 and 2			X								
Browns Ferry 1, 2 and 3	X										
Brunswick 1 and 2		X									
Byron 1 and 2			X								
Callaway			X								
Calvert Cliffs 1 and 2											
Catawba 1 and 2					X						
Clinton	X	X									
Columbia Generating Station	X	X	X								
Comanche Peak 1 and 2	X				X						
Cooper Nuclear Station											
Crystal River 3	X						X				
Davis Besse		X									
Diablo Canyon 1 and 2		X							X		
Donald C. Cook Nuclear Plant Unit 1 and 2	X		X				X				
Dresden 2 and 3		X									
Duane Arnold			X								
Farley 1 and 2		X						X			
Fermi 2		X									
FitzPatrick				X	X						
Fort Calhoun		X							X	X	
Robert E Ginna					X						
Grand Gulf 1	X	X									
Shearon Harris	X	X			X						
Edwin Hatch 1 and 2								X			
Hope Creek 1											
Indian Point 2 and 3		X			X						
Kewaunee		X									

Plant Name	Thermo-Lag	3M Interam	Darmatt	Kaowool & FP-60	Hemyc & MT	VersaWrap	Mecatiss	Promat	Pyrocrete	Pabco	Concrete
La Salle 1 and 2	X		X								
Limerick 1 and 2	X		X								
McGuire 1 and 2					X						
Millstone 2 and 3											
Monticello											
Nine Mile Point 1 and 2											
North Anna 1 and 2		X									
Oconee 1, 2 and 3											
Oyster Creek	X						X				
Palisades											X
Palo Verde 1, 2 and 3	X										
Peach Bottom 2 and 3	X		X								
Perry 1		X									
Pilgrim 1		X					X				
Point Beach 1 and 2		X									
Prairie Island 1 and 2	X		X								
Quad cities 1 and 2		X	X			X					
River Bend	X										
H. B. Robinson 2		X			X						
Saint Lucie 1 and 2	X				X		X				
Salem 1 and 2		X									
San Onofre 2 and 3		X		X[1]							
Seabrook 1		X									
Sequoyah 1 and 2	X										
South Texas Project Unit 1 and 2	X										
Summer		X		X							
Surry 1 and 2									X		
Susquehanna 1 and 2	X		X								
Three Mile Island 1	X						X				
Turkey Point 3 and 4	X										
Vermont Yankee		X									
Vogtle 1 and 2		X									
Waterford 3		X			X						
Watts Bar 1	X										
Wolf Creek 1	X		X								

[1] **San Onofre uses Certablanket which is a similar product to Kaowool**

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Author: u999cjp Subject: Highlight Date: 11/25/2009 8:22:58 AM
LaSalle also has Kaowool, so Kaowool should be checked. Thermo-Lag was replaced with Darmatt, so Thermo-Lag should not be checked.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:33:53 AM
Oyster Creek also uses 3M Interam.

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Author: Subject: Highlight Date: 11/30/2009 8:45:19 AM
General comments:

Equal time should be given to the post-79 licensing requirements, so as to not create the perception for the reader that the III.G.2 criteria of Appendix R are binding legal requirements to all sites in the country.

This section frequently intermixes contemporary NRC staff positions and information with historical positions and information, without providing a clear reference to the timeframe. It has the effect of painting licensees in a very negative light, especially when read as written. For the most part, licensees installed their fire barriers to the NRC guidance that was in effect at that time. The fact that the NRC guidance itself has changed is not clearly articulated. To some extent, it has been the changes in NRC staff positions that have led to the "disqualification" of many fire barriers.

Author: Subject: Highlight Date: 11/30/2009 8:45:29 AM
On plants licensed to operate prior to Jan 1, 1979.

3. ERFBS Regulations

During the early stage of nuclear power plant (NPP) construction and licensing, fire protection was implemented based on the performance objective of General Design Criterion (GDC) 3 in Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.

GDC 3 states,

> 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. Noncombustible and heat resistant materials shall be used whenever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Fire fighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components. (Appendix A to 10 CFR 50)

GDC 3 set high-level goals for the fire protection program but did not provide specific implementation guidance. At the time, fire protection was largely based on compliance with local fire codes and with the requirements of insurance underwriters, since there were no specific regulatory requirements. As a result, fire protection was based largely on best practices as established from other industrial facilities including, in particular, fossil fuel power plants.

Following the Browns Ferry Fire[2] in 1975 and the subsequent inspections, fundamental changes in the regulatory approach to NPP fire protection was made. The first change was new guidance published in Branch Technical Position Auxiliary and Power Conversion Systems Branch 9.5-1 (BTP APCSB 9.5-1) that established the "defense-in-depth" concept for fire protection. This concept involved a layered approach to fire protection. The fire protection defense-in-depth principles are aimed at achieving the following objectives:

- Preventing fires from starting,
- Promptly detecting, controlling, and extinguishing those fires that do occur,
- Providing protection of structures, systems, and components important to safety to ensure that a fire not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant or result in release of radioactive materials to the environment.

It also should also be mentioned that this "defense-in-depth" philosophy for fire protection actually came out of the Browns Ferry Special Review Group recommendations. (NRC IN 92-46, Attachment 1)

In November 1980, the U.S. NRC published a new set of fire protection requirements as 10 CFR 50.48 and Appendix R to 10 CFR Part 50. The new regulations imposed a minimum set of fire protection program and post-fire safe shutdown requirements. The primary focus of the

2 The Browns Ferry fire was the root cause for developing NPP fire protection regulations (10 CFR 50.48, and Appendix R). A brief overview of the Browns Ferry Fire is provided in Appendix A of this document.

requirements establishes fire protection criteria for systems needed to safely shutdown and maintain the reactor in a safe condition in the event of a fire.

APCSB 9.5-1 was applicable to plants that were issued a construction permit after July 1, 1976, while Appendix A to APCSB 9.5-1 was applicable to plants for which application for construction permits were docketed prior to July 1, 1976, and plants that were operating or were issued construction permits prior to July 1, 1976.

In the years following the Browns Ferry Fire, the U.S. Nuclear Regulatory Commission (NRC) performed numerous inspections and re-evaluated the fire risks at NPPs and, in November 1980, NRC published a new set of fire protection requirements as 10 CFR 50.48 and Appendix R to 10 CFR Part 50.[3] The new regulations imposed a minimum set of fire protection program and post-fire safe shutdown requirements. The primary focus of the requirements establishes fire protection criteria for systems needed to safely shutdown and maintain the reactor in a safe condition in the event of a fire.

10 CFR 50.48, backfit Appendix R to facilities operating prior to January 1, 1979. In additional, all plants to receive their operating license after January 1, 1979, have license condition that satisfy specific requirements of Appendix R, including III.G for redundant trains located in a fire area. Section III.G.2 of Appendix R, which states three prescriptive options for ensuring one redundant trains located in the same fire area remain free of fire damage[4], is reproduced here:

> III.G.2 Except as provided for in paragraph G.3 of this section, where cables or equipment, including associated non-safety circuits that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground, of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment, one of the following means of ensuring that one of the redundant trains is free of fire damage shall be provided:
>
> a. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier;
>
> b. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; or
>
> c. Enclosure of cable and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating, In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area;

The underlying purpose of Section III.G of Appendix R is to ensure that where redundant trains are located in the same fire area at least one means of achieving and maintaining safe

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[3] 10 CFR 50.48 and Appendix R to Part 50 are reproduced in full in Appendix F and became effective on February 19, 1981.

[4] The technical basis for Appendix R states that "(i)f specific plant conditions preclude the installation of a 3-hour fire barrier to separate the redundant trains, a 1-1-hour fire barrier and automatic fire suppression and detection system for each redundant train will be considered the equivalent of a 3-hour barrier."

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Author: Subject: Highlight Date: 11/30/2009 8:45:40 AM
Poor grammar in sentence.

Also sentence is incorrect. Most post-79 plants do not have a license condition similar to what is described here. In fact, at the Commission briefings where Appendix R was being proposed to the Commissioners, the staff made a point of noting that NUREG-0800 was more flexible than Appendix R, and that Appendix R was restrictive on purpose due to the need to force action for the Pre-79 plants. For the Post-79 plants, since NRC would not issue an operating license until they were satisfied, more flexible criteria were used. The Staff's statements to the commissioners indicates that for plants licensed after 1/1/79, the BTP 9.5-1 provides an adequate level of safety in the fire protection area, and compliance with Appendix R is not required. [NRC Commission Meeting and Vote on Appendix R, 10/16/1980, Transcript Page 5]

4. Testing Criteria

4.1 History of Testing Criteria

When the U.S. Nuclear Regulatory Commission (NRC) developed Appendix R to 10 CFR Part 50, there were no established tests for ERFBS that were found acceptable to NRC. At that time there was only the ANI testing standard, which was conducted for insurance purposes only, and was not found acceptable by NRC. During the implementation phase of Appendix R, licensees became unclear as to the acceptance criteria for ERFBS.

Following issuance of the fire protection rule in 1980, NRC began receiving questions related to the implementation of the rule. NRC developed responses to these questions and presented them in draft form in 1984 at NRC sponsored regional workshops on implementation of NRC fire protection requirements at NPPs. In 1986, NRC issued the final form of these responses in GL 86-10, "Implementation of Fire Protection Requirements." Enclosure 2 to GL 86-10 provided the staff position on several questions raised by licensees: specifically, question 3.2.1 asked NRC staff to clarify the origin of the 163°C (325°F) temperature rise criterion. Enclosure 2 to GL 86-10 provided the staff position on fire endurance test acceptance criteria for fire barrier cable-tray wraps (ERFBS), as follows;

> The acceptance criteria contained in Chapter 7, "Tests of Nonbearing Walls and Partitions," of National Fire Protection Association (NFPA) Standard 251, "Standard Methods of Fire Tests of Building Construction," was applicable to cable-tray fire wraps. These criteria stipulate that transmission of heat through the barrier "shall not have been such as to raise the temperature on its unexposed surface more than 139°C (250°F) above its initial temperature. It is generally recognized that 24°C (75°F) represents an acceptable norm. The resulting 163°C (325°F) cold side temperature criterion is used for cable tray wraps because they perform the fire barrier function to preserve the cables free of fire damage. It is clear that cable that begins to degrade at 232°C (450°F) is free of fire damage at 163°C (325°F).

Therefore, the origin of the 163°C (325°F) single point acceptance criteria was based on NPFA 251 and ASMT E-119 testing standards, along with the thermal damage threshold of cables found in use at NPPs.

It is important to understand that when ERFBS started being used in NPPs the ANI standard was the only method for testing ERFBS and was designed for insurance purposes only. NFPA 251 and American Society of Testing and Materials (ASTM) E-119 testing standards are used for qualifying traditional building members (walls, floors, columns, etc.) under fire exposure conditions, and licensees were unclear as to how to apply those standards to ERFBS. The lack of an acceptable testing standard resulted in uncertainty as to the method of qualifying ERFBS. Most nuclear utilities and ERFBS manufacturers originally tested their ERFBS to the American Nuclear Insurers (ANI) Criterion. The ANI standard, as discussed below, has its deficiencies and is not considered to be an acceptable method to NRC staff for qualifying ERFBS.

Following issuance of IN 91-47 and IN 91-79, the Texas Utilities (TU) Electric Company conducted their own fire endurance test program in the summer of 1992 to qualify their ERFBS

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Author: Subject: Highlight Date: 11/30/2009 8:39:58 AM
This statement seems unlikely to be true. From the licensee's perspective, there was no NRC-specific guidance given as to what tests are considered acceptable. Both NRC BTP ASB 9.5.1 and RG 1.120 stated that "The Nuclear Energy Liability and Property Insurance Association (NELPIA) and the Mutual Atomic Energy Reinsurance Pool (MAERP) have prepared a document entitled 'Specifications for Fire Protection of New Plants,' which gives general conditions and valuable criteria." which appears to contradict what is being said here.

Author: Subject: Highlight Date: 11/30/2009 8:46:38 AM
We are not aware of any NRC communication from the 1980 to 1986 timeframe indicating that the NRC found the ANI protocol unacceptable. In fact, some plants licensed in this timeframe indicate in their UFSARs that fire barrier qualifications have been performed in accordance with ANI NEL-PIA/MAERP test standards, and these plants UFSARs have been accepted and operating license granted.

Author: Subject: Highlight Date: 11/30/2009 8:46:54 AM
Both NRC BTP ASB 9.5.1 and RG 1.120 stated that "The Nuclear Energy Liability and Property Insurance Association (NELPIA) and the Mutual Atomic Energy Reinsurance Pool (MAERP) have prepared a document entitled 'Specifications for Fire Protection of New Plants,' which gives general conditions and valuable criteria." which appears to contradict what is being said here.

Author: Subject: Highlight Date: 11/30/2009 8:47:03 AM
NRC did not formally document this staff position until 1986, and did not make this staff position retroactive.

following the guidance and acceptance criteria of ANI as specified in ANI Information Bulletin #5 (79), "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits," July 1979. This ANI standard had been developed for insurance purposes only and provided a method that was acceptable to ANI for demonstrating that an ERFBS was capable of protecting Redundant Class 1E cables in the same fire area for particular qualification duration.

