

December 31, 1991

Mr. G. Ishack
Nuclear Safety Division
Nuclear Energy Agency
OECD
38, Boulevard Suchet
75016 Paris, France

Dear Mr. Ishack:

Enclosed is an IRS report, "Deficiencies in the Procedures for Installing THERMO-LAG Fire Barrier Materials." If you have any questions regarding this report, please call Raji Tripathi (IRS Coordinator) or John Boardman (IRS Preparer) of my staff. They can be reached at (301) 492-4435 and (301) 492-9861, respectively.

Sincerely,

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Thomas M. Novak, Director
Division of Safety Programs
Office for Analysis and Evaluation
of Operational Data

Enclosure:
As stated

cc: R. Fraley, ACRS

Distribution: (w/o enclosure)

TNovak
JRosenthal
JCrooks
PBaranowsky
VBenaroya
BKaufer

Distribution: (w/enclosure)

EJordan
DRoss
RTripathi
JWechselberger, OEDO
TPAB RF
DSP RF
Central File
JBoardman

(see previous concurrence)

AB*
Boardman
1/30/91
GEORGE1.JB)

TPAB*
RTripathi
12/ /91

TPAB
JCrooks
12/30/91

C:TPAB
PBaranowsky
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DSP
VBenaroya
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~~DOSP~~
Novak
12/31/91

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RETURN TO REGULATORY CENTRAL FILES

9201100295 XA

MHS-3-9
INCIDENT

DFX2

INCIDENT REPORTING SYSTEM

IRS NO.	EVENT DATE	DATE RECEIVED
	EVENT TITLE	
	DEFICIENCIES IN THE PROCEDURES FOR INSTALLING THERMO-LAG FIRE BARRIER MATERIALS	
COUNTRY	PLANT AND UNIT	REACTOR TYPE
USA	Perry, River Bend and Washington Nuclear Project 2	LWR
INITIAL STATUS	RATED POWER (MWE NET)	
Not relevant	1205, 934, and 1095, respectively	
DESIGNER	1st COMMERCIAL OPERATION	
GE	87/11/18, 86/6/16, 84/12/13	

ABSTRACT

On October 7, 1991, discrepancies were identified at Perry Nuclear Plant in the installation of cable tray raceway fire barriers comprised of THERMO-LAG¹ 330-1. The cause of this condition was an inadequate fire barrier installation standard specification prepared by the architect engineer (AE). This specification did not contain certain manufacturer's installation criteria concerning the maximum spacing of mechanical fasteners (banding straps).

In subsequent discussions with licensees and the manufacturer of THERMO-LAG¹ fire barrier materials, the NRC was not able to verify that all specific installations have been appropriately qualified.

The NRC issued Information Notice No. 91-79 on this problem area.

¹ THERMO-LAG is a registered U.S. Tradename.

DEFICIENCIES IN THE PROCEDURES FOR INSTALLING THERMO-LAG FIRE BARRIER MATERIALS

Please refer to the dictionary of codes corresponding to each of the sections below and to the coding guidelines manual.

	<u>1.3.1</u>	<u>1.3.2</u>	<u>1.3.4</u>	<u>1.4</u>
1. Reporting Categories:				
2. Plant Status Prior to Incident:	<u>2.0</u>			
3. Failed/Affected Systems:	<u>3.KH</u>			
4. Failed/Affected Components:	<u>4.0</u>			
5.1 Observed Causes	<u>5.1.3.2</u>			
5.2 Root Causes:	<u>5.2.8.1</u>	<u>5.2.8.2</u>	<u>5.2.8.5</u>	
6. Effect on Operation:	<u>6.0</u>	<u>6.10</u>		
7. Characteristics of the Event:	<u>7.5</u>	<u>7.13</u>		
8. Type of Failure:	<u>8.2</u>	<u>8.3</u>		
9. Proposed New Codes:				

DEFICIENCIES IN PROCEDURES FOR INSTALLING THERMO-LAG FIRE BARRIER MATERIALS

Introduction

This IRS report addresses problems that could result from improperly installed THERMO-LAG¹ 330-1 fire barriers which are used to meet NRC fire protection requirements for safe shut-down components, as specified in Title 10 of the U.S. Code of Federal Regulations, Part 50, Appendix R, Section III.G.2 (10 CFR 50, Appendix R, Section II.G.2.). THERMO-LAG products are commercially available fire protection materials provided by Thermal Science, Incorporated (TSI), which are qualified to meet these regulations as they apply to the electrical raceway fire protection requirements for safe shut-down components and systems.

