UNITED STATES NUCLEAR REGULATORY COMMISSION

ISSUANCE OF FINAL DIRECTOR'S DECISION UNDER 10 CFR § 2.206

Notice is hereby given that the Director, Office of Nuclear Reactor Regulation (NRR), has issued a Final Director's Decision concerning a petition dated December 15, 1992. Issues raised by the Petitioners in earlier submittals dated July 21, August 12, and September 3, 1992, filed by the Nuclear Information and Resource Service et al., were addressed in a Partial Director's Decision (DD-93-03) dated February 1, 1993, where it was determined that no substantial health and safety issues had been raised. The December 15, 1992, submittal was treated as a supplement to the earlier filings. The Petitioners requested emergency relief in the form of immediate suspension of the operating licenses or construction permits of all nuclear plants that use the material Thermo-Lag as a fire barrier, until the Thermo-Lag is removed and replaced. Alternatively, the Petitioners requested that the NRC order each reactor licensee to remove and replace its Thermo-Lag during its next refueling outage, or before beginning operation.

By letter dated February 4, 1993, the Petitioners were informed that their December 15, 1992, request for emergency relief was denied and appropriate action would be taken on any new issues raised which had not been addressed in the Partial Director's Decision of February 1, 1993.

The December 15, 1992, petition was considered under the provisions of 10 CFR § 2.206 of the NRC's regulations. Notice of receipt of the petition was published in the Federal Register on February 16, 1993 (58 FR 8637).

The Petitioners repeated a number of allegations of deficiencies concerning Thermo-Lag material raised in earlier petitions. These were fully

addressed by the Partial Director's Decision, including failure of Thermo-Lag fire barriers during 1-hour and 3-hour fire endurance tests, deficiencies in procedures for installation, nonconformance with NRC regulations, the combustibility of the material, ampacity miscalculations, the lack of seismic tests, the failure to pass hose stream tests, the high toxicity of substances emitted from the ignited material, and that compensatory measures such as fire watches cannot substitute indefinitely for an effective fire barrier. The Petitioners also presented new allegations which were the focus of the Final Director's Decision, regarding the existence of voids and staples in the material, and possible errors in information provided by the manufacturer concerning the weight of Thermo-Lag as installed.

The Director has determined that, with respect to the new allegations, the Petitioners have not raised substantial health and safety issues and, therefore, the Petitioners' requests for enforcement action based on the December 15, 1992, petition should be denied for the reasons stated in the "Final Director's Decision Pursuant to 10 CFR § 2.206" (DD-93-[illegible]), which is available for inspection and copying in the Commission's Public Document Room, 2120 L Street, N.W., Washington, D.C. 20555 and in the Local Public Document Rooms for the facilities listed in the petition.

A copy of the Decision will be filed with the Secretary of the Commission for Commission review in accordance with 10 CFR § 2.206(c). The Decision will become the final action of the Commission 25 days after issuance unless the Commission, on its own motion, institutes a review of the Decision within that time.

FOR THE NUCLEAR REGULATORY COMMISSION

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Dated at Rockville, Maryland
this 23rd day of May 1993

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 1, 1993

Docket Nos. 50-458, 50-445, 50-446,
50-400, 50-341, 50-244,
50-397, 50-261, 50-324,
and 50-325
(10 CFR § 2.206)

Mr. Michael Mariotte
Executive Director
Nuclear Information and Resource
Service
1424 16th Street, N.W.
Suite 601
Washington, D.C. 20036

Dear Mr. Mariotte:

I am responding to a petition filed by you on behalf of the Nuclear Information and Resource Service and other organizations (Petitioners) with the U.S. Nuclear Regulatory Commission dated July 21, 1992, as supplemented by the addendum of August 12, 1992. The petition was filed pursuant to Section 2.206 of Title 10 of the Code of Federal Regulations (10 CFR § 2.206). The original petition presented concerns regarding the use of Thermo-Lag 330-1 fire barrier material for protecting against fire in nuclear plants and requested immediate actions related to Gulf States Utilities' River Bend Station. The Petition also demanded immediate issuance of Generic Letter 92-XX, which had been issued for comment on February 11, 1992 and dealt with Thermo-Lag issues. The addendum of August 12, 1992, requested immediate actions related to the Comanche Peak, Shearon Harris, Fermi-2, Ginna, WNP-2, and Robinson facilities.

By letter dated August 19, 1992, I informed you that the petition and addendum had been referred to my office for preparation of a response. In that acknowledgement letter, I stated that the Petitioners' request for emergency relief was denied and, as provided by 10 CFR § 2.206, the NRC would take appropriate action on the specific issues raised in the petition and addendum within a reasonable time. On September 3, 1992, you submitted an "appeal" to the Commission of the staff's denial of your request for emergency relief. In the "appeal," Petitioners removed their request that the operating license for the Ginna and Robinson reactors be suspended, and added the two-unit Brunswick plant to their request for immediate enforcement action. By letter dated November 9, 1992, the Secretary of the Commission informed you that the Commission had determined not to undertake a formal review of the August 19, 1992, letter, and that the "appeal" request had been referred to my office for appropriate consideration in conjunction with the review of the issues raised in your petition and addendum.

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Your request has been considered under the provisions of 10 CFR § 2.206 of the Commission's regulations. On December 17, 1992, the NRC staff issued Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers" (Generic Letter 92-XX). To the extent that Petitioners sought issuance of Generic Letter 92-XX, this relief is granted. For reasons set forth in the enclosed "Partial Director's Decision Under 10 CFR § 2.206," I have denied the remainder of your requests.*

A copy of the Partial Director's Decision is being filed with the Secretary for review by the Commission in accordance with 10 CFR § 2.206(c). The Partial Director's Decision will constitute the final action of the Commission 25 days after the date of issuance of the Decision unless the Commission, on its own motion, institutes a review of the Decision within that time.

A copy of the Notice of Issuance of the Partial Director's Decision, which is being filed with the Office of the Federal Register for publication, is also enclosed.

Sincerely,

Thomas E Murley

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

Enclosures:
1. Partial Director's Decision (DD- 93-03)
2. Federal Register Notice
3. GL 92-08

cc with enclosures:
See next page

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*On December 15, 1992, the Nuclear Information and Resource Service (NIRS) filed another Petition pursuant to 10 CFR § 2.206 raising additional issues regarding Thermo-Lag fire barrier material. The December 15, 1992 NIRS Petition will be considered as a supplement to the Petition submitted by NIRS and others on July 21, 1992. The issues raised in the December 15, 1992 submittal will be addressed in a Final Director's Decision to be issued within a reasonable time.

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DD-93-03

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION
Dr. Thomas E. Murley, Director

In the Matter of	)	
	)	
TEXAS UTILITIES ELECTRIC COMPANY	)	Docket Nos. 50-445,
(Comanche Peak Steam Electric Station	)	50-446,
Units 1 and 2)	)	
	)	
CAROLINA POWER & LIGHT COMPANY	)	50-325,
(Brunswick Steam Electric Plant,	)	50-324,
Units 1 and 2)	)	
	)	
CAROLINA POWER & LIGHT COMPANY	)	
(Shearon Harris Nuclear Power Plant)	)	50-400,
	)	
DETROIT EDISON COMPANY	)	50-341,
(Fermi-2)	)	
	)	
WASHINGTON PUBLIC POWER SUPPLY SYSTEM	)	50-397,
(WPPSS Nuclear Project No. 2)	)	
	)	
GULF STATES UTILITIES COMPANY	)	and 50-458
(River Bend Station, Unit 1)	)	
	)	(10 CFR § 2.206)

PARTIAL DIRECTOR'S DECISION UNDER 10 CFR § 2.206

I. INTRODUCTION

By a petition dated July 21, 1992, the Nuclear Information and Resource Service (NIRS), Alliance for Affordable Energy, and Citizens Organized to Protect Our Parish (the Petitioners), requested that the U.S. Nuclear Regulatory Commission (NRC) take enforcement action regarding the Gulf States Utilities' (sometimes referred to as GSU) River Bend Station, demanding its operating license be suspended until GSU can demonstrate, through independent testing, that it meets the NRC's fire protection regulations (Appendix R to Part 50 of Title 10 of the Code of Federal Regulations [10 CFR Part 50]). In addition, the Petitioners demanded that the NRC staff immediately issue

Generic Letter (GL) 92-XX, the draft of which was circulated for public comment on February 11, 1992, and close any nuclear power plant for which the licensee cannot prove, through independent testing, that it meets fire protection regulations until it does meet them. By an addendum to the petition dated August 12, 1992, the Petitioners requested immediate action related to the Comanche Peak, Shearon Harris, Fermi-2, Ginna, WNP-2, and Robinson nuclear facilities. Joining in filing the addendum are a number of other organizations: Citizens for Fair Utility Regulation, Don't Waste New York, Citizens Against Radioactive Dumping, Coalition for Alternatives to Shearon Harris, Conservation Council of North Carolina, Safe Energy Coalition of Michigan, Steve Langdon, Essex County Citizens Against Fermi-2, Natural Guard, and Northwest Environmental Advocates.[1] The petition and addendum (sometimes collectively referred to as Petition) were submitted under the provisions of 10 CFR § 2.206 of the NRC's regulations. Notice of receipt of the Petition was published in the Federal Register on August 26, 1992 (57 FR 38702).

The Petition alleges a number of deficiencies concerning Thermo-Lag 330-1 (Thermo-Lag) material, including failure of Thermo-Lag fire barriers during 1-hour and 3-hour fire endurance tests, deficiencies in procedures for installation, nonconformance with NRC regulations for quality assurance and qualification tests, the combustibility of the material, ampacity miscalculations, lack of seismic tests, the failure to pass hose stream tests, the high toxicity of substances emitted from the ignited material, and the declaration by at least one utility, GSU, of the material as inoperable at its River Bend Station. The Petition also alleges that a fire watch cannot

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[1]Reference to Petitioners shall also include these entities.

substitute for an effective fire barrier indefinitely and that the NRC staff has not adequately analyzed the use of fire watches.

On the basis of these allegations, the Petitioners requested emergency enforcement action to immediately suspend the operating licenses for River Bend Station, Comanche Peak Unit 1, Shearon Harris, Fermi-2, Ginna, and Robinson, pending a demonstration that these facilities meet NRC fire protection requirements. The Petitioners also requested that the NRC issue a stop-work order regarding the installation of Thermo-Lag at Comanche Peak Unit 2 and a generic letter by September 5, 1992, that would require licensees to submit information to the NRC demonstrating compliance with fire protection requirements. Where facilities cannot demonstrate compliance, the Petitioners requested immediate suspension of the operating licenses for such facilities until such time as compliance with NRC fire protection requirements can be shown. The Petition was referred to the Office of Nuclear Reactor Regulation for preparation of a response.