Subsequent to several interactions between NRC and TU staff, NRC concluded that the licensees were uncertain as to whether the ANI test method established a level of fire-barrier performance equivalent to that established by the GL 86-10 acceptance criteria. In recognizing that the 1-hour and 3-hour ERFBS are unique and additional guidance on the proper implementation of GL 86-10 would be helpful, NRC issued Supplement 1 to GL 86-10, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used to Separate Redundant Safe Shutdown Trains Within the Same Fire Area," in 1994. This supplement provided the acceptance criteria that were satisfactory to NRC for qualifying an ERFBS fire rating. Supplement 1 to GL 86-10, also included performance based criteria based on the type of cable, and other factors to achieve an acceptable barrier without meeting the prescriptive test limits.

The general approach for licensees to qualify an ERFBS is to evaluate ERFBS testing results and related data to ensure it applies to the conditions under which they intend to install the barriers. If test results are not available for specific applications, the licensees are encouraged to perform independent qualification testing to provide adequate results. If all configurations cannot be tested, then an engineering analysis must be performed to demonstrate that cables would be protected adequately during and after exposure to fire. Enclosure 2 to GL 86-10 also provided guidance for instances where exact replication of plant configurations could not be tested. This guidance stated that an exemption would not be required if the following five criteria are met:

1. The continuity of the fire barrier material is maintained.
2. The thickness of the barrier is maintained.
3. The nature of the support assembly is unchanged from the tested configuration.
4. The application or "end use" of the fire barrier is unchanged from the tested configuration.
5. The configuration has been reviewed by a qualified fire protection engineer and found to provide an equivalent level of protection.

4.2 Fire Endurance Rating

The fire protection features required to satisfy GDC 3 include features to ensure that one train of those systems necessary to achieve and maintain shutdown conditions be maintained free of fire damage. One means of complying with this requirement is to separate one safe shutdown train from its redundant train in a fire area with a fire barrier having a 1- or 3-hour rating. But what exactly does "fire-rated" mean?

Fire rating is defined as the endurance period of a fire barrier or structure, which relates to the period of resistance to a standard fire exposure before the first critical point in behavior is observed. 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.

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Author: Subject: Highlight Date: 11/30/2009 8:42:15 AM
Both NRC BTP ASB 9.5.1 and RG 1.120 stated that "The Nuclear Energy Liability and Property Insurance Association (NELPIA) and the Mutual Atomic Energy Reinsurance Pool (MAERP) have prepared a document entitled 'Specifications for Fire Protection of New Plants,' which gives general conditions and valuable criteria," which appears to contradict what is being said here.

Author: Subject: Highlight Date: 11/30/2009 8:42:26 AM
This supplement was ALSO not retroactive

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T Author: Subject: Highlight Date: 11/30/2009 8:42:03 AM
Prior to issuance of GL 86-10, there is no indication of an NRC staff position to use NFPA 251.

T Author: Subject: Highlight Date: 11/30/2009 8:41:51 AM
This paragraph is false. In each edition of the BTP, NRC said that E-119 should apply to penetration seals, not cable-tray fire wraps.

The statement of considerations for Appendix R (45 FR 76602), stipulated the following:

> "Fire Barriers are 'rated' for fire resistance by being exposed to a 'standard test fire.' This standard test fire is defined by the American Society for Testing and Materials in ASTM E-119, 'Standard for Fire Resistance of Building Materials.' Fire barriers are commonly rated as having a fire resistance of from 1 to 8 hours."

Fire endurance ratings of building construction and materials are demonstrated by testing fire barrier assemblies in accordance with the provisions of the applicable sections of NFPA 251 and ASTM E-119. Assemblies that pass specified acceptance criteria (e.g., standard time-temperature fire endurance exposure, unexposed side temperature rise, hose stream impingement) are considered to have a specific fire-resistance rating.

Documentation required establishing the fire rating of a fire barrier should include the design description of the barrier and the test reports that verify its fire rating.

4.3 Acceptance Criteria & Test Standards

NRC issued the following guidance on acceptable methods of satisfying the regulatory requirements of GDC 3:

- BTP APCSB 9.5-1, "Guidelines for Fire Protection for NPPs,"
- Appendix A to BTP APCSB 9.5-1,
- BTP CMEB 9.5-1, "Fire Protection for NPPs" and
- GL 86-10, which took precedence over previous staff guidance.
- Supplement 1 to GL 86-10

In these guidance documents, NRC staff stated that as a minimum, the design of fire barriers for horizontal and vertical cable trays should meet the requirements of the American Standard ASTM E-119, "Fire of Building Construction and Materials," including the hose stream test. NRC also stated in GL 86-10 Supplement 1 that the acceptance criteria contained in NFPA 251, "Standard Methods of Fire Tests of Building Construction and Materials," pertaining to nonbearing fire barriers was applicable to cable-tray fire barrier wraps. Figure 4-1 shows a logic diagram for the qualification and acceptance criteria for ERFBS that was provided in Supplement 1 to GL 86-10.

ASTM E-119 and NFPA 251 provided acceptance criteria for testing ERFBS. However, prior to NRC issuing Supplement 1 to GL 86-10, industry had no clear understanding of the specifics on how ERFBS testing was supposed to be conducted to ensure adequate testing to NRC. In developing Supplement 1, NRC staff relied on input from industry and public stakeholders concerning various methods of testing. In particular, the Tennessee Valley Authority (TVA) had developed a detailed and sturdy engineering position on the proper way to test ERFBS. This position was presented to NRC in the early 1990s and serves as a basis to the guidance of GL 86-10 Supplement 1.

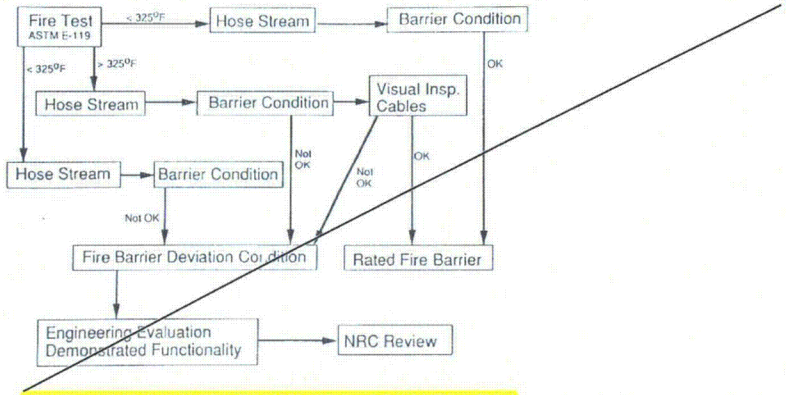

Figure 4-1. Fire Barrier Testing Acceptance Criteria Flow Chart

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Author: Subject: Highlight Date: 11/30/2009 8:41:39 AM
This figure is confusing or misleading. "NRC Review" is not normally performed, so what is the significance here? Box should be changed to "NRC Verification via Audit or Inspection"

4.3.1 American Nuclear Insurers Test Standard

The American Nuclear Insurers (ANI) test standard was enclosed in ANI Information Bulletin #5 (79), dated July 1979. This test standard was to be used by those NPPs insured by ANI to qualify (for insurance purposes only) a Protective Envelope for Redundant Class 1E Cables in NPPs when located in the same fire area. The intent of this qualification standard was to establish the ability of an ERFBS to maintain circuit integrity when exposed to a fire outside of the cabling system, adjacent to the protected cable, or when subjected to the mechanical impact of hose stream or other impact test.

The ANI standard includes a test for exposure fires and subjects the protected cable raceway to an ASTM E-119 standard temperature-time curve. Following the exposure, a hose stream test would be conducted following specific guidelines on line size, pressure, nozzle angle, and flow rate. An energized cable was placed within the ERFBS for monitoring the circuit integrity. The only failure criterion was loss of circuit integrity during the fire exposure or hose stream period. The intent of the test was to identify the onset of fire damage to the cables within the raceway fire barrier test specimen during the fire endurance test period.

NRC considers using the ANI monitoring approach to be non-conservative. Specifically, Supplement 1 to GL 86-10 states:

> The use of circuit integrity monitoring during the fire endurance test is not a valid method for demonstrating that protected shutdown circuits are capable of performing their required function during and after the test fire exposure.

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T Author: Subject: Highlight Date: 11/30/2009 8:47:42 AM
typo: "NFPA", not "ASTM"

4.3.2 ASTM E-119 and NFPA 251

GL 86-10 identifies that NRC staff found Chapter 7 of NFPA 251, "Tests of Nonbearing Walls and Partitions" to be an adequate testing acceptance criteria to use for qualifying cable tray fire barrier wraps.

Appendix A to BTP 9.5-1 Position D.3.(d), states that the design of fire barriers for horizontal and vertical cable trays should, as a minimum, meet the requirements of the American Society of Testing and Materials (ASTM) E-119, "Fire Test of Building Construction and Materials," including hose stream test. The technical basis for Section III.M of Appendix R to 10 CFR 50, stipulates that "Fire barriers are 'rated' for fire resistance by being exposed to a 'standard test fire." This standard test fire is defined by the ASTM E-119 test standard. It should also be mentioned that ASTM 251 and ASTM E-119 are nearly identical testing standards.

The following is the ASTM E-119 and NFPA 251 acceptance criteria:

- The wall or partition withstood the fire endurance test without the passage of flame or gases hot enough to ignite cotton waste, for a period equal to that for which classification is desired.
- The wall or partition withstood the specified fire and hose stream tests, without the passage of flame, gases hot enough to ignite cotton waste, or the hose stream. The assembly failed the hose stream test if an opening developed that permits the projection of water from the stream beyond the unexposed surface during the hose stream test.
- Transmission of heat through the wall or partition during the fire endurance test did not raise the temperature on the unexposed surfaces more than 139°C (250°F) above their initial temperatures.

This standard specifies that the test shall be controlled by the standard temperature-time curve presented in the standard. Table 4.1 and Figure 4-2 provide reference to the temperature-time values required by this standard. The measurement of these temperatures is the average of no fewer than nine thermocouples symmetrically disposed and distributed near all parts of the sample, at least 6 inches away from the sample.

Table 4-1. NFPA 251 Temperature Time Curve Values

Time	Temperature (°C)	Temperature (°F)
5 minutes	538	1000
10 minutes	704	1300
30 minutes	843	1550
1 hour	927	1700
2 hours	1010	1850
4 hours	1093	2000
8 hours	1260	2300

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Author: Subject: Highlight Date: 11/30/2009 8:48:51 AM
The values presented in this section could be construed to mean these construction details are NRC-approved or are somehow binding on a licensee. Question whether publishing these specific values and measurements is necessary to make the point of the publication.

The Thermo-Lag 330-1 Fire Barrier System exists in several basic designs for use in NPPs, including:

- Pre-fabricated Panel Design
- Pre-shaped Conduit Section Design
- Direct Spray Over Stress Skin Design
- Direct Spray-on Design.

The first three consist of the same material components—a Thermo-Lag Stress Skin and a Thermo-Lag 330-1 subliming material—the only difference being a prefabricated product versus a spray-over application.

The stress skin is a steel mesh[6] used in conjunction with the Thermo-Lag 330-1 ERFBS. The stress skin is composed of an open-weave, self-stiffened steel mesh and is used to provide an enclosure and mechanical base for the Thermo-Lag 330-1 subliming material. The stress skin was originally designed to be placed over cable trays, conduits, and other items, but some licensees have also applied the stress skin around the exterior of a Thermo-Lag ERFBS with a top coat of trowel grade material to help reinforce and upgrade the barrier system.

The trowel grade Thermo-Lag 330-1 material is the same material used to fabricate the prefabricated panels and preshaped or preformed conduit section. It can also be supplied by the vendor in a sprayable form. The trowel grade material was typically applied to seal the joints between adjacent Thermo-Lag panels but, as discussed later, was used to reinforce and upgrade the Thermo-Lag ERFBS. Common terms used in the trade were "pre-butter" or "post-butter" thermo-lag assemblies, meaning the trowel grade Thermo-Lag was applied prior to assembly (i.e., pre-butter) or applied after assembly to fill joints (i.e., post-butter). The trowel grade Thermo-Lag 330-1 requires a minimum of 72 hours to cure or a moisture m reading of less than 100 when using a m[7] with a scale of 0-100.

The direct spray method installations are limited to Susquehanna Steam Electric Station and limited applications at Washington Nuclear Project, Unit 2. Most Thermo-Lag fire barriers installed in the field are constructed of prefabricated Thermo-Lag 330-1 panels and preshaped conduit sections that have been cut to size and shape and fastened together with either stainless steel wires or bands. When securing the half round preshaped conduit pieces to conduit, the manufacture recommends as a minimum, an 18 gauge standard stainless steel wire and/or a 0.05 cm (0.02 in) thick by 1.27 cm (0.50 in) wide standard stainless steel banding be used.