Background

NRC requirements, and guidelines for meeting these requirements, are contained in such documents as Appendix R to 10 CFR 50; "Standard Review Plan", Section 9.5, NUREG-0800; and, NRC Generic Letter 86-10, "Implementation of Fire Protection Requirements."

NRC Information Notice (IN) 91-47, "Failure of THERMO-LAG Fire Barrier Material to Pass Fire Endurance Test," was addressed in a U.S. IRS Report submitted in November 1991. This IRS report discussed a failed 3-hour fire endurance test of a THERMO-LAG 330-1 cable tray protective envelope system conducted by Southwest Research Institute (SwRI) for Gulf States Utilities (GSU), the licensee for River Bend Station, where such protective envelope systems are installed.

Description of Circumstances

Cleveland Electric Illuminating Company (CEI) reported to the NRC in Licensee Event Report (LER) 05000440/91-020 that the mechanical fasteners (banding straps) on the fire barrier enclosures at Perry Nuclear Plant had not been installed in accordance with the TSI installation procedures manual. CEI identified these installation discrepancies while conducting routine fire wrap inspections using revised inspection criteria. The licensee identified that no fire endurance tests or engineering analysis had been performed to support the acceptability of the installed configuration.

Discussion

Perry Nuclear Plant Periodic Test Instruction (PTI-P54-P0075), "Appendix R Fire Wrap Inspection," was started on June 12, 1991 with recently revised inspection criteria. On August 27, during the accomplishment of PTI-P54-P0075, several examples of excessive band spacing were found to be used in THERMO-LAG 330-1 installations in the plant. As part of the review of NRC Information Notice 91-47, the Perry Nuclear Plant identified differences between the design for the 1-hour fire rated cable tray and conduit raceway fire wrap installed by a

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contractor and the TSI installation procedures manual. When the Perry Nuclear Plant contacted TSI, TSI indicated that the fire wrap had only been qualified by testing, and approved with a maximum spacing of twelve inches between the mechanical fasteners (banding straps). Records at Perry Nuclear Plant were reviewed and no documentation was found of fire tests for the installed configuration, and no analysis was available to support extending the distance between mechanical fasteners (banding straps). Therefore the information in the Perry Nuclear Plant design documents was not justified.

On October 7, 1991, the discrepancies in excessive banding spacing of TSI THERMO-LAG fire wrap for raceways required to meet Appendix R to 10 CFR 50, were determined to possibly result in the fire wrap being unable to perform its rated function. All un-inspected raceways and those found to have banding exceeding the specified 12-inch maximum spacing were declared impaired as a fire barrier and hourly fire watches were initiated. On October 15, 1991, the installation contractor confirmed that he had no records of fire endurance tests, or analysis of the installed configuration.

On October 16, 1991, the inspection of cable trays and conduit installations was completed. Approximately 950 feet of affected cable trays were identified throughout the plant. One example of excessive banding spacing was found on a conduit raceway.

On August 23, 1991, the vendor for THERMO-LAG, TSI, issued a letter to certain U.S. power reactor licensees that discussed specific THERMO-LAG installation concerns that were addressed in IN 91-47. TSI concluded that the SwRI 3-hour endurance test discussed in IN 91-47 was not a valid test because of the installation deficiencies of the test article.

Certain licensees have identified instances of THERMO-LAG fire barrier configurations that were not installed in accordance with the TSI installation procedures manual.

The NRC has identified a number of variances in THERMO-LAG installations during its continuing review of TSI installation procedures, and the installation specifications, procedures and practices for specific plants. Some of the installation variances observed by the NRC do not appear to be in accordance with the TSI installation procedures manual, and may comprise configurations that have not been qualified by fire endurance testing, or by engineering analysis. In several cases, such as at the River Bend Station and Washington Nuclear Project Unit 2, the installation methods used during initial construction of the plant which deviated from the TSI installation procedures manual were found to be unacceptable, after subsequent qualification fire endurance testing resulted in fire barrier failures.

On October 17, 1991, the NRC met with TSI to discuss issues regarding installation and qualification testing. TSI stated that it had not included several essential application steps and precautions in its installation procedures manual because the information was presented during the TSI certification training for installers. TSI stressed the importance of using skilled and certified installers, and qualified quality control inspectors to achieve an adequate fire barrier enclosure. Several licensees have told the NRC of receiving supplementary written and verbal installation guidance from TSI representatives that is not included in the TSI installation manual.