In a letter dated August 19, 1992, the Director, Office of Nuclear Reactor Regulation, denied the Petitioners' request for emergency relief. The NRC staff concluded that the immediate suspension of the operating licenses for River Bend Station, Comanche Peak Unit 1, Shearon Harris, Fermi-2, Ginna, and Robinson was not warranted. The NRC staff also determined that a stop-work order or the suspension of the construction permit for Comanche Peak Unit 2 was not warranted and concluded that issuance of the generic letter would be in accordance with the NRC staff's action plan regarding the Thermo-Lag issue and that acceleration of the issuance of the generic letter was not deemed necessary.

On September 3, 1992, the Petitioners filed an "appeal" with the Commission in response to the NRC staff's denial of August 19, 1992, of the

request for emergency enforcement action. In the "appeal," Petitioners removed the Ginna and Robinson plants from their request and added Brunswick Units 1 and 2. Petitioners again alleged that Thermo-Lag is an inadequate fire barrier, that compensatory measures do not substitute for regulatory compliance, and that fire watches are inadequate substitutes for fire barriers.

In a letter dated November 9, 1992, from the Secretary of the Commission, the Petitioners were informed that their "appeal" request had been referred to the NRC staff for appropriate consideration in conjunction with its review of the Petition.

Upon consideration of the information set forth in the Petition,[2] I have determined that the Petitioners have not presented any information which would constitute a basis to

- issue a stop-work order suspending installation of Thermo-Lag in, or to suspend the construction permit for, Comanche Peak Unit 2
- immediately suspend the operating licenses for Comanche Peak Unit 1, Shearon Harris, Fermi-2, WNP-2, Brunswick Units 1 and 2, and River Bend Station
- have issued GL 92-XX before September 5, 1992

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[2]As hereafter referred to, the Petition includes the "appeal" request of September 3, 1992. On December 15, 1992, NIRS filed another petition pursuant to 10 CFR § 2.206 raising additional issues regarding Thermo-Lag fire barrier material. The December 15, 1992 NIRS petition will be considered as a supplement to the Petition submitted by NIRS and others on July 21, 1992. The issues raised in the December 15, 1992 submittal will be addressed in a Final Director's Decision to be issued within a reasonable time.

II. DISCUSSION

Background

Reports of problems regarding Thermo-Lag began to surface in the late 1980s when GSU at River Bend Station (sometimes referred to as River Bend or RBS) discovered cracks and wear damage and declared the material inoperable as a fire barrier. It further discovered a Thermo-Lag panel from which stress skin had been removed during installation, and, on further investigation, discovered that this condition was common for 3-hour Thermo-Lag fire barriers installed in the fuel building. GSU received assurances from Thermal Science, Inc. (TSI), the vendor, that Thermo-Lag would function adequately without stress skin. However, GSU conducted joint tests with TSI to determine if a panel without stress skin would perform its fire barrier function. The barrier failed to meet the test acceptance criteria. On the basis of these test results, GSU established fire watches for all 3-hour Thermo-Lag fire barriers installed at RSB.

In March 1989, GSU discovered stress skin missing from some 1-hour barriers; at the same time, TSI completed a series of tests on upgraded configurations. Some of the upgraded configurations passed; however, differences existed between the tested configurations and the installations at River Bend. As a result, GSU contracted with Southwest Research Institute (SwRI) to conduct an independent test of a 30-inch cable tray in October 1989. The test report shows that the tray failed on temperature rise within 60 minutes and collapsed in less than 90 minutes. The failure of this test raised concerns regarding the adequacy of Thermo-Lag cable tray enclosures.

Gulf State Utilities categorized all 1-hour and 3-hour barriers as indeterminate and implemented compensatory measures in the form of fire watches pursuant to RBS Technical Specification 3.7.7.a.

In February 1991, the NRC staff received allegations that Thermo-Lag did not provide protection for electrical cables as claimed by TSI. In response, in May 1991, the NRC staff visited River Bend Station to review the installation procedures and fire endurance test results and concluded that a generic concern existed with 30-inch-wide trays.

In June 1991, the NRC Office of Nuclear Reactor Regulation established a Special Review Team to investigate the safety significance and generic applicability of technical issues regarding allegations and operating experience concerning Thermo-Lag fire barriers at the River Bend Station. The results of fire test failures and installation problems were discussed in Information Notices (INs) 91-47, "Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test," and 91-79, "Deficiencies in Procedures for Installing Thermo-Lag Fire Barrier Materials." In the "Final Report of the Special Review Team for the Review of Thermo-Lag Fire Barrier Performance," which was an attachment to IN 92-46, "Thermo-Lag Fire Barrier Material Special Review Team Final Report Findings, Current Fire Endurance Testing, and Ampacity Calculation Errors," the Special Review Team reached the following conclusions:

- The fire-resistive ratings and the ampacity derating factors for the Thermo-Lag fire barrier system are indeterminate.
- Some licensees have not adequately reviewed and evaluated the fire endurance test results and the ampacity derating test results used as the licensing basis for their Thermo-Lag barriers to determine the validity

of the tests and the applicability of the test results to their plant designs.

- Some licensees have not adequately reviewed the Thermo-Lag fire barriers installed in their plants to ensure that they meet NRC fire protection requirements and guidance such as that provided in GL 86-10, "Implementation of Fire Protection Requirements" (April 24, 1986).
- Some licensees used inadequate or incomplete installation procedures during the construction of their Thermo-Lag barriers.

The NRC staff has provided additional information regarding Thermo-Lag in IN 92-55, "Current Fire Endurance Test Results for Thermo-Lag Fire Barrier Material"; Bulletin 92-01, "Failure of Thermo-Lag 330 Fire Barrier System to Maintain Cabling in Wide Cable Trays and Small Conduits Free from Fire Damage"; Bulletin 92-01, Supplement 1, "Failure of Thermo-Lag 330 Fire Barrier System to Perform its Specified Fire Endurance Function"; and IN 92-82, "Results of Thermo-Lag 330-1 Combustibility Testing."[3]

The NRC staff has prepared an action plan that provides a process to resolve the technical issues identified with Thermo-Lag fire barrier systems. The action plan requires industry to address these issues. The Nuclear Management and Resources Council (NUMARC) has agreed to coordinate industry efforts which include testing. The action plan also provides for issuing inspection guidance to the NRC regional offices and conducting a testing program to determine fire endurance performance and cable ampacity derating.

The NRC's defense-in-depth fire protection concept relies on protecting safe shutdown functions by achieving a balance in (1) fire prevention

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[3]The Special Review Team Final Report, INs, and bulletins are available for public inspection at the NRC's Public Document Room and Local Public Document Rooms.

activities; (2) the ability to rapidly detect, control, and suppress a fire; and (3) physical separation of redundant safe shutdown functions. Weaknesses in one area may be dealt with by enhancing the protection capabilities of the remaining areas.[4] The NRC foresaw cases in which fire protection features would be inoperable and required licensees, through technical specifications or approved fire protection plans made legally binding by license conditions, to provide compensatory measures for the deficient condition.

Recent fire endurance testing described in Bulletin 92-01 and Bulletin 92-01, Supplement 1, confirmed that certain Thermo-Lag fire barrier configurations compromise one facet of the fire protection defense-in-depth.[5] The affected licensees have established either continuous or periodic fire watches in accordance with their technical specifications or license conditions as a compensatory measure. Fire watches are personnel trained and dedicated by the licensees to inspect for the control of ignition sources and combustible materials, to look for signs of incipient fires, to provide prompt notifications of fire hazards and fires, and to take actions to begin fire suppression activities.

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[4]The defense-in-depth concept is detailed in NRC Standard Review Plan, NUREG-0800, Section 9.5.1, Fire Protection Program, Page 9.5.1-10. *See In re Petition for Emergency and Remedial Action*, CLI-78-6, 7 NRC 400, 421 (1978).

[5]The Petitioners stated strong objection to the notion that any test results of fire barriers be considered "proprietary." The Petitioners requested that the NRC staff release the full test results of all fire barrier material tests. All fire endurance test reports submitted to the NRC as part of a particular plant's licensing basis are available in the Public Document Room (PDR). The NRC is taking steps to place all other documentation regarding fire barrier tests results which are not exempt from disclosure in the PDR. *See* 10 CFR § 9.17(a)(4).

Issues

The Petitioners generally assert that River Bend Station is in violation of NRC regulations because repeated testing of Thermo-Lag in various configurations has "conclusively" demonstrated that this material at RBS does not meet the requirements of 10 CFR § 50.48 and Appendices A and R of 10 CFR Part 50. They further allege that the "clear and present danger" occurring as a result of GSU's failure to meet essential NRC safety regulations requires a suspension of the license until GSU removes and replaces its Thermo-Lag with a new fire barrier that can meet the NRC's requirements.

The Petitioners also assert that since Shearon Harris, Fermi-2, and WNP-2 use Thermo-Lag and there is no independent testing that would demonstrate that Thermo-Lag installations at those facilities meet NRC fire protection requirements, the NRC cannot make a finding that these plants are in compliance with NRC regulations. According to the Petitioners, these plants are "seriously out of compliance with regulations and present a clear hazard to the public's health and safety."[6]

Specific issues raised by the Petitioners are summarized below, together with the NRC staff's evaluation.

A. Regulatory Compliance

The Petitioners have alleged that the River Bend facility fails to comply with the "NRC's requirements for fire protection," and that all of the reactors named by the Petitioners are in "direct violation of NRC regulations, and pose an immediate threat to the health and safety of citizens living near

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[6]Addendum (August 12, 1992) at 5-6.

these plants."[7] The Petitioners have cited two Atomic Energy Commission Appeal Board decisions in support of the proposition that "[c]ompliance with NRC safety regulations is a prerequisite to safe operation of a nuclear power plant."[8] The basis of the Petitioners' charges is that Thermo-Lag fire barriers, which have been installed in the plants identified by the Petitioners, have failed various performance tests, and thus do not meet the one hour or three hour fire endurance rating criteria contained in Section III.G. of Appendix R to 10 C.F.R. Part 50 of the Commission's regulations. The failure to meet the Appendix R criteria, according to the Petitioners, constitutes a failure to satisfy Appendix A to 10 C.F.R. Part 50 (General Design Criteria for Nuclear Power Plants), and in turn 10 C.F.R. § 50.48 (Fire Protection). As will be discussed in greater detail later in this decision, the NRC staff acknowledges that certain tests have demonstrated that Thermo-Lag barriers may not meet the fire endurance rating criteria set forth in Section III.G. of Appendix R. This does not mean, however, that there no longer is reasonable assurance of adequate protection of the public health and safety.

It should first be noted that Appendix R, which sets forth criteria for specific fire protection features to protect safe shutdown systems, is applicable only to facilities that commenced operation prior to 1979. Such plants would include Brunswick Units 1 and 2 identified by the Petitioners. Facilities commencing operation on or after January 1, 1979, while not bound by Appendix R, generally are bound by requirements that follow the criteria

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[7] *See* Petition (July 21, 1992) at 15; Appeal (Sept. 3, 1992) at 3.