In addition to protecting the raceway with the Thermo-Lag system, the vendor also recommends that all penetrations into the ERFBS should be fire protected for a distance of at least 45 cm (18 in) measured from the outer surface of the fire barriers (to prevent thermal shorts). That is, any raceways support members of adjoining raceways also need to be protected by the ERFBS for a particular distance.

---

[6] Stress Skin physical params 0.043 mcm (0.017 inch] minimum diam; 56 holes/sq. in. minimum; 1.75 lbs/sq yd min)
[7] Delmhorst D-P model m or equivalent.

the physical properties and limitations of the material nor did they understand its potential benefits. When Appendix R was published as a regulation, nuclear utilities unable to meet the requirement for 6.1 m (20 ft) of separation between redundant equipment needed to quickly correct their problem, and TSI's Thermo-Lag 330-1 ERFBS appeared to meet their need. As a result of Thermo-Lag's being readily available and having test reports documenting its performance (which would later be questioned), Thermo-Lag became the predominant ERFBS used in the industry for compliance with Appendix R. However, as discussed below, when the true nature and performance of this material became more widely understood, the licensees had to expend considerable resources (i.e., a multimillion dollar fire testing project was conducted) to bring their plants into compliance with Appendix R's requirements.

Because Thermo-Lag 330-1 had no history of use in NPPs to protect safe shutdown circuits, prior to 1980 utilities proposing to install this fire barrier material sought NRC staff acceptance. Along with their proposals to use Thermo-Lag 330-1, the utilities submitted test reports and other documentation to qualify Thermo-Lag 330-1 as a fire barrier that met NRC's fire protection requirements. NRC began receiving requests from licensees for acceptance of Thermo-Lag 330-1 in 1981, but it wasn't until after they first accepted its use that numerous additional proposals to use this material were submitted to NRC. Within a few short years over three-fourths of the nation's commercial NPPs had Thermo-Lag installed for Appendix R compliance.

NRC's concerns regarding Thermo-Lag 330-1 ERFBS began after they received licensee event reports (LERs) from Gulf States Utilities (GSU) citing failed qualification fire tests and installation problems. The LERs stated that the ASTM E-119 fire endurance testing GSU had performed at Southwest Research Institute (SwRI) showed the 3-hour Thermo-Lag ERFBS installed on wide aluminum cable trays resulted in a complete failure within about 60 minutes (i.e., 1-third of the 3-hour requirement). GSU conducted this confirmatory testing after identifying that the fire barriers had not been installed at its River Bend Station (RBS) in accordance with the manufacturer's specifications. NRC issued IN 91-47, "Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test," dated August 6, 1991, to inform NPP licensees of this issue. At the time of issuance, NRC knew of at least 40 plants that had used Thermo-Lag to construct fire barrier assemblies with 3-hour and 1-hour ratings to enclose electrical raceways and other safe shutdown equipment. The amount of Thermo-Lag used at each plant varied from only two conduits at Monticello to over 1858 m^2 (20,000 ft^2) at Comanche Peak Steam Electric Station, Unit 1.

As a result of its wide use, Texas Utilities Electric Company (TU Electric) conducted a series of full-scale fire endurance tests to qualify the Thermo-Lag 330-1 electrical raceway fire barrier configurations it had installed at its Comanche Peak Steam Electric Station. These tests produced additional fire endurance failure results on wide cable trays and small conduits. On December 6, 1991, NRC issued IN 91-79, "Deficiencies in the Procedures for Installing Thermo-Lag Fire Barrier Materials," which provided information on deficiencies in procedures that the manufacturer (TSI) provided for installation Thermo-Lag 330 fire barrier material, along with details of the TU Electric test failures.

In response to GSUs operating experience, NRC established a special review team in June 1991 to review the safety significance and generic applicability of the technical issues regarding the use of Thermo-Lag. As part of the teams' effort, about 40 fire endurance test reports and 9 ampacity derating test reports were reviewed. Based on this review, the team determined that the fire endurance rating of the Thermo-Lag 330-1 system to be indeterminate and the ampacity derating tests indicated conflicting results. In addition, the team found that some licensees did not adequately review and evaluate the test results, did not adequately review their

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Author: Subject: Highlight Date: 11/30/2009 8:49:19 AM
Providing a date of this notification would be helpful, in the context of the previous paragraph which says all this occurred in "a few short years".

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Author: Subject: Highlight Date: 11/30/2009 8:50:03 AM
ML041120065 provides similar, but more detailed information. why relrvnnt it?

Author: u999cjp Subject: Highlight Date: 10/28/2009 2:59:00 PM -04'00'
TMI: Confirmatory order and Order completion information shown here is incomplete and does not reflect final transmittals on subjects.. TMI-1 has 2 orders (08/11/1999 (ML003764024)) & 2 completion letters (03/12/2000 (ML003693928)).

See ML003732407 for a complete listing.

Table 5-1. Thermo-Lag 330-1 Confirmatory Order Documentation

Plant	(Docket No.)	Confirmation Order		Order Completion	
St. Lucie 1	(50-335)	07/13/98	ML013580124	04/07/00	ML003703549
Three Mile Island 1	(50-289)	05/22/98	ML003765653	12/30/99	ML003676460
Columbia	(50-397)	03/25/98	ML022130143	01/19/00	ML003678400
Peach Bottom 2&3	(50-277,278)	05/19/98	ML040990313	10/12/99	ML040990314
Limerick 1&2	(50-352,353)	05/19/98	ML011560778	09/17/99	ML040990326
Crystal River 3	(50-302)	05/21/98	ML020670496	05/25/00	ML003722384
Susquehanna 1&2	(50-387,388)	07/02/98	ML010160064	04/28/00	ML003711917
North Anna 1	(50-338)	06/15/98	ML013530026	02/01/99	ML040990189
Sequoyah 1&2	(50-327,328)	06/18/98	ML013320074	06/30/99	ML040990478
Davis-Besse	(50-346)	06/22/98	ML021210216	01/25/99	ML040990274
Clinton	(50-461)	06/26/98	ML020990547	04/27/99	ML040990340
Comanche Peak 1&2	(50-445,446)	07/28/98	ML021820291	12/22/98	ML040990491
Turkey Point 3&4	(50-250,251)	07/09/99	ML013390600	06/18/01	ML011770240
Oyster Creek	(50-219)	05/22/98	ML040990167	01/30/01	ML010370267
Hatch 1&2	(50-321,366)	06/24/98	ML013030297	10/16/98	ML040990196
Surry 1&2	(50-280,281)	07/09/98	ML012700090	02/01/99	ML040990189
South Texas Project 1&2	(50-498,499)	10/02/98	ML040990301	02/08/99	ML040990180

On May 20, 1994, NRC staff briefed the Commission on the status of Thermo-Lag issues. As a result of this meeting the staff was directed to provide details on which plants had achieved compliance with Appendix R, how much Thermo-Lag material was previously used in these plants, and the corrective actions performed. Section 6 provides plant-specific information related to resolution of Thermo-Lag ERFBS issues.

In addition to providing NRC Information Notices on numerous deficiencies with Thermo-Lag ERFBS, NRC special technical review team, the U.S. Attorney's Office, NRC Office of Inspector General, and NRC Office of investigations conducted an investigation as a result of numerous anomalies with the reviewed test report. On March 30, 1994, the testing laboratory that certified the original Thermo-Lag fire tests, Industrial Testing Laboratories, Inc. (ITL) of St. Louis, Missouri, and Alan M. Siegel, the president of the company, pleaded guilty to five counts of making and aiding and abetting the making of false statements within the jurisdiction of NRC, in violation of Title 18, US Code, Section 1001 and 1002. More than 30 false reports transmitted from Thermal Science, Inc. to NRC and other entities. Industrial Testing Laboratories, Inc. was fined $150,000 and agreed to fully cooperate in the criminal investigation and prosecution of organizations and individuals associated with the Thermo-Lag fire barrier material. On September 29,1994, TSI was charged by a federal grand jury in Maryland with seven counts of wrongdoing, including conspiracy and fraud. On August 1, 1995, a Federal jury found Thermal Science, Inc. (TSI), and its president not guilty of making false statements about the role of Industrial Testing Laboratories (ITL) in the qualification testing of Thermo-Lag ERFBS.

5.1.2 Problems

NRC Staff Findings

Following issuance of IN 91-47 NRC staff visited several sites to inspect the as installed Thermo-Lag ERFBS and associated documentation. During those site visits, NRC staff found a number of field installations that were not constructed in accordance with the vendor

recommended installation procedures. The staff also found that the vendor had revised its recommended installation procedures without notifying the licensees, and that the vendors' installation procedures were not complete. These two issues were a major cause of Thermo-Lag ERFBS variations among plants because the installers would construct the barriers following either the old procedures or their own judgment when the procedures didn't provide specific instruction regarding a particular aspect of the installation. As a result, the qualification of all barriers so constructed was brought into question.

Upon further review, the staff identified some configurations that did not appear to be qualified by fire endurance testing, and installations that deviated from the tested configurations without adequate engineering justification. From these findings, it was clear to the staff that further regulatory oversight was needed to ensure that issues identified in the field were brought to resolution and all licensees who used ERFBS had qualified and properly installed barriers for the configurations in their plants.

Acceptable Test Report Become Unacceptable

Beginning in 1981, NRC had received numerous reports documenting fire tests of Thermo-Lag 330-1 that were conducted by TSI and witnessed and documented by ITL. Review of a number of these reports disclosed that the TSI tests had not been performed in accordance with the required standards. For example, the test furnace and temperature measuring devices used by TSI during the tests did not meet the ASTM E-119 standard. Although NRC requires full-scale fire endurance tests, the tests conducted by TSI were "small-scale" tests. Also, NRC requirements state that a fire endurance test on barrier materials must be conducted by a nationally recognized fire testing laboratory. Although it was later learned that neither ITL nor TSI had acceptable fire testing experience, NRC staff (erroneously) accepted the ITL test reports of the TSI tests[10], and those reports were subsequently used throughout the industry to qualify Thermo-Lag 330-1 for use in NPPs.

A later OIG inspection found that although the ITL test reports state the fire tests were supervised and controlled entirely by ITL, the ITL representative was present only as a witness to verify that a test was conducted. The test reports were actually written by TSI and then signed by the President of ITL with no substantive verification that the data in the reports reflected the actual tests. In some instances, the ITL President merely signed test report cover sheets without seeing the test report. OIG identified about 25 tests of Thermo-Lag 330-1 that were conducted by TSI with ITL "acting as a witness." Since neither TSI nor ISL were qualified per NRC requirements to conduct the tests, further discussion of who ran and who witnessed the tests is important only for legal or administrative issues.

Installation Errors & Procedure Issues

The most prominent problem involving Thermo-Lag 330-1 ERFBS was the differing and changing installation requirements. NRC staff found that although the Thermo-Lag 330-1 materials performed adequately in laboratory test furnaces, field installations introduced uncertainties due to variations in the training and abilities of installation personnel. In several instances, NRC staff found that the protection provided did not qualify as a 1- or 3-hour fire

[10] NRC staff review of the test reports consisted of an audit of the paperwork submitted by the utilities. NRC staff considered it to be the responsibility of the utilities to provide accurate information concerning the conduct of the qualification tests. The licensees' submittals were under oath and affirmation per 10 CFR 50.9, "Completeness and Accuracy of Information."

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Author: Subject: Highlight Date: 11/30/2009 8:50:37 AM
as written, this paragraph intermixes events that occurred in 1981 with events that occurred in 1992. NRC received test reports in 1981. NRC found fault with them in 1992. NRC staff position did not "require" "full scale" tests until GL 86-10 Supplement 1 was issued.

barrier because the licensee applied the material improperly and in untested configurations. When these configurations were tested, results showed that the 1-hour barriers would actually only provide a nominal 32-minute to 50-minute fire rating while the 3-hour application might provide a 150-minute to 160-minute fire rating.

While conducting site visits after issuing IN 91-47, NRC staff observed that the vendor had revised its recommended installation procedures without notifying the licensees, that the vendor installation procedures were incomplete, that a number of field installations were not constructed in accordance with the vendor recommended installation procedures, that some installations did not appear to be qualified by fire endurance testing, and that some installations deviated from the tested configurations without justification. All of these issues resulted in wide variation in the barriers' performance among the plants.

Simple material params, such as, inadequate Thermo-Lag thickness also resulted in fire barrier degradation. One of the larger problems associated with installation of the Thermo-Lag 330-1 fire barrier assemblies resulted from the product's not coming from the vendor as a complete assembly (such as a fire door assembly). Instead, assemblies were often "custom built" to meet variations in the actual in-plant installations as compared to the tested configurations, these variations commonly resulted in plant-to-plant dissimilarities in the barriers' performance.

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Ampacity Derating

The special review team reviewed nine ampacity derating test reports and found conflicting test results. For example, the vendor has reported derating factors for cable trays that range from 7 percent to 28 percent for 1-hour fire barriers and from 16 percent to 31 percent for 3-hour barriers. In addition, ampacity derating tests of Thermo-Lag materials conducted for 3M found the ampacity derating to be 37 percent for a 1-hour barrier, 9 percent higher than what had been previously reported by the vendor. There are similar inconsistencies for conduit barriers. In addition, Sandia National Laboratories conducted Ampacity testing of a Thermo-Lag 330-1 "U"-shaped configuration and found Ampacity Derating factors to be even higher than that specified by the previous testing. (See Section 5.1.3.1 below for more information on the SNL ampacity testing.)