The NRC has discussed installation details with licensees, and has visited a number of sites. The NRC staff has observed variation among the installation procedures and practices regarding the following installation details:

- Methods for sealing and filling joints between panel sections.
- The orientation and application methods for stress skin.
- The requirements for raceway support protection.
- Allowable gap widths between panel sections.
- The configuration and orientation of structural ribs.
- Methods for installing vaults and fire-walls.
- Banding material and application methods.
- Scoring and grooving of panels for fabricating and bending the panels around bends in raceways.
- Thickness acceptance criteria.

For example, an important task during installation of THERMO-LAG fire barriers is the filling of the joints between adjoining pre-fabricated panel sections with "trowel-grade" material to the full depth of the panels. Some licensees use a method in which the ends of individual panel sections are butt joined to one another, and the seam between the panel sections is filled and covered with THERMO-LAG "trowel grade" material (commonly referred to as "dry-fitting"). Certain licensees fill the joints by "pre-buttering" the edges of the individual panel sections with "trowel grade" material before they join the panels to ensure that the gap between the panels is completely filled. TSI did not include this method as an option for installing cable tray enclosures in its current installation procedures manual. However, on October 17, 1991, TSI stated to the NRC that this method was acceptable for installing THERMO-LAG panels to cable trays.

In its August 23, 1991 letter to licensees, TSI stated that stress skin must be placed over panel joints to ensure a continuous outer layer of stress skin for 3-hour barriers. A recent TSI procedure, TSI Technical Note 20684-AL, dated October 1989, provides updated installation procedures for aluminum cable trays and requires that each butt joint be covered by an additional layer of stress skin and trowel grade material. The current TSI generic installation procedures manual does not provide any guidance for installing a continuous layer of stress skin.

Root Cause(s)

The cause of the event at Perry Nuclear Plant was inadequate design which resulted in a potentially un-qualified installation. The licensee's installation standard specification and periodic test instruction for fire wrap inspection, which were provided by the licensee's architect-engineer, did not reflect the TSI installation criteria concerning maximum spacing of the mechanical fasteners (banding straps).

Licensees that have experienced installation problems with THERMO-LAG 330-1 have attributed most of these problems to errors made by installers/contractors, incomplete or incorrect design documents, and inadequate quality control oversight.

Corrective Actions

The Perry Nuclear Plant immediate corrective action was to initiate hourly fire watches, with operable fire detection in all areas, for the fire impairment situation. These fire watches will continue until all installations are properly upgraded. The licensee's installation standard specification, design drawings, and installation procedure will be revised to reflect the installation criteria specified by the TSI installation procedures manual.

NRC Response

The NRC has not been able to verify that all of the specific installation variations observed have been qualified by independent qualification testing or engineering analyses. The NRC is continuing to review other technical issues regarding THERMO-LAG 330-1 fire barriers, including issues concerning the adequacy of qualification testing. Generic Letter 86-10, "Implementation of Fire Protection Requirements," provides additional NRC guidance on fire barrier qualification test acceptance criteria and evaluation of deviations from tested configurations to substantiate field installations. The NRC issued Information Notice 91-79 to alert licensees of U.S. nuclear power reactors to these problems.

Safety Significance

Fire barrier wrap materials, including THERMO-LAG 330-1, are required to provide reasonable assurance that the effects of a fire are limited to one train, or division, of a component or system required for safe shut-down of a reactor plant, while the other train(s), or division(s), remain operable. Had a fire occurred during the time that these fire barriers were not properly installed, the potential existed for impairing the ability of the plant components and systems required to achieve and maintain a safe shut-down utilizing the methods described in the Perry Nuclear Plant's Fire Hazards Analysis.

Similar Other Instances

A similar problem was reported in the U.S. IRS Report submitted in November 1991 regarding NPC IN 91-47, "Failure of THERMO-LAG Fire Barrier Material to Pass Fire Endurance Test." This Information Notice addressed problems with THERMO-LAG installations at River Bend Station which did not comply with the TSI installation procedures manual, were consequently not covered by the TSI qualification, and subsequently failed an installation-specific fire endurance qualification test.

Generic Implications

At least 40 NRC-licensed power reactors use THERMO-LAG materials to construct fire barrier assemblies requiring 1-hour and 3-hour fire ratings in order to protect safety-related electrical raceway and other safe shut-down systems. The NRC has not been able to verify that all of the specific installation variations observed have been qualified by independent qualification testing or engineering analyses. The identified concerns are therefore relevant to all licensed power reactors with THERMO-LAG installations.

NEA Reportability Criteria

This IRS report is being submitted pursuant to Criterion 3.0, "Safety Deficiencies in Design, Construction, Operations, Quality Assurance, or Evaluation;" and, Criterion 4.0, "Generic Problems of Safety Interest."