[8] *See* Petition (July 21, 1992) at 16.

set forth in Appendix R through license conditions.[9] The facilities identified by the Petitioners, other than Brunswick Units 1 and 2, are in this category. Accordingly, to the extent that the Petitioners have relied upon "violations" of Appendix R as a basis to conclude the plants they have identified are unsafe, their reliance is misplaced at the outset regarding plants other than the Brunswick Units since facilities that commenced operation prior to 1979 are the only ones that are directly required to comply with, and thus may violate, Appendix R.

Even assuming, *arguendo*, that all of the plants identified by the Petitioners are not in compliance with Appendix R, it does not follow that the failure to comply with a regulation indicates the absence of adequate protection.[10] The Commission has explained that:

> [W]hile it is true that compliance with all NRC regulations provides reasonable assurance of adequate protection of the public health and safety, the converse is not correct, that failure to comply with one regulation or another is an indication of the absence of adequate protection, at least in a situation where the Commission has reviewed the noncompliance and found that it does not pose an "undue risk" to the public health and safety.

Ohio Citizens for Responsible Energy, Inc.; Denial of Petition for Rulemaking. 53 Fed. Reg. 41180 (1988).

The Petitioners have noted an Appeal Board statement that "once a regulation is adopted, the standards it embodies represent the Commission's

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[9]In addition, there are a very limited number of plants, which commenced operation on or after January 1, 1979, that are not subject to specific license conditions but have made commitments to comply with NRC fire protection requirements, including Section III.G. of Appendix R. The NRC is in the process of elevating such commitments to license conditions.

[10]Perhaps the clearest illustration of this point is when an exemption has been granted pursuant to 10 C.F.R. § 50.12. In such cases, although compliance with a particular regulation is no longer required, there is still no undue risk to the public health and safety. *See* 10 C.F.R. § 50.12(a)(1).

definition of what is required to protect the public health and safety." Petition at 16, quoting *Vermont Yankee Nuclear Power Corp.* (Vermont Yankee Nuclear Power Station), ALAB-138, 6 AEC 520, 528 (1973). More recently, however, the Commission made it clear that its "rules do not, strictly speaking, 'define' adequate protection, . . . they only presumptively assure it." 53 Fed. Reg. 41180 (1988). The Petitioners further refer to the *Maine Yankee*[11] Appeal Board decision in support of the proposition that compliance with NRC regulations is a "prerequisite to safe operation of a nuclear power plant." Petition at 16. However, at issue in *Maine Yankee* was not a purported *failure* to comply with a regulation, but rather whether the Licensing Board below could find adequate protection of the public health and safety on the basis of demonstrated compliance with regulations, notwithstanding "residual risks" stipulated to by the parties. The issue raised here by the Petitioners -- whether a finding of inadequate protection is compelled by reason of demonstrated noncompliance with a regulation -- is the converse to the *Maine Yankee* issue; thus, consistent with the Commission's views set out above, *Maine Yankee* is not precedent for the Petitioners' position that failure to comply with Appendix R means plants are necessarily unsafe.

All of the plants identified by the Petitioners have instituted fire watches as required by their action statements regarding inoperable barriers contained in their technical specification or fire protection programs

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[11] *Maine Yankee Atomic Power Co.* (Maine Yankee Atomic Power Station), ALAB-161, 6 AEC 1003 (1973).

subject to license conditions.[12] Generally, action statements provide alternative remedial actions to shutting down a plant when limiting conditions for operations are not met.[13] Compliance with the required remedial actions provides reasonable assurance that the public health and safety is adequately protected notwithstanding the plant's continued operation and failure to meet the respective limiting condition for operation. Here, since all of the identified plants have implemented the required fire watches in accordance

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[12]The Petitioners' assertion that River Bend Station fails to comply with the "Commission's requirements" for fire protection may not be accurate if the Petitioners' use of the term "requirements" is not strictly limited to regulations, given River Bend Station's compliance with the required remedial action measures contained in its technical specifications.

[13]*See generally* 10 C.F.R. § 50.36(c)(2), which in relevant part provides that:

> *Limiting conditions for operation.* Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met.

For example, in the River Bend Unit 1 technical specifications regarding fire-rated assemblies, the Limiting Condition for Operation provisions state:

> LIMITING CONDITION FOR OPERATION
> 3.7.7 All fire barrier assemblies shall be operable. * * *
>
> ACTION:
>
> a. With one or more of the above required fire-rated assemblies or sealing devices inoperable, within 1 hour establish a continuous fire watch on at least one side of the affected assembly and/or sealing device or verify the OPERABILITY of fire detectors on a least one side of the inoperable assembly or sealing device, and establish an hourly fire watch patrol.

Remedial actions may also be specified in a plant's approved fire protection program subject to a license condition.

with plant-specific requirements, their continued operation does not pose an undue risk to the public health and safety.

The Petitioners have asserted that fire watches are "acceptable only as a temporary measure while the plants are shut down to replace Thermo-Lag,"[14] that the Staff response of August 19, 1992, "gives no indication that these compensatory measures will be temporary," and that fire watches are essentially "indefinite generic exemption[s] . . . [without a] legal basis."[15] In general, provisions for remedial action may include time limits by which the relevant limiting condition must be restored. Here, however, fire watches without specified time limits are judged by the NRC to be acceptable compensatory measures adequate to protect the public health and safety. They have not been determined to be permanent measures; thus, fire watches are not "generic exemptions" without a legal basis,[16] as asserted by the Petitioners, but in fact are legally sanctioned remedial actions based on 10 C.F.R. § 50.36(c)(2).[17]

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[14]Addendum (Aug. 12, 1992) at 6.

[15]Appeal (Sept. 3, 1992) at 5.

[16]Even accepting *arguendo* the Petitioners' characterization, in each case where there has been approval of technical specifications or license conditions permitting fire watches without specified time limits, the NRC, when licensing the affected facilities, made mandated findings relating to adequate protection of the public health and safety required under the Atomic Energy Act. Even if the procedural steps set forth by 10 C.F.R. § 50.12 required to grant an exemption may not have been followed in each case, that does not undermine the ultimate conclusion that there is adequate protection of the public health and safety when a fire watch is implemented.

[17]In instances where fire protection programs have been moved from technical specifications and are now subject to license conditions, the NRC's approval of the fire protection programs subject to license conditions provides the legal basis for the implementation of fire watches as a remedial measure.

In sum, notwithstanding the failure to have operable fire barriers meeting the fire endurance rating criteria specified by Section III.G. of Appendix R, a plant is not necessarily unsafe to continue operation. To the contrary, fire watches, as will be discussed in greater detail below in response to the particular concerns raised by the Petitioners, are judged by the NRC to be adequate remedial measures that provide reasonable assurance that the public health and safety is protected. By reason of full compliance by River Bend and all other facilities named by the Petitioners with their technical specifications or fire protection program action statements requiring the implementation of fire watches, adequate protection of the public health and safety is still reasonably assured for such plants. No significant health or safety issue has thus been raised. Because the Commission has discretion regarding enforcement of its regulations, and given the circumstances here where no significant health and safety issues have been raised, enforcement action of the nature requested by the Petitioners is not warranted.

B. Sufficiency of Compensatory Measures Contained in License Conditions or Technical Specifications

The central argument in the Petitioners' allegations is that the measures taken by licensees to compensate for degraded barrier conditions, specifically fire watches, are not adequate to protect the public health and safety. The Petitioners' concerns may be broadly categorized as follows:

- the performance of assigned functions by fire watch personnel
- the ability of fire watches to compensate for a degraded barrier, even assuming full performance

(a) Performance by Fire Watches of Their Assigned Functions

(i) Falsification of Records

The Petitioners have alleged that, whatever a fire watch is intended to do, the watches are not always being performed. In support of this assertion, Petitioners claim that there is adequate documentation that utility personnel have not always taken fire watches seriously and have falsified records attesting that fire watches have been undertaken when such was not the case.

The NRC considers falsification of records and inattentiveness serious offenses which could subject licensees to enforcement sanctions. In addition, the NRC staff conducts periodic inspections that are effective in identifying specific instances of inattentiveness or falsifications. In those few cases where deficiencies have been identified in the performance of fire watches, appropriate enforcement action has been taken. For example, Texas Utilities Electric Company has paid a fine of $50,000.00 for missed fire watches and falsified fire watch records at Comanche Peak (EA-91-015). Such an enforcement action serves as an example to the nuclear industry that fire watches serve an important function and must be adequately performed. Isolated instances of nonperformance do not indicate that, in general, fire watches are not being performed adequately.

Licensee responses to NRC Bulletin 92-01 and Bulletin 92-01, Supplement 1, indicate that appropriate fire watches have been implemented. While there is no absolute guarantee that every stated fire watch is in fact being performed, absent substantial evidence that instances of nonperformance are not isolated, and given enforcement sanctions and the measure of assurance they provide, the NRC staff concludes there is reasonable assurance that fire

watches, as required by technical specifications or license conditions, are being performed.

(ii) Toxicity of Thermo-Lag

The Petitioners have alleged that, based on the results of tests conducted by SwRI, Thermo-Lag has been shown to emit extremely high amounts of hydrogen cyanide gas when exposed to fire. They assert that fire watch personnel could discover a fire and be overcome or otherwise harmed by the toxic gases rendering them unable to perform their functions.

The test report referenced by the Petitioners has been reviewed and evaluated by the NRC staff. Questions concerning the toxicity of Thermo-Lag, in part raised by the SwRI test report, prompted the NRC staff to conduct an independent toxicological evaluation of the combustion products of Thermo-Lag fire barrier material. The NRC, in conjunction with the National Institute of Standards and Technology (NIST), determined that the products of combustion do not include high amounts of hydrogen cyanide and are comparable in toxicity to the burning of Douglas Fir lumber. The thermal decomposition of Thermo-Lag under actual fire conditions does not increase the toxicity of the expected fire gases being produced as a result of a fire that burns other typical in-plant combustibles. The toxicity levels evaluated did not suggest that precautions above and beyond those that would normally be taken during an in-plant fire should be considered. Thus, the staff has concluded that fire watch personnel can perform their function of finding incipient fires and notifying appropriate response personnel without sacrificing personal safety.

(b) Ability of Fire Watches to Compensate for a Degraded Barrier

(i) Thermo-Lag Deficiencies

The Petitioners have alleged a number of deficiencies concerning Thermo-Lag material, including failure of the barriers during 1-hour and 3-hour fire endurance tests, failure of the barrier to pass a hose stream test, lack of seismic tests and inability of the material to survive a seismic event, and combustibility of the material. The Petitioners have also alleged that the material has been improperly installed and failed to meet NRC quality assurance requirements and qualification tests, which contribute further to the poor performance of Thermo-Lag.