The results of an OIG inspection identified the root cause of the inconsistencies, excerpt follows:

> Originally, TSI reported to Comanche Peak that Thermo-Lag 330-1 would require a 10-percent ampacity derating. In 1982, TSI conducted an ampacity derating test with ITL as the witness and produced a derating factor of about 17 percent. During this same time period, manufactures of other fire barrier materials conducted ampacity derating tests and reported ampacity derating figures far higher than those reported by TSI, some as high as 40 percent.
>
> In 1986, an ampacity derating test on Thermo-Lag 330-1 was conducted at a nationally recognized laboratory—Underwriters Laboratories (UL). However, TSI refused to follow the UL ampacity derating testing procedure and these non-standard tests resulted in ampacity derating figures of about 31-percent for the 3-hour Thermo-Lag 330-1 and about 28-percent for the 1-hour Thermo-Lag 330-1 ERFBS. These figures were significantly larger than those previously reported by TSI. Following TSI representative leaving the UL testing facility, UL performed an additional ampacity test on Thermo-Lag 330-1 following UL procedures, resulting in

ampacity derating factors of nearly 40-percent for the 3-hour barrier and 36-percent for the 1-hour.

Unfortunately, these results were not reported to NRC at the time they were discovered and were only identified during an OIG inspection in 6 years later, in 1992.

Licensee Review Evaluation

When licensee performed independent testing to verify an installed barriers capability, they typically found two physical deficiencies (1) for conduits less then 10.2 cm (4 in) the temperatures recorded during testing exceeded the maximum allowable limits, and (2) joints on the barriers where two sections of material butted were opening during the fire test.

Initial confirmatory and plant-specific testing raised numerous questions associated with the capability of Thermo-Lag 330-1 ERFBS to perform its design function. For example, during tests did the Thermo-Lag 330-1 structurally remain intact for the fire exposure? Is there a sufficient quantity of Thermo-Lag 330-1 material (i.e., thickness) to protect electrical raceways of differing mass and materials?

Bounding Plant Installations

A few instances were identified where facilities had installed fire barriers without a basis for their fire rating such as an Underwriters Laboratories, Incorporated (UL) Listing or testing conducted by a nationally recognized testing laboratory for the configurations installed in the plant. Some licensees did not adequately reviewed and evaluated the fire endurance test results and ampacity derating test results used as the licensing basis for their Thermo-Lag 330-1 barriers to determine the validity of the tests and the applicability of the test results to their plant designs. Some licensees did not adequately review installed fire barrier configurations to ensure that they either replicate the tested configuration or provide an equivalent level of protection.

Combustibility

The NIST testing (Section 5.1.3.1) provided results that allowed NRC to conclude that the Thermo-Lag 330-1 ERFBS is a combustible material. NRC fire protection requirements (Section III.G, Appendix R to 10 CFR 50) preclude the use of combustible material to (1) enclose other combustibles, such as cables, between redundant safe shutdown trains to eliminate the combustibles as a fire hazard or (2) provide radiant energy heat shield protection form shutdown components inside containments.

OIG Inspection Report

In August 1992, an OIG investigation determined that NRC staff had accepted manufacturer fire qualification test results for Thermo-Lag that were reported to have met required standards but were later found to have been falsified.

The Office of Inspector General, in its Inspection Report entitled, "Adequacy of NRC Staff's Acceptance and Review of Thermo-Lag 330-1 Fire Barrier Material," of August 12, 1992, found that NRC staff did not conduct an adequate review of fire endurance and ampacity derating information concerning the ability of Thermo-Lag fire barrier material. The findings suggest that had NRC staff conducted a thorough review, they would have found that the TSI test furnace was not adequate along with the inadequacy of the TSI quality assurance procedures.

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Author: Subject: Highlight Date: 11/30/2009 8:51:08 AM
Prior to NRC issuance of Info Notice 84-09, there was no specific NRC guidance indicating that fire barriers (walls, floor, ceilings, wraps) be subject to testing by UL or nationally recognized testing laboratories. BTP APCSB 9.5-1 required this for doors, but not fire barriers.

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Moreover the report shows that had a vendor inspection been conducted, NRC would have determined that the tests were not conducted, as required by a nationally recognized testing laboratory and that the vendor had falsified the test reports. However, because these review and inspections were not conducted, it was not until 1992 when the staff determined that the performance of Thermo-Lag 330-1 with respect to fire resistance ratings and ampacity derating was indeterminate. The OIG report concludes that in seven instances between 1982 and 1991, NRC did not pursue reports of problems with Thermo-Lag 330-1.

Former NRC Chairman Ivan Selin responded to the OIG report by directing the staff to address the following three matters:

(1) the reasons the initial review process did not identify the problems with Thermo-Lag 330-1 and the causes of deficiencies in NRC's response to later indications of problems that were brought to the agency's attention;

(2) whether the problems identified with respect to the initial review and the lack of follow-up to latter indications of problems represented a systematic weakness with our review and response programs; and

(3) what corrective actions are necessary to rectify the deficiencies identified with respect to the review and response processes.

5.1.3 Testing

Attachment 2 to IN 92-46, "The Final Report of the Special Review Team for the Review of Thermo-Lag Fire Barrier Performance," documented the teams finding on 34 of the available 49 Thermo-Lag fire test reports. This effort by NRC raised several concerns regarding compliance with NRC requirements and guidance, compliance with ASTM E119, and adherence to good engineering practices. The team's specific concerns involved test procedures, test facilities, test equipment and personnel, methods of assembly, quality assurance, and acceptance criteria. The team also found that the configurations of the test specimens for many of the previously performed tests are atypical of the field installations observed during the special review teams site visit to the plant. The Final Report concluded that many of the tests did not meet NRC requirements and guidance and, therefore, may not provide adequate technical bases for establishing fire resistance ratings of Thermo-Lag fire barriers.

Generic Letter (GL) 92-08, "Thermo-Lag 330-1 Fire Barriers," required all licensees to individually confirm that Thermo-Lag systems have been qualified by representative fire endurance tests, ampacity derating values have been derived from valid tests, and barriers have been installed with appropriate procedures and quality controls to ensure that they comply with NRC's requirements. The following discusses the various testing completed by NRC, NEI, and licensees.

5.1.3.1 NRC Fire Endurance Testing

NRC conducted two testing programs at separate national laboratories to independently evaluate the performance of the Thermo-Lag 330-1 ERFBS material. NIST performed the initial small-scale testing which resulted in the need for full scale testing, subsequently conducted by SNL. The following provides a brief description of these tests and the results.

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Author: Subject: Highlight Date: 11/30/2009 8:51:31 AM
This is misleading.

Prior to NRC issuance of Info Notice 84-09, there was no specific NRC guidance indicating that fire barriers (walls, floor, ceilings, wraps) be subject to testing by UL or nationally recognized testing laboratories. BTP APCSB 9.5-1 required this for doors, but not fire barriers.

engineering assessments of their plant specific applications for the barrier to perform its intended design function.

5.2 3M Interam™ E-50 Series & Rigid Panel System

Minnesota Mining and Manufacturing (3M) manufactures several lines of fire protection products used to protect electrical raceways, including CS-195, FS-195, E-20 series and E-50 series materials. The most commonly used 3M ERFBS in use at operating NPPs is the 3M Interam™ E-50 Series and more specifically, the E-53A and E-54A mats products. Both are flexible mat products that are commonly used to provide 1- and 3-hours of fire protection to electrical raceways. The E-53A is a green mat of 7.6 mm (0.3 in) thickness and the E-54A is a blue mat with a nominal thickness of 10.2 mm (0.4 in). Except for color and thickness, these two products are the same. These mats contain aluminosilicate fibers bound in an organic matrix that is sandwiched between a metal foil (aluminum or stainless steel) on one side and a synthetic polymer (nylon) scrim laminated on the other.

The manufacture identifies the type of foil backing by the postscript "A" for aluminum backed mats and "C" for stainless steel backed mats. These laminates are 2.00 mm (0.08 in) thick and attached to the base mat by the use of adhesive. Type "C" backing is an annealed Type 304 stainless steel foil and this product is typically used for inside containment where aluminum is not allowed. UL Test report R10125, 86NK2919 dated May 30, 1986, was conducted to determine any differences in thermal protection among the two barriers. Identical raceways were constructed and one was protected with an E-50A series material while the other used an E-50C barrier. The results indicated that the two barrier are very similar in their thermal conductance, however the stainless steel E-50C barrier did experience a slightly higher internal temperature at the 1-hour time period (approximately 12°C (10°F) higher). The purpose of the metallic backing is to provide a reflective substrate that will reflect radiant energy away from the barrier and reduce the thermal transmission of heat through the barrier.

The 3M Interam™ E-50 Series 1-hour and 3-hour ERFBS achieve its fire performance and endurance properties by a combination of chemical and physical properties. The thermal protection is provided by the absorption of heating during an endothermic reaction (from a chemically-bound ingredient that releases chemically bound water), and via the thermal mass (heat sink) of the mat. After the endothermic reaction has gone to completion, remaining ceramic fibers act as a high-temperature insulator. In addition, the added thermal mass of the electrical raceways and cables also contributes to slow the rate of heat rise.

Prior to the introduction of the E-53A and E-54A products into the nuclear industry, 3M manufactured the E-50A, E-10A, and E-50D fire protection mats of nominal thickness 5.1 mm (0.2-in), and 10.2 mm (0.4-in), respectively. The current E-53A and E-54A products are direct replacements for the previous 3M materials, provided that the total system thickness of the substitute mat layers are equal to or greater than the originally specified mat system thickness. Both old and current mat products are identical in composition except for thickness and color. Therefore, test reports summarized below and in Appendix D for the E-50A system should be bounding for an E-53A or E-54A system, provided that the same or greater thickness of material is used. However, with the addition of extra thickness, system weight and ampacity derating characteristics change and need to be accounted for the in the overall system design.

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Author: Subject: Comment on Text Date: 11/30/2009 9:08:25 AM
The second paragraph states the stainless steel E-50C barrier experienced a slightly higher internal temperature at the 1-hour time period (approximately 12 degrees C, 10 degrees F higher). A difference of 12 degrees C is 21.6 degrees F). A difference of 10 degrees F is 5.56 degrees C. The conversion appears to be wrong.

The 3M Interam™ E-50 Series ERFBS is installed and repaired to meet the requirements described in 3M installation guidelines and drawing packages, by trained and certified installers. A typical 3M Interam™ E-50 Series ERFBS consists of the following;

- 3M Interam™ E-50 series mats (number of layer dependent on rating),
- 3M FireDam 150 Caulk (used as a smoke and flame sealant),
- 3M Interam™ T-49 Aluminum Foil Tape or T-65 Stainless Steel Foil (used as a vapor barrier, radiant heat reflector and installation aid.)
- 3M Scotch® Brand 989 Filament Tape (used as an installation aid)
- 3M Fire Barrier CS-195 Composite Sheet (used to cover openings and as a collar at the termination of fire protection envelopes), and
- 3M Fire Barrier CP 25N/S Caulk (used as a smoke and flame sealant).

The FireDam 150 Caulk is used to seal mat-to-mat assemblies and is a paste version of the E-50 series mat. 3M recommended the use of CP 25N/S Caulk be used as a sealant whenever the 3M fire barrier terminates at a wall or floor, and whenever caulking is required along the CS-195 product. These two caulks are the only material in the 3M ERFBS which are applied wet.

The 3M Interam™ CS-195 composite sheet is reddish brown in color, 7 mm (0.28-in) thick, with sheet metal on one side and aluminum foil on the other. The sheet metal side faces away from the 3M mat, when installed around a 3M mat. It should be noted that the CS-195 is an intumescent material that will combust if exposed to a heat source that raises its temperature above the materials auto (or pilot with pilot present) ignition temperature. As a result, this material CS-195 should be used inside containment unprotected.

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CS-195 will combust if exposed to a heat source that raises its temperature above the materials auto (or pilot with pilot present) ignition temperature. As a result, this material CS-195 should be used in containment unprotected. Was the intent to say the material should NOT be used in containment unprotected?

Although many different methods and configurations exist for installing various 3M components, the manufacturer specified the following generic installation requirements to construct an ERFBS capable of providing the required level of protection.

Table 5-4. 3M E-50 Series Minimum Installation Specifications

Items	Minimum Layers Required (1-hr)
Cable Trays	
< 25% cable fill	2 layers of E-54A
≥ 25% cable fill	1 layer of E-54A and 1 layer of E-53A
Conduits	
Steel	3 layers of E-53A
Aluminum ≥ 5" dia.	3 layers of E-53A
Aluminum < 5" dia.	1 layer of E-54A and 2 layer of E-53A
Air drops	3 layers of E-54A
Junction Boxes	3 layers of E-54A
Supports and heat transfer items	
a. Supports underneath cable tray	2 layers of E-54A
b. Supports partially protected	1 layer E-54A for 12" or 2 layer E-53A for 9"

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Table 5-5. 3M Design Comparison Old-to-New appears to have numerous mathematical errors. E-53A is 0.3 inches thick and E-54A is 0.4 inches thick. 4 layers of E-54A = 1.6 inches, not 1.2 inches. 5 layers of E-54A = 2.0 inches, 5 layers of E-53A = 1.5 inches not 2.0 inches.

following table (Table 5-5) as a comparison of the barrier design for pre-GL 86-10 Supplement 1 barriers and post GL 86-10 Supplement 1 barriers.

Table 5-5. 3M Design Comparison Old-to-New

Raceway	Rating	Pre GL 86-10/S1 Configuration	GL 86-10/S1 Configuration
Conduit	1	0.9" Thick (3 Layers of E-53A)	1.2" Thick (4 Layers of E-54A)
Tray	1	0.8" Thick (2 Layers of E-54A)	1.2" Thick (4 Layers of E-54A)
Junction Box	1	0.9" Thick (3 Layers of E-53A)	1.2" Thick (4 Layers of E-54A)
Air Drop	1	0.9" Thick (3 Layers of E-53A)	1.2" Thick (4 Layers of E-54A)
Conduit	3	2.0" Thick (5 Layers of E-53A)	2.8" Thick (5 Layers of E-54A with 2 0.4" Air Gaps
Tray	3	2.0" Thick (5 Layers of E-53A)	2.8" Thick (6 Layers of E-54A with 1 0.4" Air Gap)
Junction Box	3	2.0" Thick (5 Layers of E-53A)	3.2" Thick (6 Layers of E-54A 2 Air Gaps)
Air Drop	3	2.0" Thick (5 Layers of E-53A)	2.0" Thick (5 Layers of E-54A)

5.2.2 Problems

5.2.2.1 Information Notice 93-41

IN 93-41 indentifies an NRC inspection of the testing basis for Salem using a 3M FS-195 fire barrier test report stated,

> "According to the test report, the metal duct temperature on the unexposed side of the fire barrier material exceeded 139°C (250°F) above ambient in about 30 minutes. At 60 minutes the temperature was 326.5°C (620°F). The test specimen was not subject to a hose stream test. The condition of the cables at the end of the test was not reported."

IN 93-41 also identified that a test report issued by Twin City Testing Corporation, dated September 1986, for an Interam™ E-50 Series fire barrier produced by 3M Company didn't adequately document the justification for qualification for this barrier. For this test, circuit integrity acceptance criterion specified by the American Nuclear Insurers was used. The temperatures within the fire barrier and the conditions of the cables at the end of the test were not reported. In addition, the fire barrier construction details and methods of fire barrier application for the test specimens were not documented in the test report.

Many of the early test reports did not fully document all of the pertinent information needed by today's guidance to ensure the acceptable qualification of the ERFBS. In addition, Supplement 1 to GL 86-10 did not exist when these early testing was being performed, which resulted in a majority of the testing having not conducted hose stream tests, cable fill or placement of thermocouples, as specified in current NRC guidance documents.

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Typo. "well"

5.4.1 History

Kaowool was originally developed by Babcock and Wilcox to be an asbestos replacement material and is commonly used to insulate high temperature furnaces, forges, and kilns. Its low density of 64.1, 96.1, or 128.1 kg per m^3 (4.0, 6.0, or 8.0 lbs per ft^3), very low thermal conductivity and ease of handling and cutting resulted in Kaowool being used in numerous commercial applications and configurations.

As a result of its successful use in other industrial applications, Kaowool insulation was one of the first materials to be used in protecting electrical raceways containing fire safe shutdown (FSSD) circuits. This is primarily due to the fact that, during the late 1970's and early 1980's there were concerns that there were no material commercially available that clearly met a 1-hour fire barrier requirement and because some licensees had experience with Kaowool installation to meet BTP APCSB 9.5.1, Kaowool was chosen as a viable solution to Appendix R fire barrier applications. Although the use of Kaowool and FP-60 material in the nuclear industry was a result of Appendix R requirements, the material was in existence will before the need for its employment as an ERFBS.

Subsequent to the issuance of GL 92-08, "Thermo-Lag 330-1 Fire Barriers," NRC began evaluation other known fire barrier materials and systems that are used by licensees to fulfill NRC Fire Protection Requirements. Following NRC staffs review of the Kaowool and FP-60 test reports provided by Thermal Ceramic (manufacture) and a reverification inspection at Salem in 1993 NRC issued two Information Notices regarding potential problems with Kaowool and FP-60 ERFBS. IN 93-40, "Fire Endurance Test Results for Thermal Ceramics FP-60 Fire Barrier Material," and IN 93-41, "One Hour Fire Endurance Test Results for Thermal Ceramics Kaowool, 3M Company FS-195 and 3M Company Interam E-50 Fire Barrier Systems." Both Information Notices informed the nuclear industry of deficiencies found in the test reports concerning qualification the barriers and that NRC would continue its review of the barriers ability to perform its fire resistive function and will issue further generic communications, if needed. Although no other generic communications were issued, NRC continued to interface with industry to determine its use and compliance with regulations.

During an NRC inspection of Joseph M. Farley Nuclear Plant (FNP) in 1996, the inspectors identified technical issues associated with the design, installation, and fire-resistive performance of Kaowool raceway fire barriers installed at FNP. In the later part of 1996, NRC Region II offices requested Office of Nuclear Reactor Regulation (NRR) support in reviewing the identified issues through a Task Interface Agreement (TIA) 96-023. Following a detailed review of the performance and licensing basis of the use of Kaowool at Farley, NRC staff determined that the fire rating of the Kaowool installed at Farley was indeterminate, but less than the 1-hour needed to meet the Appendix R requirements. A response to TIA 96-023 was provided to the Region II offices on June 18, 1999. The response concluded that the licensee FNP did not have a sound technical basis for concluding that the Kaowool ERFBS installed at FNP meet the regulatory requirements or provided an adequate level of fire protection for the post-fire safe-shutdown capability. In SECY-99-204, NRC staff informed the Commission of its review of this matter and provided its TIA 96-023 response as an attachment.

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typo. "alone"

5.6.4 Resolution & Staff Conclusion

There have been no generic problems identified with the use of Versawarp ERFBS at US NPPs. As can be seen from the testing results, stand along configurations of Versawrap can withstand severe fire exposures provided that they are properly installed to bound qualified tested configurations. The testing also indicated that the use of Versawrap as an upgrade to other barriers encountered some difficulties in achieving the required endurance rating. As of this writing, only two sites use Versawarp as a stand alone ERFBS, Arkansas Nuclear One and Quad Cities. Susquehanna uses a partial Versawrap upgrade to their Thermo-Lag barriers. It consists of only using the cloth intumescent outer layer of the Versawrap system to enclose the Thermo-Lag and to improve its structural integrity during fire exposure. Therefore, based on its review the staff concludes that the current use of Versawrap is in accordance with specific requirements and is capable of providing the required protection provided that the barrier remains installed in configurations bounded by acceptable test results.

5.7 Mecatiss

Mecatiss ERFBS is manufactured by Mecatiss of Morestal, France. According to the Mecatiss website (www.mecatiss.com), Mecatiss specializes in passive fire barrier systems, watertight, airtight, and biological protections, but can also provide private laboratory and testing facilities.

The Mecatiss ERFBS used in US NPPs consists of several layers, including a silicon fabric, a mineral wool insulation, a silicon based mastic, and an adhesive. The silicon fabric, called Silco cloth is a nominal 0.05 cm (0.02-in) thick woven glass silicon fabric. This material is claimed to be gas and water tight at normal pressures and chemically inert. It is applied around the cable raceway and again around the exterior of the completed barrier and held together by the use of an adhesive identified as Silicone Glue Mastic Type 75A. The 75A adhesive is cold application silicon-based mastic used in thin layers for filling, coating, insulating, bonding and joining work. It is used to seal the SILCO fabric and bounds Silco to itself, concrete, metal, etc. The MPF-A and MPF-B refractory mineral wool insulation provided that actual thermal insulation of the system. The type and number of layers used depend on the deign of the ERFBS, but all mineral wool mats are held together with Mecatiss refractory glue Type F-active adhesive. This adhesive is an air-hardening adhesive component and exhibits adhesive characteristics up to 1302°C (2375°F). Figure 5-18 shows a conduit test assembly protected with Mecatiss prior to testing.

6.4 Browns Ferry Units 1, 2 and 3, Sequoyah Units 1 &2

TVA relies upon Thermo-Lag fire barrier material to protect fire safe shutdown circuits at Browns Ferry Nuclear Plant (BFN) Units 2 and 3, Sequoyah Nuclear Plant (SQN) Units 1 and 2, and Watts Bar Nuclear Plant (WBN) Unit 1 as approved by NRC Staff. In addition, TVA is using Thermo-Lag fire barrier material to protect safe shut down circuits as part of the recovery of BFN Unit 1. Configurations installed at TVA facilities are in accordance with the tested configurations or have been evaluated by persons knowledgeable in fire barrier design and installation. The results of both the testing and engineering evaluations have been documented consistent with accepted engineering and industry standards. These configurations, both those specifically tested and unique configurations, are documented in facility design basis documentation that are controlled and maintained in accordance with TVA's Design Control and Quality Assurance Programs.

Initially Browns Ferry Unit 2 was the only unit to originally use Thermo-Lag 330-1. Approximately 200 linear feet of conduit barrier was used in Unit 2, which was subsequently upgraded per TVA tested configurations. TVA has Thermo-Lag installed in the BFN1 Intake Pumping Station to provide a 1-hour fire barrier. Most of the Thermo-Lag material in Browns Ferry Unit 1 was found to be unnecessary to comply with 10CFR50 and abandoned in place. Instead of costly amounts of fire barrier material, the plant chose to reroute electrical cables essential to the plant's safe shutdown. Abandoned Thermo-Lag which was accessible and cost effective to remove was discarded completely by June 20, 1996.

Ampacity derating issues at Browns Ferry Nuclear Plant Units 1-3 with regards to GL 92-08 were considered complete by NRC in a letter dated July 16, 1999.

6.5 Brunswick Steam Electric Plant

Brunswick Steam Electric Plant (BSEP) has used Thermo-Lag 330-1 to satisfy 10 CFR 50.48 separation requirements, licensing commitments, and conditions associated with its Fire Protection Program. Only 12m (40 linear feet) of a 1-hour rated Thermo-Lag 330-1 barrier were used to protect two 6 m (20 foot) sections of cable trays. The majority of Thermo-Lag used was applied to conduits, which included 320m (1050 linear feet) of a 1-hour barrier and 430m (1410 linear feet) of a 3-hour barrier. In addition, 113 m^2 (1220 ft^2) of a 3-hour and 12 m^2 (130 ft^2) of a 1-hour barrier were used to protect junction boxes, equipment enclosures, door transoms, and penetration seals.

BSEP uses Kaowool as part of an approved Appendix A Fire Protection Program and Appendix R exemption. Kaowool provides additional protection defense-in-depth, but it is not credited as a 1-hour or 3-hour barrier as required by Appendix R.

BSEP uses 3M Interam E50A and E54A ERFBS materials for Appendix R purposes. The materials used in the 3M barriers have been installed to manufacturer's instructions and has been independently tested in accordance with national standards.

6.6 Byron Station

Byron Station used about 954 m (3129 linear feet) of Thermo-Lag 330-1 ERFBS to protect redundant cable trains within the same fire area. Both 1- and 3-hour Thermo-Lag configurations were used in both units. By letter dated January 17, 1997, t, which included; 1) re-analysis of Safe Shutdown Analyses to eliminate the need for the fire barrier, 2) re-routing of cables such

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Missing wording from Jan 17, 1997 letter, appears to be a typo. Original letter wording stated

"three methods of resolution were utilized, which included..."

that redundant safe shutdown trains are not located in the same fire zone, or 3) replacement of the Thermo-Lag 330-1 with a qualified fire barrier (see Section 5.3 above on Darmatt KM-1). he licensee informed NRC that all planned modifications had been completed, as a result of GL 92-08. These modifications included, removing Thermo-Lag 330-1 ERFBS from several safe shutdown cables located in Unit 1 and protecting them with Darmatt KM-1 ERFBS, rerouting the remaining cables and their redundant counterparts and associated support equipment cables such that they are not located in the same zone. Circuits that no longer required protection have the Thermo-Lag 330-1 ERFBS abandoned in place.

Byron Station currently uses Darmatt KM-1 fire barrier on all electrical raceways where a fire barrier is required to ensure separation of redundant trains in the same fire zone. Darmatt KM-1 material was installed as a qualified replacement of the Thermo-Lag 330-1 fire barrier as part of Byron Station's corrective actions in response to GL 92-08.

By letter and SE dated November 2, 1999 NRC determined that all ampacity related concerns have been resolved and the licensee has provided adequate technical basis to ensure that all of ERFBS enclosed cables are operating within acceptable ampacity limits.