The NRC staff acknowledges and has stated that certain Thermo-Lag fire barrier configurations have failed to demonstrate the ability to perform their fire resistance functions. In this regard, the NRC staff, in Bulletin 92-01, Supplement 1, has stated that Thermo-Lag fire barriers should be treated as inoperable until licensees can declare the fire barriers operable on the basis of successful, applicable tests. The NRC staff also has recognized that Thermo-Lag barriers have failed hose stream tests. A failure of a fire barrier to pass a hose stream test in and of itself does not imply a probability of short circuits because the cable insulation is designed to protect the cable from a short if the cable becomes wet. However, cables may be damaged by the thermal effects of the fire if the barrier fails as a result of a hose stream, and thus would be more likely to short.[18]

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[18]Recognizing this, the NRC staff will require the successful completion of a hose stream test in fire barrier qualification.

The NRC staff also recognizes that Thermo-Lag is combustible[19] as shown by the results of the American Society for Testing and Materials (ASTM) E-136 tests conducted for the NRC.[20]

In addition, the NRC staff has concluded that Thermo-Lag may crack or crumble into small fragments during a seismic event.[21]

Given the forgoing deficiencies identified for Thermo-Lag, the NRC staff agrees that compensatory measures are necessary until a licensee can declare fire barriers operable on the basis of applicable tests which demonstrate successful barrier performance.

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[19]The Petitioners have stated that "Appendix A and Appendix R both refer specifically to a requirement for non-combustible materials for fire barriers. Appeal at 10. While Appendix A expressly states only that "[n]oncombustible and heat resistant materials shall be used wherever practical..." combustibility is still an issue that warrants consideration.

[20]Under this testing standard, the material is considered to be "combustible" if three out of four samples tested exceed the following criteria: (1) the recorded temperature of the specimen's surface and interior thermocouples, during the test, rises 54°F (30°C) above the initial furnace temperature; (2) there is flaming from the specimen after the first 30 seconds of irradiance; and (3) the weight loss of the specimen, due to combustion during the testing, exceeds 50 percent. Of the four Thermo-Lag specimens tested, all experienced a weight loss of greater than 50 percent and flaming continued in excess of 30 seconds.

In Information Notice 92-82, "Results of Thermo-Lag 330-1 Combustibility Testing," issued December 15, 1992, licensees were provided with the results of the NRC tests and were asked to review the information for applicability to their facility where Thermo-Lag may be used to enclose intervening combustibles and for constructing radiant energy heat shields inside containment.

[21]The particular seismic issue raised by the Petitioners, that, during a seismic event, Thermo-Lag could shatter cable trays and shear cables used for safe shutdown systems, is addressed in Section C below.

(ii) Adequacy of Fire Watches

The Petitioners have questioned the effectiveness of fire watches in providing adequate protection since tests have shown that Thermo-Lag can fail in a shorter time than a 1-hour roving or periodic fire watch could detect, and a 1-hour periodic watch does not provide continuous fire detection capability. In addition, the Petitioners claim that a fire watch is an additional way to detect a fire while a fire barrier is a mode of physically protecting a reactor against fire. Therefore, a fire watch duplicates fire detection but does not provide a barrier or shield capability that has been lost through the degradation of a barrier. Further, the Petitioners argue that the fire watch was intended as a short-term, stop-gap measure, not as a final solution to the [Thermo-Lag] problem.

Despite the acknowledged shortcomings identified with Thermo-Lag fire barriers and after fully considering the arguments presented by the Petitioners regarding the ability of fire watches to provide adequate compensation, the NRC staff has determined that the fire watch compensatory measures are adequate and acceptable to ensure public health and safety.

The use of fire watches in instances of degraded or inoperable barriers is an integral part of NRC-approved fire protection programs. These NRC staff-approved compensatory measures require the establishment of a continuous fire watch or an hourly fire watch if automatic detection systems protecting the affected components have been verified. While it is true that Thermo-Lag is intended as a barrier and fire watch personnel cannot act as physical shields, a fire watch provides more than simply a detection function. Personnel assigned to fire watches are trained by the licensee to inspect for the control of ignition sources and combustible materials, to look for signs

of incipient fires, to provide prompt notifications of fire hazards and fires, and to take appropriate actions to begin fire suppression activities. Fire watch personnel are capable of determining the size, actual location, source, and type of fire--valuable information that cannot be provided by an automatic fire detection system.

During a plant fire, temperatures are likely to be much less severe at the early stages. On the basis of enhanced capabilities provided by fire watches and notwithstanding that the level of barrier-type protection may be reduced, the NRC staff has determined that there is a margin of safety to ensure adequate protection in cases where fire watches were approved.[22]

Finally, the Petitioners argue that fire watches were intended as a short-term compensatory measure and not as a final solution. The NRC staff agrees that fire watches are not a final solution. The NRC staff's action plan is directed towards restoring the functional capability of fire barriers on an expedited basis. It is true that there has never been a time limit associated with the use of fire watches as a compensatory measure.[23] Given the significant margin of safety a fire watch brings to a fire protection program, as discussed above, the NRC staff has determined that fire watches without specified time limits may serve as a compensatory measure while barriers are inoperable, and has issued technical specifications and license conditions for all operating nuclear power plants specified by the Petitioners

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[22]In specific cases, the NRC staff may have granted exemptions to Appendix R requirements partially on the basis of the ability of a fire barrier to perform its function. In cases where the barrier is now treated as inoperable, the licensee must implement a continuous or hourly fire watch, as appropriate, to compensate for the inoperable barrier.

[23]*See supra* text accompanying notes 14-17.

that permit fire watches without specified time limits. This does not alter, however, the NRC staff's position that fire watches are not a final solution.

The NRC staff has carefully evaluated the use of fire watches to compensate for any degradation in the effectiveness of required fire barriers, and has concluded that fire watches continue to assure adequate protection of the public health and safety. Therefore, the Petitioners' assertion that the use of Thermo-Lag insulation at nuclear power facilities warrants immediate shutdown of these facilities is without merit.

C. Seismic Issues

The Petitioners have alleged that Thermo-Lag, as a heavy cementitious preformed plate, can break up during a seismic event, act as a shear severing cables, and shatter cable trays necessary for safe shutdown. Moreover, according to the Petitioners, if a seismic event should occur and the product shatters the cable tray, safe shutdown is further jeopardized by fire incidence.

In defining the term "safe shutdown earthquake" (SSE) in Section III(c) of Appendix A to 10 CFR Part 100, the regulation requires certain structures, systems, and components to remain functional under the postulated SSE. These structures are required to be designed to withstand the effects of the postulated SSE with adequate margins of safety against their functional failure (e.g., large deformations). The margin of safety against shattering of the tray is substantially larger than margins against deformations.

To the NRC staff's knowledge, TSI has not performed seismic tests of prefabricated panels. However, Dr. Philip L. Gould, Professor of Civil Engineering, Washington University, St. Louis, Missouri, as an independent consultant to TSI, has performed a seismic analysis of Thermo-Lag material

attached to cable trays and conduit sections. The NRC staff reviewed the analysis[24] and observed the following:

- The analysis was performed on the most commonly used cable tray configurations and conduit sections with Thermo-Lag material attached in accordance with TSI's installation procedures.
- The bounding analysis was performed with the applied horizontal seismic acceleration of 7.5g combined with the vertical seismic acceleration of 5.0g.
- The maximum acceptable stresses in the material are limited to one-half the strengths of the material in tension, flexure, and shear.

The NRC staff believes the maximum amplified accelerations (MAAs) expected under the postulated SSEs in the plants east of the Rocky Mountains are considerably lower than those used in the analysis, and the MAAs expected in the west coast plants are in the same range or lower than the ones used in the analysis. It is the NRC staff's judgment after a thorough review of Dr. Gould's analysis, that preformed Thermo-Lag panels are not likely to get detached from cable trays or conduits during an SSE. The material, however, may crack or crumble into powdery material or small fragments under an SSE. This crumbling and cracking behavior would not damage safe shutdown systems. Recognizing the design requirements for the raceways and the above attributes of the material, the NRC staff concludes that shattering of raceways or severing of the cables required for safe shutdown under an SSE are not credible scenarios.

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[24]Philip L. Gould, "Stress Analysis of Thermo-Lag Subliming Compound Coating Applied to Electrical Power Trays and Conduit," performed for Thermal Science, Inc., in Technical Notes 41582 dated April 15, 1982, 12683 and 12983 dated January 12, 1983, and 12584 dated February 1984.

D. Ampacity Derating Errors

The Petitioners have essentially alleged that an error in ampacity derating could result in the use of inappropriate cables, which, if undersized, could prematurely age, or worse, overheat and ignite. The Petitioners noted that in NRC IN 92-46 the NRC staff reported that TSI made a calculation error on the ampacity derating factor for Thermo-Lag. The Petitioners have also asserted that TSI has not performed a qualified ampacity test to date and that the Underwriters Laboratory (UL) Report 86NK23826 (file no. R6802) has been cited as "indeterminate" by the NRC staff because assembly of the test fixture was not reviewed or witnessed by UL personnel.

Ampacity derating is the lowering (derating) of the current carrying capacity of cables enclosed in electrical raceways protected with fire barrier materials because of the insulating effect of the fire barrier material. This insulating effect limits the ability of the cable insulation to shed heat. If not accounted for, the increased cable insulation temperature could lead to premature insulation failure. Other factors also affect ampacity derating, including the extent of cable fill in the raceway, cable type, raceway construction, and ambient temperature. The National Electrical Code, Insulated Cable Engineers Association (ICEA) publications, and other industry standards provide ampacity derating factors for open air installations. These standards do not provide derating factors for fire barrier systems. Although a national standard test method has not been established, ampacity derating factors for raceways enclosed with fire barrier material are determined by testing for the specific installation configuration.

The manufacturer of Thermo-Lag has documented a wide range of ampacity derating factors that were determined by testing, for raceways enclosed with

fire barrier materials. On October 2, 1986, TSI informed its customers that, while conducting tests in September 1986 at UL, it found that the ampacity derating factors for Thermo-Lag barriers were greater than previous tests indicated. However, the cable fill and tray configuration were different for each test than those tested previously. In addition, the NRC staff learned that UL performed a duplicate cable tray test that resulted in an even higher derating factor. The NRC staff also learned of the determination of other derating factors during its review of other tests conducted at SwRI.[25]

The NRC Special Review Team concluded, as the Petitioners asserted, that ampacity test results thus far, including the UL test results, were indeterminate. This conclusion was based on observed inconsistencies in the derating test results of the various testing laboratories. There is no national consensus test standard (e.g., Institute of Electrical and Electronics Engineers [IEEE] or American National Standards Institute [ANSI]) for conducting these tests. In addition, some licensees have not adequately

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[25]The test procedures and test configurations differed among the testing laboratories. Therefore, the results from the different ampacity tests may not be directly comparable to each other.

The NRC staff is concerned that the ampacity derating factors, as determined in UL tests for Thermo-Lag barrier designs, are inconsistent with TSI results for similar designs because different times were allowed for the temperature to stabilize before taking current measurements. Inconsistent stabilization times would call into question the validity of previous TSI results. The NRC also noticed during the review of the Industrial Testing Laboratories (ITL) test reports that ambient temperature and maximum cable temperature were allowed to vary widely for some tests. Therefore, those tests in which the ambient and maximum cable temperatures were not maintained within specified limits may be questionable. Additionally, a licensee discovered a mathematical error for the ampacity derating factor published in an ITL test report. A preliminary assessment of the use of a lower-than-actual ampacity derating factor indicates that higher-than-rated cable temperatures are possible for Thermo-Lag installations. Higher-than-rated cable temperatures could accelerate the aging effects experienced by the cable.

reviewed ampacity derating test results to determine the validity of the tests and the applicability of those test results to their plant design. The Special Review Team recognized that, in hypothetical cases, nonconservative ampacity derating factors could have been instrumental in the installation of inappropriate cables, which as a result, could suffer premature cable jacket and cable insulation failures over a period of time. However, the NRC staff has determined that in practice the ampacity derating factor resulting from Thermo-Lag insulating properties represents only one of many variables used in determining the design ampacity for cable systems and that, as discussed below, sufficient margin exists in this area to preclude any immediate safety concerns.

For actual installations, various derating factors are typically applied to the ICEA ampacity values provided for each cable size. In general it can be expected that the cables typically used in actual installations have higher current carrying capacity than the ICEA ampacity values.[26] Also, cables are sized based on full-load current plus a 25-percent margin to account for starting current requirements of the load. Given the short duration of typical equipment starts, this margin is available to compensate for any errors in ampacity derating. Further, use of a cable size larger than normal may be required as a result of voltage drop considerations for long circuit lengths. In typical applications this also provides additional current carrying capacity. Given these conservatisms inherent in the design ampacity of cable systems and in addition the fact that most power cables required for safe shutdown are not normally energized, but are typically operated during

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[26]ICEA ampacity values include conservatisms to compensate for skin and proximity effects and shield and/or sheath losses which may or may not apply in specific situations.

surveillance testing for short time periods, the likelihood that cables could ignite as a result of Thermo-Lag ampacity derating errors has been judged by the NRC staff to unlikely. In addition, based on these conservatisms and the currently available information on existing plants, ampacity design and operating history, the NRC staff believes that the ampacity derating issue is not an immediate safety issue but rather is an aging issue to be resolved over the long term.[27]

E. Issuance of a Generic Letter

The Petitioners contend that even though the NRC staff has recognized the generic implications of the repeated test failures of Thermo-Lag material (see draft GL 92-XX, "Thermo-Lag 330-1 Fire Barriers," February 11, 1992), it has delayed issuing a generic letter, apparently because of industry pressure. The Petitioners state as an example that, on July 7, 1992, despite overwhelming evidence of the failures of Thermo-Lag to pass meaningful tests, the nuclear industry trade association NUMARC continued to badger the NRC staff to change its definition of Thermo-Lag from "inoperable" to "degraded." In addition, the Petitioners assert that NUMARC repeatedly balked at the idea of requiring utilities to test their Thermo-Lag installations.

The Petitioners' concern with regard to GL 92-XX ignores the fact that the NRC staff has issued a Bulletin and Supplement in 1992 dealing with the

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[27]On December 17, 1992, the NRC staff issued Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," which requires licensees to review the ampacity derating factors used for all raceways protected by Thermo-Lag 330-1 (for fire protection of safe shutdown capability or to achieve physical independence of electrical systems) and to determine whether the ampacity derating test results relied upon are correct and applicable to the plant design. The licensee's findings and any corrective actions and compensatory measures taken by licensees are to be identified in a written report to the NRC staff. Future actions being contemplated by the NRC staff include independent ampacity testing and an analysis of the industry testing program results.

Thermo-Lag issue. In NRC Bulletin 92-01 and its Supplement, issued on June 24, 1992 and August 28, 1992, respectively, the NRC staff informed licensees to consider certain Thermo-Lag barriers as inoperable and take compensatory actions. For licensees to consider these barriers operable in the future, analyses and/or testing will be in order. These actions on the part of the NRC staff accomplished much of what the NRC staff intended to accomplish with GL 92-XX. These actions indicate that the NRC staff has responded aggressively to the Thermo-Lag problem and has not succumbed to industry pressure.

The NRC staff has carefully evaluated the issues associated with using Thermo-Lag material in an action plan presented to and reviewed by the Commission. The action plan provided for the issuance of the generic letter according to a NRC staff-developed schedule. During an August 12, 1992, public meeting with NUMARC, the NRC staff stated that it had considered public comments it had received on the draft GL and that it had assigned a high priority to issuing the letter. As discussed herein, the NRC staff has determined that the Petitioners have not raised any immediate significant health or safety issues; thus, there was no need for the NRC staff to deviate from its established schedule for the issuance of GL 92-XX. On December 17, 1992, the NRC staff issued GL 92-08 in accordance with its action plan.

The Petitioners further allege that only the manufacturer of Thermo-Lag knows exactly which licensees have purchased and installed Thermo-Lag, and even this company may not know all the different configurations in which this material has been installed at these plants.

To the contrary, the NRC staff is aware of all plants that use Thermo-Lag. NRC Bulletin 92-01 and Supplement 1, required operating reactor licensees to identify areas of their plants that had Thermo-Lag installed and determine the plant areas that used this material for the protection and separation of safe shutdown capability. The NRC staff also required that this information be submitted to the staff within 30 days of receipt of the bulletin and supplement. The NRC staff's review of licensees' responses to Bulletin 92-01 shows that 83 operating plants have Thermo-Lag installed and 28 operating plants do not. In addition, all licensees with Thermo-Lag installed for protection of safe shutdown capability have reported that they have implemented compensatory measures consistent with their technical specifications or license conditions for an inoperable fire barrier.

F. Request for Stop-Work Order for Comanche Peak Unit 2

In their August 12, 1992, addendum to their initial Petition, the Petitioners requested that the NRC staff immediately issue a stop-work order to Texas Utilities regarding continued installation of Thermo-Lag at Comanche Peak Unit 2. This request was generally based on the Petitioners' conclusion that Thermo-Lag is "in violation of the NRC's fire protection regulations." In response, the NRC staff through its acknowledgment letter dated August 19, 1992, stated that it was not necessary to issue an order to stop continued installation of Thermo-Lag at Comanche Peak Unit 2 or to suspend the facility's construction permit because the licensee proceeded with construction at its own risk, and the NRC would ensure at the operating license stage that "issues related to Thermo-Lag at Comanche Peak Unit 2 are sufficiently resolved to ensure adequate protection of the public health and

safety."[28] The Petitioners in turn alleged in their "appeal" dated September 3, 1992, that to allow continued installation of Thermo-Lag is irresponsible, will result in unnecessary costs to ratepayers who will have to pay for replacement, and at worst will result in a "risk of meltdown caused by fire."[29]

As has been made abundantly clear by earlier discussion in this Decision, various deficiencies concerning Thermo-Lag have been acknowledged by both the NRC and licensees. Testing of the material in all configurations, however, has not been completed, leaving open the possibility that certain installations of Thermo-Lag may be found to be acceptable. One cannot say with certainty at this juncture that any and all installations of Thermo-Lag at Comanche Peak Unit 2 would still yield "a truly major deficiency" in adequate fire protection.[30] Further, as the Petitioners themselves recognize, Thermo-Lag and fire barriers in general may be removed, reinstalled, or replaced practically at any time during the construction or operating life of the plant. This is in sharp contrast to a situation where defects may not be curable or even subject to identification beyond a certain point in time during plant construction, or may adversely affect the construction activities of other plant components, thus perhaps warranting a stop-work order. For example, in *Consumers Power Co.* (Midland Plant, Units 1

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[28]Letter from T. Murley to M. Mariotte (Aug. 19, 1992) at 4.

[29]Appeal (Sept. 3, 1992) at 8.

[30]*See generally Philadelphia Electric Co.* (Limerick Generating Station, Units 1 and 2), DD-85-11, 22 NRC 149, 161 (1985) ("If a truly major deficiency or deficiencies on the part of a licensee are identified through the inspection process, or otherwise, the agency is authorized to issue a variety of orders, including stop-work orders, to assure appropriate remedial action.").

and 2), CLI-74-3, 7 AEC 7 (1974), where field inspectors had found serious deficiencies in cadwelding operations (a process for fusing together metal bars used in reinforced concrete construction), the successful completion of which is "a prerequisite for performance of further construction work on significant structures and components important to nuclear safety," *id.* at 11-12, the Commission upheld a show cause order that had immediately suspended cadwelding activity without prior written notice.

As indicated previously in the NRC staff's acknowledgment letter, "[a] licensee pursues construction work under a construction permit at its own risk pending approval of the final design of the plant." *Commonwealth Edison Co.* (Byron Station, Units 1 and 2), DD-81-5, 13 NRC 728, 731 (1981). Moreover, before the granting of an operating license for Comanche Peak Unit 2, Texas Utilities "will be required to do anything necessary to ensure safe operation of the plant." *Id.* Thus, to the extent that the Petitioners' fear that continued installation of Thermo-Lag at Comanche Peak Unit 2 will somehow result in an unreasonable "risk of a meltdown," such fear is unfounded given the NRC's statutory mandate to ensure safe operation before granting an operating license. Further, given that not all configurations of Thermo-Lag have been excluded from possibly being able to meet regulatory standards, it is not at all clear that continued installation will result in "unnecessary costs to ratepayers." Accordingly, a stop-work order, as requested by the Petitioners, is not warranted in this instance.

III. CONCLUSION

The Petitioners request that the NRC order the immediate suspension of the operating license of River Bend, Shearon Harris, Fermi-2, WNP-2,

Brunswick 1 and 2, and Comanche Peak 1. In addition, the Petitioners ask that a stop-work order or, if necessary, an order suspending the construction permit be issued for Comanche Peak Unit 2. The Petitioners ask that these orders be in place until a tested and effective fire barrier, in accordance with Appendices A and R to 10 CFR Part 50, is installed. The Petitioners also request that the NRC staff immediately issue a generic letter (GL 92-XX dated February 11, 1992).

On December 17, 1992, the NRC staff issued GL 92-08, "Thermo-Lag 330-1 Fire Barriers." To the extent Petitioners sought the issuance of the Generic Letter, this relief is granted. With regard to the other requests made by the Petitioners, the institution of proceedings pursuant to 10 CFR § 2.202 to shut down certain facilities using Thermo-Lag fire barrier material and to issue a stop-work order regarding continued installations of Thermo-Lag material at Comanche Peak Unit 2, as requested by Petitioners, is appropriate only where substantial health and safety issues have been raised. *See Consolidated Edison Company of New York* (Indian Point, Units 1, 2, and 3), CLI-75-8, 2 NRC 173, 175 (1975), and *Washington Public Power Supply System* (WPPSS Nuclear Project No. 2), DD-84-7, 19 NRC 899, 923 (1984). For the reasons discussed above, I find no basis for taking such actions. Rather, on the basis of the review efforts by the NRC staff, I conclude that no substantial health and safety issues have been raised by the Petitioners. Accordingly, the Petitioners' remaining requests for action pursuant to 10 CFR § 2.206 are denied.