6.7 Callaway Plant

The Callaway Plant initially used limited quantities of Thermo-Lag 330-1 for raceway protection. The plant utilized approximately 33 linear feet (165 ft^2) of 3-hour cable tray barriers, 135 linear feet of 1-hour conduit barriers, and 617 linear feet of 3-hour conduit barriers. In order to satisfy the requirements of 10 CFR 50, Appendix R, the licensee made several modifications to the use of Thermo-Lag ERFBS. An Appendix R, Section III.G.2 reanalysis was performed which documented the technical basis for removal of Thermo-Lag from cables that were not needed for safe shutdown. A conduit was re-routed to meet the 20 foot separation criteria and local manual controls were added to the "B" and "C" steam dump valves in order to eliminate the need for the pre-existing fire barrier and Thermo-Lag on the raceways. In areas of the plant where a barrier remained necessary for compliance with Appendix R, Thermo-lag was removed and Darmatt KM-1 was installed. The Callaway Plant notified NRC that the issues identified in GL 92-08 had been completed as of December 31, 1996.

As noted above, the Callaway Plant use Darmatt KM-1 ERFBS for protection of redundant trains located in the same fire area that satisfies 10 CFR 50, Appendix R, III.G requirements. The fire barriers were tested and installed according to the guidance provided in GL 86-10, Supplement 1 with any deviations from the tested configurations evaluated against GL 86-10. NUREG 0830, supplement 3 provides NRC determination that the use of a 1-hour rated barrier at Callaway was found acceptable. Ampacity derating testing was provided to NRC on December 11, 1996.

6.8 Calvert Cliffs

There are no ERFBS in use at Calvert Cliffs.

6.9 Catawba Nuclear Station

Catawba Nuclear Station (Catawba) uses Hemyc ERFBS as a 1-hour rated barrier to provide compliance with Appendix R. Hemyc is used in both Units Auxiliary Feedwater (AFW) Pump rooms, with each pump room containing approximately 91 m (183 m total) (300 linear feet (600 linear feet total)). Following IN 2005-07, the licensee evaluated their use of Hemyc fire barrier and determined that the Hemyc ERFBS does not meet the required 1-hour fire rating. As

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Change 33 linear feet to 31 linear feet. Remove the 165 ft². Change 135 linear feet to 132 linear feet. Change 617 linear feet to 614 linear feet.

Author: sph Subject: Highlight Date: 11/30/2009 8:56:04 AM

Author: Subject: Note Date: 11/30/2009 8:58:04 AM
Add sentence "Darmatt KM-1 was added to additional raceways requiring protection where Thermo-Lag was not present."

compensatory measure, the licensee has implemented additional control on transient combustible/flammable materials entering these affected areas and established continuous fire watches under certain circumstances. On February 28, 2006, the licensee submitted its intent to voluntarily transition the Catawba Fire Protection Licensing Basis to NFPA 805 in accordance with 10 CFR 50.48(c). The NFPA 805 transition process is expected to bring the Hemyc concerns to resolution.

6.10 Clinton Power Station

Clinton Power Station (CPS) uses Thermo-Lag and 3M Interam ERFBS where required to ensure separation of redundant trains in the same fire zone. Clinton Power Station utilizes 167 m (547 linear feet) of 1-hour Thermo-Lag 330-1 cable tray fire barriers and 45 m (149 linear feet) of 3-hour fire barriers at 10 different locations throughout the plant. In addition, CPS uses 34 m (112 linear feet) of 1-hour conduit fire barriers and 31 m (103 linear feet) of 3-hour conduit fire barriers. Following issuance of GL 92-08, CPS implemented a Thermo-Lag corrective actions program to document the station's engineering evaluations to ensure the Thermo-Lag ERFBS provide the necessary level of protection. A letter dated June 26, 1998 from NRC declared that CPS should proceed with corrective actions in accordance with the plant's proposed schedule of completion by May 22, 1998.

By letter dated September 29, 1998, NRC recognized that CPS Thermo-Lag 330-1 corrective actions and requested information in accordance with GL 92-08 were complete.

The 3M Interam ERFBS used at CPS were installed in the late 1990's. Engineering evaluations were conducted for these installations, including a review of the fire barrier design, materials, and installation configurations to ensure the ERFBS capability to provide the needed level of protection. In addition, CPS had Promatec Technologies Inc. provide test reports documenting acceptability of the 3M Interam E-54C system installed at CPS, in accordance with Appendix R Section III.G.2.b and GL 86-10, Supplement 1.

6.11 Columbia Generating Station

Columbia Generating Station (CGS) uses Darmatt KM-1 to ensure the necessary level of protection of redundant trains located in a single fire area. CGS documented its evaluation of Qualification of Darmatt Raceway Fire Barrier in its Columbia Fire Protection File 1.2.3, Item 2. The evaluation concluded that the Darmatt configurations used at CGS are bounded by the fire testing of Darmatt performed in accordance with GL 86-10, Supplement 1. The Darmatt KM-1 ERFBS are installed in 1 or 3-hr rated designs qualified by fire testing meeting Supplement 1 to GL 86-10.

Columbia Generating Station (CGS) credits a 250 foot section of 3M Interam 3-hour barrier to ensure the necessary level of protection of redundant trains located in a single fire area. Columbia Fire Protection File 1.2.2, Item 1, "Analysis of 3M Fire Barrier Wrap," provides CGS evaluation. The evaluation concluded that the 3M Interam configurations used at CGS are bounded by the fire testing performed in accordance with GL 86-10, Supplement 1.

Columbia Generating Station (CGS) used Thermo-lag 330-1 to comply with Appendix R regulations and to address Regulatory Guide 1.75 concerns. Approximately 5,500 linear feet of Thermo-lag 330-1 in both 1- and 3-hour fire barrier assemblies were used at CGS. Following issuance of GL 92-08, the licensee re-assessed the need for Thermo-Lag 330-1 by minimization of the equipment credited for safe shutdown, re-routing cables, and revising some fire area

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Author: u999cjp Subject: Highlight Date: 11/25/2009 8:19:24 AM

Information as written is out-of-date. Clinton Power Station originally used the amounts listed in sentence two (547 linear feet, 149 linear feet, etc., as documented in letter U-602250, L30-94(02-09)LP, dated February 9, 1994).

The following letter should be cited as the source of these values for original amounts of thermo-lag. It is not currently referenced in the NUREG:

Letter from J. S. Perry (Clinton Power Station) to S. A. Varga (U.S. NRC), "Illinois Power's Response to the Nuclear Regulatory Commissions Request for Additional Information Regarding Generic Letter 92-09,'Thermo-Lag 330-1 Fire Barriers'" letter U-602250, L30-94(02-09)LP, dated February 9, 1994

However, Clinton eliminated dependence of Thermo-Lag as a credited fire barrier through several different methods, including: modification of the existing design to provide divisional separation through rerouting of cables/conduits, installation other barrier designs, or development of deviations.

In addition to the use of Hemyc and MT, HNP also uses Thermo-Lag 330-1 and 3M Interam E-54A barriers to provide Appendix R related equipment protection. Both of these materials were tested per the guidance of GL 86-10 supplement 1 for specific applications used at HNP. Vendor testing was used for the 3M material and proprietary HNP fire testing was performed to qualify the Thermo-Lag installations.

6.27 Hatch Nuclear Plant (HNP)

HNP uses Promat-H material to construct cable tray ERFBS required for separation of redundant trains located within a single fire area. The licensee (Sothern Company) stated that "Promat-H is a material tested in accordance with UL standard 263, "Fire Tests of Building Construction and Materials," which references ASTM E-119-83…and NFPA 251…tests." Promat-H configurations used at HNP were tested and qualified to ASTM E-119-83 by Performance Contracting, Inc. under Omega Point Project No. 8806-90254 (Promat Report SR90-005).

The test acceptance criteria used were that of ASTM E119-83 Section 16 "Conditions of Acceptance" which meets the acceptance criteria of GL 86-10, Supplement 1. This criterion allows a maximum temperature rise of 250 degrees Farenheit above the initial temperature. (ML072060088) Testing on Promat-H included time-temperature tests, full scale fire testing on the wall, and small scale fire testing on the ceiling, all of which is documented in Promat Report SR90-005. The initial ambient temperature used during experimentation was 75 degrees Farenheit.

Hatch used approximately 1,250 linear feet of FP-60 in its river intake structure, and procured approximately 4,000 linear feet for installation in its Control Building and Reactor Building. Hatch installed its Kaowool barriers in 1984. On April 18, 1984, NRC granted Hatch an exemption for the use of Kaowool in the river intake structure with the area-wide automatic fire suppression system not required for the entire river intake structure. On January 2, 1987, another exemption was granted to the extent that a 20-foot separation was not required for cable in conduit and cable in trays wrapped with Kaowool blankets. The Kaowool ERFBS used at Hatch were subsequently replaced with FP-60 material in the 1992-1993 timeframe because of wear and degradation of the Kaowool material. The addition of the 2-mil aluminum skin covering provides protection to the Kaowool ceramic material. Hatch also uses Kaowool to provide physical separation RG 1.75 and to reduce combustible loading in a given fire area for compliance with Appendix A to Branch Technical Position APCSB 9.5-1. The licensee has submitted an evaluation to Region II staff that Kaowool is not used as a 1-hour fire barrier. The Regional staff's review indicates that this application is acceptable.

6.28 Hope Creek Generating Station

Hope Creek Generating Station does not use any ERFBS.

6.29 Indian Point Units 2 and 3

Hemyc ERFBS is used at Indian Point to provide separation and/or safe shutdown protection for compliance with Appendix R requirements. Exemptions from the requirements of Appendix R have been granted for each case where Hemyc is used to require the Hemyc ERFBS to have a fire resistance rating of 30 minutes. Approximately 102 linear feet of Hemyc is used in Unit 2 and approximately 295 linear feet is used in Unit 3. Unit 3 also uses Hemyc as a RES inside

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Replace section 6.29 entirely with the following wording:

Hemyc ERFBS is used at Indian Point to provide separation and/or safe shutdown protection for compliance with Appendix R requirements. Approximately 102 linear feet of Hemyc is used in Unit 2 and approximately 295 linear feet is used in Unit 3.

Exemptions from the requirements of Appendix R have been granted for each case where the Hemyc ERFBS is used and credited to provide a fire resistance rating of 30 minutes or one hour. The exemptions were granted based on minimal fire challenge and other mitigating defense-in-depth factors.

Unit 3 also uses Hemyc as a RES inside reactor containment. As part of closeout actions associated with GL 2006-03, NRC inspection staff verified that appropriate corrective actions were taken while Hemyc ERFBS were considered inoperable, and that Hemyc ERFBS upgrade modifications, where required, had been completed.

Indian Point Unit 2 also uses 3M Interam E54 for Appendix R purposes, configured as a 3-hour rated ERFBS outside the reactor containment, and as a RES inside the reactor containment. The 3M Interam E54 installations were evaluated to ensure the capability to provide the necessary level of protection at the time the barriers were installed, and were reevaluated to confirm their adequacy after issuance of IN 95-52.

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containment. As part of closeout actions associated with GL 2006-03, NRC inspection staff verified that appropriate corrective actions were taken while Hemyc ERFBS were considered inoperable.

Indian Point Unit 2 also uses 3M Interam E54C ERFBS for Appendix R purposes. The 3M installations at the plant were evaluated for ensure the capability to provide the necessary level of protection at the time the barriers were installed and were re-evaluated after issuance of IN 95-52. Thermo-Lag and 3M ERFBS are not used in Unit 3.

6.30 Kewaunee Power Station

Kewaunee Power Station (KPS) uses 3M Interam E-50A endothermic mat to meet 3-hour rated configurations on conduits. These conduit ERFBS were installed in accordance with UL design listing (UL Electrical Circuit Protective System (FHIT) No. 7).

Although not used to provide Appendix R protection, KPS also uses a 3-hour fire-rated Marinite board/Kaowool/Flameastic electrical circuit large pull box protective enclosure.

6.31 LaSalle County Station

LaSalle County Station initially relied on Thermo-Lag 330-1 barriers to meet 10 CFR 50.48 regulations and to provide separation between redundant electrical systems. Darmatt KM-1 material was installed as a qualified replacement for the 112 linear feet of Thermo-Lag 330-1 fire barrier as part of LCS response to GL 92-08. Therefore, LaSalle County Station (LCS) now uses Darmatt KM-1 fire barriers in areas where a fire barrier is required to ensure separation of redundant trains in the same fire zone. By letter dated January 17, 1997, the licensee of LCS informed NRC that all Thermo-Lag 330-1 ERFBS material had been replaced with Darmatt KM-1 material. By letter and SE dated December 22, 1999, NRC staff determination that all ampacity derating concerns were resolved for LCS Units 1 and 2, and the licensee provided an adequate technical basis to ensure that all of the fire barrier enclosed cables are operating within acceptable limits.

LaSalle County Station also uses a limited amount of Kaowool fire barrier in one reactor building to augment the approximately 12 m (40-foot) spatial separation between cabling of redundant trains, and extends protection out to 15 m (50 feet) from the redundant cable. NRC has approved use of Kaowool in this limited application due to lack of automatic fire suppression in the area. The Kaowool used has a performance rating of 90 minutes and is layered approximately 7.6 cm (3.0 in) thick along the length of fire-protected area.