A copy of this Decision will be placed in the Commission's Public Document Room, Gelman Building, 2120 L Street, N.W., Washington, D.C. 20555, and at the Local Public Document Room for the named facilities.

A copy of this Decision will also be filed with the Secretary for the Commission's review as provided in 10 CFR § 2.206(c) of the Commission's regulations.

FOR THE NUCLEAR REGULATORY COMMISSION

Thomas E. Murley

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

Dated at Rockville, Maryland
this 1st day of February 1993

UNITED STATES NUCLEAR REGULATORY COMMISSION

ISSUANCE OF PARTIAL DIRECTOR'S DECISION UNDER 10 CFR 2.206

Notice is hereby given that the Director, Office of Nuclear Reactor Regulation (NRR), has issued a Partial Director's Decision concerning a petition dated July 21, 1992, supplemented by an addendum dated August 12, 1992, and an "appeal" request dated September 3, 1992, filed by the Nuclear Information and Resource Service, et al. (Petitioners). The Petitioners requested NRC enforcement action against Gulf States Utilities' (GSU) River Bend Station, demanding that the operating license be suspended until the licensee can demonstrate, through independent testing, that it meets NRC's fire protection regulations (Appendix R to 10 CFR Part 50). In addition, the Petitioners demanded that the NRC staff immediately issue Generic Letter (GL) 92-XX, draft issued February 11, 1992, and close any nuclear power plant for which the licensee cannot prove, through independent testing, that it meets fire protection regulations until it does meet them. The addendum of August 12, 1992, requested immediate action related to the Comanche Peak Unit 1, Shearon Harris, Fermi-2, Ginna, WNP-2, and Robinson nuclear facilities, and requested the suspension of the construction permit for Comanche Peak Unit 2. The Petitioners' "appeal" dated September 3, 1992, of the initial staff denial of the requested relief removed Ginna and Robinson from the Petitioners' request for enforcement action and added Brunswick Units 1 and 2.

By letter dated August 19, 1992, the Petitioners were informed that the request for emergency relief was denied and appropriate action would be taken on the specific issues they raised. By letter dated November 9, 1992, the

Petitioners were further informed by the Secretary of the Commission that the "appeal" had been referred to the Director, NRR, for appropriate consideration in conjunction with review of the issues raised in the petition and addendum.

The petition, addendum and "appeal" were considered under the provisions of 10 CFR § 2.206 of the NRC's regulations. Notice of receipt of the petition dated July 21, 1992, and addendum dated August 12, 1992, was published in the Federal Register on August 26, 1992 (57 FR 38702).

The Petitioners alleged a number of deficiencies concerning Thermo-Lag material including failure of Thermo-Lag fire barrier during 1-hour and 3-hour fire endurance tests, deficiencies in procedures for installation, nonconformance with NRC regulations, the combustibility of the material, ampacity miscalculations, the lack of seismic tests, the failure to pass hose stream tests, the high toxicity of substances emitted from the ignited material, and the declaration by at least one utility (GSU) of the material as inoperable at its River Bend Station. The Petitioners also alleged that a fire watch cannot substitute for an effective fire barrier indefinitely and that the NRC staff has not adequately analyzed the use of fire watches.

On December 17, 1992, the NRC staff issued Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers." To the extent that Petitioners sought issuance of Generic Letter 92-XX, this relief is granted.

The Director has determined that the Petitioners' remaining requests should be denied for the reasons set forth in the "Partial Director's Decision Pursuant to 10 CFR § 2.206" (DD-93-03), which is available for inspection and copying in the Commission's Public Document Room, 2120 L Street, N.W., Washington, D.C. 20555 and at the Local Public Document Rooms for Comanche Peak, Shearon Harris, Fermi-2, Brunswick, River Bend, and WNP-2.

On December 15, 1992, the Nuclear Information and Resource Service (NIRS) filed another Petition pursuant to 10 CFR § 2.206 raising additional issues regarding Thermo-Lag fire barrier material. The December 15, 1992 NIRS Petition will be considered as a supplement to the Petition submitted by NIRS and others on July 21, 1992. The issues raised in the December 15, 1992 submittal will be addressed in a Final Director's Decision to be issued within a reasonable time.

A copy of the Decision will be filed with the Secretary for Commission review in accordance with 10 CFR § 2.206(c). The Decision will become the final action of the Commission 25 days after issuance unless the Commission, on its own motion, institutes a review of the Decision within that time.

FOR THE NUCLEAR REGULATORY COMMISSION

Thomas E. Murley

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

Dated at Rockville, Maryland
this 1st day of February 1993

OMB No.: 3150-0012
NRCB 92-01

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

June 24, 1992

NRC BULLETIN NO. 92-01: FAILURE OF THERMO-LAG 330 FIRE BARRIER SYSTEM TO MAINTAIN CABLING IN WIDE CABLE TRAYS AND SMALL CONDUITS FREE FROM FIRE DAMAGE

Addressees

For Action:

All holders of operating licenses for nuclear power reactors.

For Information:

All holders of construction permits for nuclear power reactors.

Purpose

This bulletin notifies you of failures in fire endurance testing associated with the Thermo-Lag 330 fire barrier system that is installed to protect safe shutdown capability, requests all operating reactor licensees to take the recommended actions, and requires that these licensees provide the U.S. Nuclear Regulatory Commission (NRC) with a written response describing the actions taken associated with this bulletin.

Background

On August 6, 1991, the NRC issued Information Notice (IN) 91-47, "Failure of Thermo-Lag Fire Barrier Material To Pass Fire Endurance Test," which provided information on the fire endurance tests performed by the Gulf States Utilities Company on Thermo-Lag 330 fire barrier systems installed on wide aluminum cable trays and the associated failures. On December 6, 1991, the NRC issued Information Notice 91-79, "Deficiencies In The Procedures For Installing Thermo-Lag Fire Barrier Material," which provided information on deficiencies in procedures that the vendor (Thermal Science, Inc.) provided for installing Thermo-Lag 330 fire barrier material. As a result of on-going concerns associated with the indeterminate qualifications of Thermo-Lag 330 fire barrier installations, on June 23, 1992, the NRC issued Information Notice 92-46, "Thermo-Lag Fire Barrier Material Special Review Team Final Report Findings, Current Fire Endurance Testing, and Ampacity Calculation Errors."

Description of Circumstances

Upon reviewing INs 91-47 and 91-79, Texas Utilities (TU) Electric instituted a fire endurance testing program to qualify its Thermo-Lag 330 electrical

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raceway fire barrier systems for its Comanche Peak Steam Electric Station. The testing was performed during the weeks of June 15 and June 22, 1992.

TU Electric's test program consisted of a series of 1-hour fire endurance tests (using the ASTM-E119 Standard Time Temperature Curve) on a variety of cable tray and conduit "mock-ups." TU Electric designed these "mock-ups" or test articles to duplicate existing installed plant configurations. Plant personnel used stock material to construct the test articles. The Thermo-Lag fire barrier installation on the test articles was performed in accordance with TU Electric's Thermo-Lag installation procedures. These procedures were developed from the vendor's recommended installation procedures.

The Thermo-Lag fire barrier systems for the TU Electric test articles were constructed using pre-formed 1-hour Thermo-Lag 330 panels and conduit shapes. The joints and seams were constructed by pre-buttering seams and joints with trowel grade Thermo-Lag 330-1 and holding the assembly together with stainless steel banding.

On June 17, 1992, the first test article was tested. This article consisted of a junction box with a 3/4-, 1-, and 5-inch conduit entering and exiting through the junction box. Throughout the 1-hour fire endurance test, the cabling routed inside the conduits was monitored in accordance with the American Nuclear Insurer's criteria for low voltage circuit integrity and continuity. Throughout the test, none of the cables experienced a failure in circuit integrity. The licensee noted that the thermocouple temperature on the inside cover of the junction box on the unexposed side reached 539 °F and that hot spots (temperatures on the cable in excess of 500 °F) on the 3/4-inch conduit and the 1-inch conduit developed. On June 18, 1992, the cables were pulled from the test article. There were no visible signs of thermal degradation on the cables routed in the 5-inch conduit. The cable inside the 3/4-inch conduit was thermally damaged in two locations and cable in the 1-inch conduit was damaged in one location.

On June 18, 1992, TU Electric performed a 1-hour fire endurance test on a 12-inch wide tray configuration. Preliminary test result information indicated that the configuration passed the test satisfactorily. Throughout the fire endurance test, the thermocouple temperatures on the cables inside the test article were less than 325 °F.

On June 19, 1992, a 30-inch wide ladder back tray configuration was tested. At 17 minutes into the test, the Thermo-Lag 330 panel on the bottom of the test article began to sag. At 18 minutes, the joint at the interface between the tray support and the tray showed signs of weakening and separation. The internal temperatures within areas of the test article showed signs of exceeding 325 °F at 25 minutes. The joint fully separated in 41 minutes resulting in cable circuit integrity failure and fire damage to the cables.

Discussion

Section 50.48(a) of Title 10 of the Code of Federal Regulations (10 CFR 50.48(a)) requires that each operating nuclear power plant have a fire

protection plan that satisfies Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 3, "Fire Protection." GDC 3 requires structures, systems, and components important to safety be designed and located to minimize, in a manner consistent with other safety requirements, the probability and effects of fires and explosions. In 10 CFR 50.48(b), the NRC states that Appendix R to 10 CFR Part 50 establishes fire protection features required to satisfy Criterion 3 of Appendix A to 10 CFR Part 50 for certain generic issues for nuclear power plants licensed to operate prior to January 1, 1979. Sections III.G, III.J, and III.O of Appendix R are applicable to nuclear power plants licensed to operate prior to January 1, 1979. In 10 CFR 50.48(e), the NRC requires that all plants licensed to operate after January 1, 1979, shall complete all fire protection modifications needed to satisfy Criterion 3 to Appendix A of 10 CFR Part 50 in accordance with the provisions of their operating licenses.

NRC-approved plant fire protection programs as referenced by the Plant Operating License Conditions and Appendix R to 10 CFR Part 50, Section III G.1.a, "Fire Protection of Safe Shutdown Capability," require one train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control stations to be free from fire damage.

To ensure that electrical cabling and components are free from fire damage, Section III G.2 of Appendix R requires the separation of safe shutdown trains by separation of cables and equipment and associated circuits of redundant trains by a fire barrier having a 3-hour rating or 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 to providing the 1-hour barrier, fire detection and an automatic fire suppression system shall be installed in the fire area.

Under fire conditions, the thermal degradation of an electrical raceway fire barrier system, such as the Thermo-Lag system, could lead to both trains of safe shutdown systems being damaged by fire. This may significantly affect the plant's ability to achieve and maintain hot standby/shutdown conditions.

The NRC considered the failures of the recent Thermo-Lag fire barrier fire endurance testing and has determined that the 1- and 3-hour pre-formed assemblies installed on small conduit and wide cable trays (wider than 14 inches) do not provide the level of safety as required by NRC requirements.

Requested Actions

All holders of operating licenses for nuclear power reactors, immediately upon receiving this bulletin, are requested to take the following actions:

1. For those plants that use either 1- or 3-hour pre-formed Thermo-Lag 330 panels and conduit shapes, identify the areas of the plant which have Thermo-Lag 330 fire barrier material installed and determine the plant areas which use this material for protecting either small diameter conduit or wide trays (widths greater that 14 inches) that provide safe shutdown capability.

2. In those plant areas in which Thermo-Lag fire barriers are used to protect wide cable trays, small conduits, or both, the licensee should implement, in accordance with plant procedures, the appropriate compensatory measures, such as fire watches, consistent with those which would be implemented by either the plant technical specifications or the operating license for an inoperable fire barrier.

3. Each licensee, within 30 days of receiving this bulletin, is required to provide a written notification stating whether it has or does not have Thermo-Lag 330 fire barrier systems installed in its facilities. Each licensee who has installed Thermo-Lag 330 fire barriers is required to inform the NRC, in writing, whether it has taken the above actions and is required to describe the measures being taken to ensure or restore fire barrier operability.

Backfit Discussion

These types of fire barriers are currently installed at operating power reactor sites and are required to meet either a condition of a plant's operating license or the requirements of Section III.G of Appendix R to 10 CFR Part 50. The actions requested by this bulletin do not represent a new staff position but are considered necessary to bring licensees into compliance with existing NRC rules and regulations where these test results are relevant. Therefore, this bulletin is being issued as a compliance backfit under the terms of 50.109(a)(4). In addition, pursuant to the Charter of the Committee to Review Generic Requirements (CRGR), this bulletin is being issued as an immediately effective action (10 CFR 50.109(a)(6)). This bulletin is being issued with the knowledge of the CRGR.

Address the required written reports to the U. S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555, under oath or affirmation under the provisions of Section 182a, Atomic Energy Act of 1954, as amended and 10 CFR 50.54(f). In addition, submit a copy to the appropriate regional administrator.

This request is covered by Office of Management and Budget Clearance Number 3150-0012, which expires June 30, 1994. The estimated average number of burden hours is 60 person hours for each licensee response, including those needed to assess the new recommendations, search data sources, gather and analyze the data, and prepare the required letters. This estimate of the average number of burden hours pertains only to the identified response-related matters and does not include the time needed to implement the requested action. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch, Division of Information Support Services, Office of Information Resources Management, U. S. Nuclear Regulatory Commission, Washington, D.C. 20555, and to the Paperwork Reduction Project (3150-0011), Office of Information and Regulatory Affairs, NEOB-3019, Office of Management and Budget, Washington, D.C. 20503.

Although no specific response is required with respect to the following information, the following information would assist the NRC in evaluating the cost of complying with this bulletin:

(1) the licensee staff's time and costs to perform requested inspections, corrective actions, and associated testing;

(2) the licensee staff's time and costs to prepare the requested reports and documentation;

(3) the additional short-term costs incurred to address the inspection findings such as the costs of the corrective actions or the costs of down time; and

(4) an estimate of the additional long-term costs that will be incurred as a result of implementing commitments such as the estimated costs of conducting future inspections or increased maintenance.

If you should have any questions about this matter, please contact one of the technical contacts listed below or the appropriate NRR project manager.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contacts: Ralph Architzel, NRR
(301) 504-2804

Patrick Madden, NRR
(301) 504-2854

Attachment:
List of Recently Issued NRC Bulletins

LIST OF RECENTLY ISSUED NRC BULLETINS

Bulletin No.	Subject	Date of Issuance	Issued to
91-01	Reporting Loss of Criticality Safety Controls	10/18/91	All fuel cycle and uranium fuel research and development licensees.
89-01, Supp. 2	Failure of Westinghouse Steam Generator Tube Mechanical Plugs	06/28/91	All holders of OLs or CPs for PWRs.
89-01, Supp. 1	Failure of Westinghouse Steam Generator Tube Mechanical Plugs	11/14/90	All holders of OLs or CPs for PWRs.
90-02	Loss of Thermal Margin Caused by Channel Box Bow	03/20/90	All holders of OLs or CPs for BWRs.
90-01	Loss of Fill-Oil in Transmitters Manufactured by Rosemount	03/09/90	All holders of OLs or CPs for nuclear power reactors.
89-03	Potential Loss of Required Shutdown Margin During Refueling Operations	11/21/89	All holders of OLs or CPs for PWRs.
88-10, Supp. 1	Nonconforming Molded-Case Circuit Breakers	08/03/89	All holders of OLs or CPs for nuclear power reactors.
89-02	Stress Corrosion Cracking of High-Hardness Type 410 Stainless Steel Internal Preloaded Bolting in Anchor Darling Model S350W Swing Check Valves or Valves of Similar Design	07/19/89	All holders of OLs or CPs for nuclear power reactors.
89-01	Failure of Westinghouse Steam Generator Tube Mechanical Plugs	05/15/89	All holders of OLs or CPs for PWRs.

OL = Operating License
CP = Constructon Permit

ENCLOSURE 4

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

August 28, 1992

NRC BULLETIN NO. 92-01, SUPPLEMENT 1: FAILURE OF THERMO-LAG 330 FIRE BARRIER SYSTEM TO PERFORM ITS SPECIFIED FIRE ENDURANCE FUNCTION

Addressees

For Action:

All holders of operating licenses for nuclear power reactors

For Information:

All holders of construction permits for nuclear power reactors

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this bulletin supplement to notify licensees and construction permit holders of additional apparent failures in fire endurance testing associated with the Thermo-Lag 330 fire barrier system which many plants have installed to protect safe shutdown capability, to request all operating reactor licensees that have Thermo-Lag fire barriers to take the recommended actions, and to require that these licensees submit a written response to the NRC describing the actions taken associated with this bulletin supplement.

Background

On August 6, 1991, the NRC issued Information Notice (IN) 91-47, "Failure of Thermo-Lag Fire Barrier Material To Pass Fire Endurance Test," which contained information on the fire endurance tests performed by the Gulf States Utilities Company on Thermo-Lag 330 fire barrier systems installed on wide aluminum cable trays and the associated failures. On December 6, 1991, the NRC issued IN 91-79, "Deficiencies In The Procedures For Installing Thermo-Lag Fire Barrier Materials," which contained information on deficiencies in procedures that the vendor (Thermal Science, Inc.) supplied for installing Thermo-Lag 330 fire barrier material. Recognizing the concerns stated in INs 91-47 and 91-79 regarding the Thermo-Lag 330 fire barrier system, Texas Utilities (TU) Electric instituted a fire endurance testing program to qualify its Thermo-Lag 330 electrical raceway fire barrier systems for its Comanche Peak Steam Electric Station. On June 17-23, 1992, TU Electric conducted the first series of these "full scale" fire endurance tests at Omega Point Laboratories in San Antonio, Texas.

The results of these tests have raised questions regarding the ability of the Thermo-Lag 330 fire barrier system to perform its specified function as a 1-hour fire barrier. On June 23, 1992, the NRC issued IN 92-46, "Thermo-Lag Fire Barrier Material Special Review Team Final Report Findings, Current Fire Endurance Testing, and Ampacity Calculation Errors," in which it discussed the safety implications of these questions. On June 24, 1992, the NRC issued NRC Bulletin 92-01, "Failure of Thermo-Lag 330 Fire Barrier System to Maintain Cabling in Wide Cable Trays and Small Conduits Free From Fire Damage."

Description of Circumstances

TU Electric and the NRC recently sponsored additional testing of Thermo-Lag 330 material.

TESTS SPONSORED BY TU ELECTRIC

On August 19-21, 1992, TU Electric sponsored a second series of tests at the Omega Point Laboratory to aid in qualifying its Thermo-Lag 330 electrical raceway fire barrier systems for its Comanche Peak Steam Electric Station.

This series of tests consisted of 1-hour fire endurance tests (using the ASTM E-119 Standard Time Temperature Curve) on a variety of cable tray and conduit "mock-ups." TU Electric designed these "mock-ups" or test articles to duplicate existing installed plant configurations. Plant personnel used stock material to construct the test articles. The Thermo-Lag fire barriers were installed on the test articles in accordance with TU Electric's Thermo-Lag installation procedures. TU Electric wrote these procedures based on vendor recommended installation procedures.

The Thermo-Lag fire barrier systems for the TU Electric test articles were constructed using pre-formed 1-hour Thermo-Lag 330 panels and conduit shapes. The joints and seams were constructed by pre-buttering seams and joints with trowel grade Thermo-Lag 330-1 and holding the assembly together with stainless steel banding as required by TU procedures and as the system is installed in the plant.

The articles tested during this series of tests consisted of a conduit configuration, which exposed five conduits of various sizes (3-inch, 2-inch, 1-1/2-inch and two 3/4-inch) to the same test fire, a 24-inch wide cable tray with a T-section and a 30-inch wide cable tray.

On August 19, 1992, TU Electric performed a 1-hour fire endurance test on the conduit configuration. The fire barrier systems installed on the 3-inch, 2-inch and 1-1/2-inch conduits and their associated cable pull boxes were constructed using 1-hour Thermo-Lag 330 conduit pre-shapes and panels, respectively. The 3/4-inch conduits were constructed using a Thermo-Lag 330 conduit pre-shape as a base material. The two 3/4-inch conduits were divided at the middle of the test specimen, and four different enhanced barrier systems were tested. The first of these consisted of a 3/4-inch conduit run, one half of which was protected by a 3/4-inch Thermo-Lag 330 fire barrier conduit pre-shape, and the other half protected with a 1/2-inch thick conduit

pre-shape with a wire mesh "stress skin" applied on the exterior and 1/4-inch of trowel grade Thermo-Lag applied to the stress skin. One half of the second 3/4-inch conduit run was protected by a 1/2-inch thick conduit pre-shape with a 1/4-inch thick Thermo-Lag flexi-blanket wrap. The other half was protected by a 1/2-inch thick conduit pre-shape with a 1/4-inch thick pre-shape overlay. TU Electric did not conduct a hose stream test after the fire endurance test. The post-fire visual inspection of the test specimen revealed that the interface joints between the vertical conduit runs and the cable pull boxes had opened and exposed conduit metal surfaces to the fire. In addition, the cables exhibited visible fire damage to cable jackets in all conduits, except for the 3/4-inch conduit protected by the 1/2-inch thick conduit pre-shape with the 1/4-inch pre-shape overlay. Throughout the fire endurance test, the thermocouple temperatures on the cables inside the 3/4-inch conduit protected by the overlay never reached 163 °C (325 °F). All other conduit configurations exceeded 163° (325 °F) on the cables during the test.