6.32 Limerick Generating Station & Peach Bottom Atomic Power Station

Limerick Generating Station (LGS) and Peach Bottom Atomic Power Station (PBAPS) use Darmatt KM-1 and Thermo-Lag where a fire barrier is required to ensure separation of redundant trains the same fire area. As a result of GL 92-08, both sites implemented a Thermo-Lag corrective actions plan that documented the analysis, testing, and modifications to ensure ERFBS relied upon to provide separation of redundant safe shutdown trains within the same fire area provide the necessary level of protection.

Limerick Generating Station (LGS) and Peach Bottom Atomic Power Station (PBAPS) both use Thermo-Lag 330-1 ERFBS to comply with their fire protection plans. The licensee uses this barrier to protect electrical power and control cables for systems and components used for

achieving and maintaining safe shutdown conditions but Thermo-Lag isn't used for physical independence (RG 1.75). One hour and 3-hour Thermo-lag installations are used at both sites accounting for approximately 1341 m (4,400 feet) of Thermo-Lag at each station. In response to GL 92-08, the licensee identified that it had not performed plant specific fire endurance tests of Thermo-Lag 330-1 material, but relied on the manufactures (TSI) and other licensee tests to qualify the licensees' installations.

Safe shutdown re-analysis was completed to minimize reliance on Thermo-Lag 330-1 by use of operation actions and economically justifiable plant modifications and identification of cables that require protection by some type of ERFBS. Destructive examination of a sample of Thermo-Lag installations was performed at LGS to ensure that the Thermo-Lag installation was assembled with materials of acceptable quality (void of cracks, voids, and deformations).

A NRC inspection team reviewed the design and qualification testing for the Darmatt KM-1 electrical raceway fire barriers, and performed a walk down of installed barriers for the selected areas. This review was performed to verify that the selected items of the fire barrier system met their design and licensing bases. No findings of significance were identified. (ML020080162)

By letter dated September 21, 1998, NRC informed the licensee that all information requested in GL 92-08 had been received and all actions related to Thermo-Lag 330-1 ERFBS used at LGS, except ampacity derating, had been closed out. LGS completed all of its Thermo-lag related corrective actions by September 1999 and PBAPS actions were completed by October 1999. Safety Evaluation dated January 12, 2000, documents NRC staff evaluation of the Thermo-Lag ampacity derating issues at the PBAPS and LGS. The staff found that the ampacity derating analysis results are acceptable and there are no significant safety hazards associated with the application of the licensee ampacity derating methodology.

6.33 McGuire Nuclear Station

Thermo-Lag was initially used at McGuire Nuclear Station (McGuire) but cable that used Thermo-Lag ERFBS to provide the required protection have been replaced with a fire resistive electrical cable manufactured by Meggitt Safety Systems (previously known as Whittaker Electronic Systems) for several "A" train cables that are not separated by greater than 20ft from redundant "B" train cables. This electrical cable is a type of mineral insulated cable and the use of this cable at McGuire has been approved by NRC SE dated January 13, 2003.

McGuire uses approximately 20 linear feet of Hemyc ERFBS in Unit 1 and 44 linear feet in Unit 2, as a 1-hour rated barrier for compliance with Appendix R requirements. In response NRC and industry testing results, the licensee determined that their use of Hemyc does not meet the 1-hour fire rating to comply with McGuire licensing basis. As compensatory measure, the licensee has implemented additional control on the types of materials introduced into areas containing Hemyc and performs routine fire watches in the affected areas. On April 18, 2006, McGuire licensee submitted it intent to transition to NFPA 805 in accordance with 10 CFR 50.48(c). The licensee expects to resolve all issues related to the Hemyc ERFBS during the NFPA 805 transition process.

6.34 Millstone

Millstone Unit 3 used a 1-hour rated Thermo-Lag 330-1 ERFBS to protect approximately 40 ft conduits containing Appendix R required cables. The licensee replaced the Appendix R required cables with a 1-hour fire rated cable, to eliminate its reliance on Thermo-Lag materials.

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Author: u999cjp Subject: Highlight Date: 11/25/2009 8:32:36 AM
"Thermo lag is not used for physical independence" is **not** correct for Limerick.

The cable tray installation specification allowed the use of installed thermo-lag in place of metal tray covers when minimum physical electrical separation distances could not be maintained.

In these instances the thermo-lag serves a dual purpose as a fire barrier and an electrical separation barrier.

This was communicated to the NRC in a GL92-08 PECO to NRC RAI letter dated February 4 1994, under item 1.c. (Report reference 214)

PECO performed physical testing to validate that THERMO-LAG 330-1 AND DARMATT KM-1 RACEWAY ENCAPSULATIONS ARE ACCEPTABLE WITHOUT TRAY COVERS TO LIMIT THE SPREAD OF ELECTRICAL DAMAGE TO ADJACENT CABLES/RACEWAY, AS REQUIRED FOR REDUCED SEPARATION APPLICATIONS AT LGS, UNITS 1&2, PER UFSAR COMMITMENTS REGARDING REGULATORY GUIDE 1.75 - 1978, PHYSICAL INDEPENDENCE OF ELECTRICAL SYSTEMS, AND IEEE 384 –1974 IEEE STANDARD CRITERIA FOR INDEPENDENCE OF
CLASS 1E EQUIPMENT AND CIRCUITS

THE EVALUATION IS APPLICABLE TO THERMO-LAG 330-1 (ORIGINAL 1-HOUR AND 3-HOUR), THERMO-LAG (UPDATED 3-HOUR), AND DARMATT KM-1 RACEWAY ENCAPSULATION FOR 1 HOUR AND 3 HOUR RATINGS. Reference 99-00218 and ENGINEERING ANALYSIS LEAF-0013, THERMO-LAG 330-1 & DARMATT KM-1 ENCAPSULATION FOR RG 1.75 SEPARATION

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:30:50 AM
The length documented is for PBAPS only. Recommend that the length either be omitted or if the length is needed, add up the listed amounts for the 1 hour and 3 hour barriers documented in the GL92-08 PECO to NRC RAI letter dated February 4 1994, appendix 1 to provide an accurate length for Limerick. (Report reference 214)

Some of the items tended to in order to comply with 10 CFR 50 include upgrading control building walls which could be ignited by turbine fires to a 3-hour rating, including fire dampers, fire doors, and penetration seals. The walls of the cable spreading room and diesel generator room were also upgraded to a 3-hour fire rating. The viewing window was also upgraded to a two-hour fire rating, as well as the walls of the control room were upgraded to a two-hour fire rating that separates the service building and general auxiliary building ventilation exhaust filters from the remainder of the auxiliary building.

6.46 Prairie Island Nuclear Generating Plant

Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2 use Darmatt KM-1 and 3M Interam E50 series ERFBS to provide Appendix R safe shutdown circuit protection. These two barriers were qualified for a 1-hour fire rating in accordance with GL 86-10 Supplement 1 guidance.

Applications of Kaowool at the nuclear plant were removed due to the fact that they are no longer required by 10CFR50, Appendix R. All applications of Kaowool fire barrier were analyzed before removal to make sure they are necessary to comply with 10CFR50. Prairie Island determined that several installations of the fire barrier were unnecessary, and also that several locations were in need of a fire barrier, Field testing showed that some barriers met the required 20 foot separation criteria, allowing Kaowool to be removed and not replaced with upgraded fire barriers. Cables were also rerouted during a scheduled power outage to meet separation criteria and reduce the plant's reliance on fire barrier applications.

Through NRC approval and by letter dated December 27, 2000, Prairie Island Nuclear Generating Plant declared its completion date for Kaowool replacement and cable rerouting as February 28, 2001.

6.47 Quad Cities Nuclear Power Station

Quad Cities Nuclear Power Station (QCNPS) uses several different types of ERFBS to ensure separation of redundant trains in the same fire zone, including, Darmatt KM-1, Versa Wrap, and 3M Interam.

In 1994, QCNPS commissioned an independent review of the 3M Interam ERFBS installation and fire tests. The review evaluated installation configurations and test data the meet industry standards and GL 86-10 sup 1 acceptance criteria with the instillations at QCNPS. Where plant configurations that didn't bound the acceptable test configurations, a plant modification was performed to ensure the installed fire barrier was bounded by a tested configuration.

QCNPS uses Darmatt KM-1 and Versa Wrap 1-hour rated ERFBS. These barriers were installed in the late 1990's and an engineering evaluation for the modifications included a review of the fire barrier endurance testing to ensure the capability of these two ERFBS.

6.48 River Bend Station

River Bend Station relies on Thermo-Lag 330 to provide the protection to safe shutdown circuits required by Appendix R. Both one and three hour Thermo-Lag materials are used for safe shutdown purposes at River Bend Station. There is approximately 923 linear feet of 1-hour Thermo-Lag material and approximately 366 feet of 3-hour Thermo-Lag installed on cable trays. For conduits, there are about 4282 feet of 1-hour material and 1429 feet of 3-hour material. In

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Author: Subject: Comment on Text Date: 11/30/2009 9:05:59 AM
Prairie Island does not use Interam or Darmatt in Unit 1 Containment (FA 1). Marinite is used as a radiant energy shield.

Author: sph Subject: Comment on Text Date: 11/30/2009 9:01:33 AM

addition, Thermo-Lag is utilized to cover approximately 741 ft^2 of 1-hour and 277 ft^2 of 3-hour items including junction boxes, instruments, instrument racks, motor operated valves, a ceiling assembly, a steel beam, and one radiant energy shield.

All Thermo-Lag barriers at River Bend Station were declared inoperable on October 26, 1989. In response to its failed 3-hour fire endurance testing of Thermo-Lag 330, and supplementary testing by NEI, RBS developed a new post-fire safe shutdown analysis to reduce the plant's dependence on Thermo-Lag. In addition new Thermo-Lag configurations replaced the previous ones using new materials based on successful NEI test results.

Implementation of the new materials was delayed due to ampacity derating issues. Fire barriers at RBS were installed in accordance with TSI Technical Note 20684, but after planning and testing new fire barrier configurations, RBS became concerned that insufficient experimental results would prevent RBS from implementing any upgrades. River Bend removed the cable configurations from service in order to perform cable degradation tests and reduce overload on numerous cables in order to resolve electrical concerns from NRC Electrical Engineering Branch and SNL. NRC sent a letter to RBS dated September 15, 1999 stating that there are no remaining ampacity derating issues as identified in GL 92-08.

Author: Subject: Comment on Text Date: 11/30/2009 9:01:56 AM
Where it describes how RBS protects its Appendix R cables, the entire first paragraph is RBS prior to declaring Thermo-Lag inoperable. It is PRE-1989 history. The second paragraph is correct, but should include the fact that all the Thermo-lag configurations used at RBS are 1-hour rated barriers. In order to meet the requirements of Appendix R Section III.G.2.c, automatic suppression systems were extended into some areas. In addition to reworking the Thermo-Lag enclosed raceways, RBS also rerouted some Appendix R cables to remove them from the fire area of concern. The combination of the revised Post-fire Safe Shutdown Analysis and rerouting safe shutdown cables reduced the total quantity of Thermo-Lag to approximately 500 feet of 1-hour material. In the last sentence of part 6.48, the NRC sent the letter to RBS on NOVEMBER 15, 1999, not September 15.

6.49 H.B. Robinson Steam Electric Plant

Hemyc ERFBS is used at H.B. Robinson Steam Electric Plant (HBRSEP) as a 1-hour fire rated barrier to protect conduits in accordance with Appendix R. The use of Hemyc at HBRSEP was granted by NRC in exemptions dated October 25, 1984 and October 17, 1990. Approximately 120 linear feet of Hemyc is installed in the Component Cooling Water Pump Room to protect the pump power cables. This application includes two 4-inch and two 3-inch conduits. Following notification of the Hemyc fire testing failures, the licensee considered these Hemyc barriers inoperable and undertook compensatory measures until such barriers could be determined operable. On June 10, 2005, the licensee notified that it intended to transition to NFPA 805 and would disposition any Hemyc related issues then. However as a proactive measure, the licensee intends to replace the Hemyc with a ERFBS that has been tested and qualified to the required rating per guidance provided in GL 86-10 supplement 1. By letter dated August 2, 2007, the licensee notified NRC that all Hemyc installations had been removed and replaced with a 1-hour fire rated 3M Interam E54A ERFBS. NRC inspection staff verified the licensees' installation of the 3M ERFBS, documented in IR 05000261/2007007 and Exercise of Enforcement Discretion, December 20, 2007.

MT fire barrier material is used at HBSEP to cover both sides of two penetration seals containing the steam generator blowdown lines. Therefore, this application of MT material is not used an ERFBS to protect cables, but to provide added thermal insulation for the expansion and contraction of the steam generator blowdown lines.

6.50 St. Lucie

Approximately 110 feet of Hemyc material is used at St. Lucie as a noncombustible Radiant Energy Shield inside Unit 2 containment to satisfy a license basis requirement for separation of safe shutdown cables in the event of a fire. In a safety evaluation dated March 27, 1984, NRC determined that installation of a 1-1/2 inch insulating blanket manufactured by B&B Insulation, Inc. for protection of cable tray configuration inside containment was acceptable. The noncombustible RESs are installed beneath the lowest redundant Division A & B cable trays at each elevation and all conduits inside Unit 2 Containment not separated by 20 feet are enclosed

Author: Subject: Highlight Date: 11/30/2009 9:23:01 AM
In addition to the items stated here, an additional contributing factor to historical problems with ERFBS appears to be that the NRC did not develop detailed expectations/ guidance regarding ERFBS qualification until well after most plants had completed their ERFBS installations.

7. Summary of Findings

(1) Use of ERFBS in NPPs is a direct result of the 1975 Brown Ferry Fire and the subsequent NRC fire protection regulations. The rush for NPPs to achieve compliance with the new regulation and wide use of ERFBS resulted in problems with proper testing, design, installation, maintenance, and ability of the barrier to perform its desired function.

(2) If Electric Raceway Fire Barrier Systems are properly designed, tested, configured, installed, inspected, and maintained, there is reasonable assurance that they will provide the fire resistance of the tested configuration.

(3) Plant specific deficiencies have been, and will continue to be found on occasion during routine licensee surveillances and NRC inspections. Fire protection defense in depth provides reasonable assurance that such deficiencies will not present an undue risk to the public health and safety.

(4) A large number of fire endurance tests have established the fire-resistive capabilities of the ERFBS material, designs, and constructions installed in NPPs. The test results support the conclusion that the regulatory requirements can be met by these fire barrier systems.

(5) Satisfactory NRC guidance on testing ERFBS, including performance, design, and acceptance criteria are available in Supplement 1 to GL 86-10. Although availability of this guidance earlier would have eliminated most ERFBS issues identified in the past.

(6) The potential problems that were raised about ERFBS have been addressed. The staff did not find safety-significant plant-specific problems nor did it find problems with potential generic implications.

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Author: u999cjp Subject: Highlight Date: 11/25/2009 8:07:04 AM
Braidwood is not transitioning to 50.48(c) at this time.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:07:18 AM
Byron is not transitioning to 50.48(c) at this time.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:07:39 AM
Clinton is not transitioning to 50.48(c) at this time.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:08:02 AM
Dresden is not transitioning to 50.48(c) at this time.

Appendix F Summary of GL 06-03 Responses

Compiled Listing of ERFBS used in NPP as of December 21, 2007

Plant Name	Licensee Response Letter(s)	NRC Closeout Letter(s)	Type(s) of Barrier	10 CFR 50.48(c) Transition
Arkansas Nuclear 1 and 2	ML061720459	ML062620115	Hemyc, Thermo-Lag, Versa Wrap	Yes
Beaver Valley 1 and 2	ML061710429 ML070370315	ML070680131	Thermo-Lag, 3M Interam, Darmatt	
Braidwood 1 and 2	ML061640343 ML071520085	ML071700766	3M Interam	
Browns Ferry 1, 2 and 3	ML061600208	ML070250411	Thermo-Lag	
Brunswick 1 and 2	ML061640386	ML071580106	3M Interam	
Byron 1 and 2	ML061640343	ML071000347	Darmatt	
Callaway	ML061570382 ML062060383	ML062680005	Darmatt	
Calvert Cliffs 1 and 2	ML061650026	ML070880103	None	
Catawba 1 and 2	ML061640310	ML071430127	Hemyc	Yes
Clinton	ML061640343 ML071520085	ML071700766	Thermo-Lag, 3M Interam	
Columbia Generating Station	ML061710470	ML062850088	Thermo-Lag, 3M Interam, Darmatt	
Comanche Peak 1 and 2	ML061660092	ML071230006	Hemyc, Thermo-Lag	No
Cooper Nuclear Station	ML061530275	ML061650200	None	
Crystal River 3	ML061570390	ML071580594	Thermo-Lag, Mecatiss	
Davis Besse	ML061710429 ML070370315	ML070680131	3M Interam	
Diablo Canyon 1 and 2	ML061720079	ML063390066	3M Interam, Pyrocrete	
Donald C. Cook Nuclear Plant Unit 1 and 2	ML061600213	ML070180221	Thermo-Lag, Darmatt, Mecatiss	
Dresden 2 and 3	ML061640343	ML063000065	3M Interam	

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Author: u999cjp Subject: Highlight Date: 11/25/2009 8:25:32 AM
LaSalle (Units 1 and 2) are not transitioning to 50.48(c) at this time.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:28:15 AM
LaSalle Unit 1 Uses Darmatt and Kaowool. Reactor Building elevation 740' has the Kaowool wrap as described on page 6-14.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:26:36 AM
LaSalle Unit 2 uses Darmatt and Kaowool fire barriers and Darmatt was installed as a replacement for Thermolag. This is described in ML061640343.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:08:24 AM
Limerick is not transitioning to 50.48(c) at this time.

Plant Name	Licensee Response Letter(s)	NRC Closeout Letter(s)	Type(s) of Barrier	10 CFR 50.48(c) Transition
		ML071360223		
Duane Arnold	ML061640269	ML070860462	Darmatt	
Farley 1 and 2	ML061600376 ML063330230	ML071280045	3M Interam, Promat	
Fermi 2	ML061660087 ML070580135	ML070860419	3M Interam	
Fitzpatrick	ML061650025	ML062960164	Hemyc, FP-60	No
Fort Calhoun	ML061530476 ML070850193	ML071090295	3M Interam, Pyrocrete, Fabrio	
Robert E Ginna	ML061650026	ML070940337	Hemyc, MT	Yes
Grand Gulf 1	ML061570135	ML061650383	Thermo-Lag, 3M Interam	
Shearon Harris	ML061240052 ML061710062	ML062900541	Hemyc, MT, Thermo-Lag, 3M Interam	Yes
Edwin Hatch 1 and 2	ML061600376 ML072060088	ML072180188	Promat	
Hope Creek 1	ML061660080	ML061810011	None	
Indian Point 2 and 3	ML061720091	ML073320029	Hemyc, 3M Interam	No
Kewaunee	ML061590505 ML071520515	ML072500079	3M Interam	
La Salle 1	ML061640343	ML062300114 ML071360223	Darmatt	
La Salle 2	ML061640343	ML062300114 ML071360223	Thermo-Lag, Darmatt	
Limerick 1 and 2	ML061640343	ML071000347	Thermo-Lag, Darmatt	
McGuire 1 and 2	ML061640310	ML071430162	Hemyc	Yes
Millstone 2 and 3	ML061590505 ML071520515	ML073060163	None	
Monticello	ML061600209	ML061810437	None	
Nine Mile Point 1 and 2	ML061650026	ML070880123	None	
North Anna 1 and 2	ML061590505 ML071520515	ML071910366	3M Interam	

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:08:37 AM
Oyster Creek is not transitioning to 50.48(c) at this time.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:09:58 AM
Oyster Creek currently uses Thermo-Lag, Mecatiss, and 3M Interam.

3M Interam was added after completion of thermolag resolution actions.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:10:11 AM
Peach Bottom is not transitioning to 50.48(c) at this time.

Author: u999cjp Subject: Highlight Date: 11/25/2009 8:10:32 AM
Quad Cities is not transitioning to 50.48(c) at this time.

Plant Name	Licensee Response Letter(s)	NRC Closeout Letter(s)	Type(s) of Barrier	10 CFR 50.48(c) Transition
Oconee 1, 2 and 3	ML061640310	ML061650421	None	
Oyster Creek	ML061640343	ML071000847	Thermo-Lag, Mecatiss	
Palisades	ML061600209	ML070660064	Concrete	
Palo Verde 1, 2 and 3	ML061650261	ML063540027	Thermo-Lag	
Peach Bottom 2 and 3	ML061640343	ML071000347	Thermo-Lag, Darmatt	
Perry 1	ML061710429 ML070370315	ML070680131	3M Interam	
Pilgrim 1	ML061640132	ML063620110	3M Interam, Mecatiss	
Point Beach 1 and 2	ML061600209 ML062550167	ML061640009	3M Interam	
Prairie Island 1 and 2	ML061600209	ML062050077	3M Interam, Darmatt	
Quad cities 1 and 2	ML061640343 ML071630310	ML071700766	3M Interam, Darmatt, Versa Wrap	
River Bend	ML061570394 ML061670210	ML061650386	Thermo-Lag	
H. B. Robinson 2	ML061640136 ML072250063	ML071070583	Hemyc, 3M Interam	Yes
Saint Lucie 1 and 2	ML061640269 ML062680162	ML063070029	Hemyc, Thermo-Lag, Mecatiss	Yes
Salem 1 and 2	ML061660091	ML061810077	3M Interam	
San Onofre 2 and 3	ML061590310 ML071710548	ML071920538 ML072770906	3M Interam, Cerablanket	
Seabrook 1	ML061640269 ML071990101	ML072010149	3M Interam	
Sequoyah 1 and 2	ML061600208	ML070250184	Thermo-Lag	
South Texas Project Unit 1 and 2	ML061510352	ML071130024	Thermo-Lag	
Summer	ML061590311 ML062220348	ML061660200	3M Interam, Kaowool	
Surry 1 and 2	ML061590505 ML071520515	ML071910366	Pyrocrete	

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Author: u999cjp Subject: Highlight Date: 11/25/2009 8:10:41 AM
TMI is not transitioning to 50.48(c) at this time.

Plant Name	Licensee Response Letter(s)	NRC Closeout Letter(s)	Type(s) of Barrier	10 CFR 50.48(c) Transition
Susquehanna 1 and 2	ML061660076	ML062160010	Thermo-Lag, Darmatt	
Three Mile Island 1	ML061640343	ML061810093	Thermo-Lag, Mecatiss	
Turkey Point 3 and 4	ML061640269	ML062910197	Thermo-Lag	
Vermont Yankee	ML061630231	ML063620129	3M Interam	
Vogtle 1 and 2	ML061600376	ML063490324	3M Interam, Cementitious material	
Waterford 3	ML061600210	ML062300315	Hemyc, 3M Interam	Yes
Watts Bar 1	ML061600208	ML070250345	Thermo-Lag	
Wolf Creek 1	ML061570375	ML061650179	Thermo-Lag, Darmatt	

Author: Subject: Highlight Date: 11/30/2009 9:25:06 AM
A citation is needed for this paragraph. NRC performed a review of NUREG 1724 and forwarded comments to UL regarding the standard. A citation to this correspondence should be provided in the NUREG.

Appendix G Additional Information on ERFBS Acceptance Criteria

G.1 UL Subject 1724

UL Subject 1724, "Outline of Investigations for Fire Tests for Electrical Circuit Protective Systems," is an acceptable method of qualifying ERFBS provided the cable qualification testing of UL 1724 Appendix B and Generic Letter 86-10 Supplement 1 is performed.

Appendix B to UL Subject 1724 provides a method acceptable to NRC to determine circuit integrity of insulated electrical cables protected with ERFBS. This method evaluates the circuit integrity independent of use of an ERFBS. The method consists of exposing unprotected cable samples to elevated temperatures in a circulating air oven. The exposure temperatures are based on fire endurance test temperature data collected on a bare # 8 American Wire Gauge (AWG) conductor protected in a raceway by an ERFBS (data from separate test).

The cables under evaluation are arranged in a cable raceway (i.e., conduit or ladder-backed or solid cable tray) along with a bare #8 AWG conductor that is used to monitor and control the air oven temperature. All conductors are energized and monitored for electrical circuit faults (1) between individual conductors in a multiconductor cable, (2) between adjacent individual conductors (cables), and (3) between the electrical conductors and ground or raceway. The air oven exposes the cables to the thermal environment experienced within an ERFBS. The testing is conducted until the air oven temperature reaches the maximum interior ERFBS endurance test temperature or when a circuit fault occurs.

During the test, the cables are under constant compression loading to simulate the maximum allowable fill of insulated electrical cable. In addition, the test assembly is subjected to an impact test representative of the impact force and frequency of impacts that could be encountered by the raceway from falling material (e.g., ceiling) during a fire. Circuit integrity is monitored during these impact tests.

Appendix B is typically used when the ERFBS fire endurance testing temperature rise acceptance criteria were not met. UL Subject 1724 provides one method to demonstrate the functionality of the electrical cables protected with an ERFBS exposed to elevated temperatures.

G.2 NRC Acceptance Criteria

Supplement 1 to Generic Letter 86-10, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used to Separate Redundant Safety Shutdown Trains within the Same Fire Area," and RG 1.189, "Fire Protection for NPPs," provide guidance related to the criteria found acceptable to NRC for qualifying ERFBSs. It should be understood that these guidance documents only provide one particular method that is acceptable to NRC; however, other acceptable methods exist such as those used by TVA to license Watts Bar Unit 1 in 1995. Based on past reviews, NRC staff acceptance is based on the barriers performance in the following areas:

- Fire Endurance
  - Test Specimen Construction
  - Hose Stream Test