On August 20, 1992, TU Electric sponsored a test of a 24-inch wide ladder back tray with a T-tray configuration. Post-fire inspection of this specimen revealed that five joint and seam type openings had occurred. These openings were both in horizontal and vertical runs of the cable tray. Fire damage to the cables was also identified during the post-fire inspection, raising questions whether the cables would have functioned properly during a fire. The thermocouples indicated that internal temperatures in certain areas of the test article exceeded 163 °C (325 °F) at 47 minutes. The maximum monitored cable temperature during the test was 194 °C (381 °F).

On August 21, 1992, TU Electric sponsored a test of a 30-inch wide ladder back tray configuration. During the post-fire inspection of this specimen, five joint and seam type openings were identified in horizontal and vertical runs of the cable tray. The Thermo-Lag barrier also experienced areas of loss of its material, leaving spots of bare stress skin covering the tray. Fire damage to the cables was identified during the post-fire inspection. Thermocouples indicated that internal temperatures in certain areas of the test article exceeded 163 °C (325 °F) at 30 minutes. The maximum monitored cable temperature during the test was approximately 371 °C (700 °F).

Although previous tests conducted by TU Electric (see Bulletin 92-01) resulted in the apparent successful performance of large diameter conduits and narrow trays, new information provided by these recent tests has led the NRC to believe that potential early failures of Thermo-Lag barriers are not limited to specific sizes. The NRC considers the openings at the joints and seams of the Thermo-Lag material to be of high significance. The characteristics of the configurations of the material protecting the trays or conduits in question seemed to impact the effectiveness of the barrier material more than their specific sizes. The tests sponsored by TU Electric revealed that the Thermo-Lag material lost its structural integrity primarily at the seams and joints and that cable damage was most significant at these seam and joint separations.

Following the tests conducted in June 1992, the test assemblies were subjected to hose streams which altered the conditions of the barriers. Due to the hose stream, post-fire inspection of these assemblies for joint failures and burn

through was prevented. The assemblies tested in August 1992 were cooled with water, essentially leaving the test assemblies in the condition they were in at the completion of the fire test. Areas of burn through and seam and joint failures were observed during post-fire inspection.

Further, the TU Electric assemblies tested in June 1992 were constructed using supports that were covered with two layers of Thermo-Lag material. The assemblies tested in August 1992 had supports which were insulated to only 9 inches, corresponding to the TU Electric actual plant installations. Thus, the June 1992 tests did not model the installed plant configuration, as was the case in the August 1992 tests.

TESTS SPONSORED BY THE NRC

On July 15 and 17, 1992, the NRC sponsored a series of "small scale" fire endurance tests on 1- and 3-hour Thermo-Lag 330 pre-formed fire barrier panels at the National Institute of Standards and Technology (NIST). On July 27, 1992, the NRC issued the results of the first series of small scale tests in IN 92-55, "Current Fire Endurance Test Results for Thermo-Lag Fire Barrier Material." On August 6-7 and 14, 1992, the NRC sponsored a second series of 1- and 3-hour small scale fire endurance tests on Thermo-Lag 330 fire barrier pre-formed panels.

On July 15, 1992, the NRC sponsored a 1-hour fire endurance test. The 1-hour panel stress skin was oriented away from the fire exposure, according to vendor recommendation. The average thermocouple reading on the unexposed surface exceeded 162.7 °C (325 °F) in approximately 22 minutes, and the unexposed surface of the material reached an average temperature of 652 °C (1206 °F) at 45 minutes. The unexposed surface of the material exhibited visible browning in 35 minutes. During the test, the thermocouple on the unexposed surface reached a peak reading of 935 °C (1716 °F), exceeding the corresponding furnace temperature of 923 °C (1694 °F), as the material burned and added heat to the baseline furnace temperature. The panels burned through at two locations in 46 minutes, resulting in a corresponding drop in surface thermocouple readings as the cold air entered the furnace. After 1 hour, approximately 85 percent of the unexposed surface was blackened.

On July 17, 1992, the NRC sponsored a 3-hour test. The 3-hour panels had stress skin installed on both sides of the Thermo-Lag material. To prepare for the test, the technicians installed the ribbed side of the specimen on the unexposed side with the non-ribbed side of the material towards the furnace side. The stress skin on the furnace side of the specimen was restrained by the furnace specimen support lip during the test. The average thermocouple reading exceeded 162.7 °C (325 °F) in 2 hours and 20 minutes, the average temperature at the end of 3 hours was 206 °C (403 °F), and the peak of thermocouple reading was 222 °C (432 °F). After the test, the material was soft and exhibited plastic deformation, and the fire-exposed stress skin crumbled upon contact. Nevertheless, visible signs of damage on the unexposed side were limited to off-gassing, slight browning, and crystallization at the surface.

On August 5, 1992, the NRC sponsored a fire endurance test on a 3-hour Thermo-Lag fire barrier panel, which had stress skin on both sides. The edges of the stress skin of the 3-hour material were cut away from the exposed side of the panel so that the outer edges of the stress skin contacted the support lip of the furnace. The stress skin was kept from being restrained in compression at the edges of the panel around the lip of the furnace. The average thermocouple temperature of the unexposed surface exceeded the ASTM E-119 temperature acceptance criterion of 163 °C (325 °F) in 45 minutes. After 1 hour, the unexposed surface temperature reading was 756 °C (1392 °F). At 1 hour and 20 minutes, the panel was burned through. This 3-hour configuration performed quite differently during this test than did the Thermo-Lag 330 fire barrier panel in the July 17, 1992, 3-hour fire test in which the stress skin was restrained on the side exposed to the fire. In this previous test, the average unexposed surface temperature of the restrained specimen did not exceed 163 °C (325 °F) until 2 hours and 20 minutes into the test, and the maximum temperature at the end of the 3-hour test was 194 °C (381 °F). The specimen tested on July 17, 1992 did not burn through.

On August 6, 1992, the NRC sponsored a second 1-hour fire endurance test on a Thermo-Lag 330 1-hour panel, which had stress skin on one side only. This panel was placed on the furnace with the stress skin towards the fire, although the vendor recommends that the 1-hour panel be installed with the stress skin away from the fire exposure. The deviation from the vendor recommendation aided in the determination of the material's sensitivity to installation variations. The stress skin was restrained by the furnace specimen support lip. The average unexposed surface temperature of the specimen exceeded 163 °C (325 °F) in 34 minutes, and at 1 hour, the maximum temperature of the unexposed surface was 237 °C (458 °F). However, the specimen was not burned through. The performance of the specimen in this test was superior to the specimen tested on July 15, 1992, at which the stress skin faced the unexposed side, as recommended by the vendor. The specimen tested on July 15, 1992, exceeded the 163 °C (325 °F) acceptance criterion in 20 minutes and the unexposed surface reached 649 °C (1200 °F) in 37 minutes. Burn through was observed in 46 minutes.

On August 7, 1992, the NRC sponsored a third 3-hour fire endurance test. Two 1-hour fire barriers were dry fitted together with their stress skins on the outer sides of the test specimen. As in the test conducted on August 5, the exposed side stress skin was trimmed away to prevent the material from being restrained. One hour into the test, the specimen abruptly began releasing gases, and the thermocouple readings inside the furnace indicated that the thermocouple had come into contact with burning material. The average thermocouple reading exceeded 163 °C (325 °F) in 1 hour and 26 minutes. After 2 hours, burn holes were observed in several locations. After the burn holes formed, unexposed surface thermocouple readings oscillated dramatically, with a peak reading of 947 °C (1737 °F) at the end of the test. Nonetheless, this test specimen performed better than did the prefabricated 3-hour panel with its stress skin trimmed away.

On August 14, 1992, the NRC sponsored a final 3-hour test, again using two 1-hour panels dry fitted together with their stress skins on the outer sides of the test specimen. The stress skin was not trimmed away from the specimen

for this test; it was restrained in compression at the edges of the panel. The average thermocouple reading exceeded 163 °C (325 °F) in 2 hours and 40 minutes and reached 176 °C (349 °F) at the end of the test. Visible signs of damage were limited to off-gassing and slight crystallization at the surface of the unexposed side, and no browning was observed.

The following table summarizes the data collected during these small scale tests.

Test Date	Barrier Rating	Stress Skin Restraint	Stress Skin Orientation	Time to Exceed 163 °C* (hrs:min)	Burn Through (hrs:min)
7/15/92	1 hour	N/A	unexposed	0:22	0:46
8/06/92	1 hour	restrained	exposed	0:34	none
7/17/92	3 hour	restrained	both sides	2:20	none
8/05/92	3 hour	unrestrained	both sides	0:45	1:20
8/07/92	3 hour**	unrestrained	both sides	1:26	2:03
8/14/92	3 hour**	restrained	both sides	2:40	none

* Average unexposed surface thermocouple temperature
** Two 1-hour panels fitted face to face

In IN 92-55, the staff listed specific furnace specifications and test assembly parameters used in both series of tests conducted by NIST.

The NRC views the results of the NIST tests as indicative of an inability of the Thermo-Lag material itself to provide protection according to its specified fire resistive rating, depending on its configuration. The tests conducted at NIST were not considered definitive in that the tests were not full scale and only panels were tested. However, the information gleaned from the tests provided enough evidence to the NRC to confirm doubts raised during the TU Electric tests, such as the bare stress skin observed following the TU 30-inch wide cable tray test on August 21, 1992, discussed above, leading to a conclusion that Thermo-Lag fire barriers should be treated as inoperable in the absence of successful, applicable plant specific tests.

Discussion

Section 50.48(a) of Title 10 of the Code of Federal Regulations (10 CFR 50.48(a)) requires that each operating nuclear power plant have a fire protection plan that satisfies Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 3, "Fire Protection." GDC 3 requires that structures, systems, and components important to safety be designed and located to minimize, in a manner consistent with other safety requirements, the probability and effects of fires and explosions. 10 CFR 50.48(b) states that Appendix R to 10 CFR Part 50 establishes fire protection features required to satisfy

Criterion 3 of Appendix A to 10 CFR Part 50 for certain generic issues for nuclear power plants licensed to operate before January 1, 1979. Sections III.G, III.J, and III.O of Appendix R apply to nuclear power plants licensed to operate before January 1, 1979. In 10 CFR 50.48(e), the NRC requires that all licensees for plants licensed to operate after January 1, 1979 shall complete all fire protection modifications needed to satisfy Criterion 3 of Appendix A to 10 CFR Part 50 in accordance with the provisions of their operating licenses.

NRC-approved plant fire protection programs as referenced by the Plant Operating License Conditions and Appendix R to 10 CFR Part 50, Section III G.1.a, "Fire Protection of Safe Shutdown Capability," require one train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control stations to be free from fire damage.

To ensure that electrical cables and components are free from fire damage, Section III G.2 of Appendix R requires the separation of safe shutdown trains by separation of cables and equipment and associated circuits of redundant trains by a fire barrier having a 3-hour rating or 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 to providing the 1-hour barrier, a fire detection and an automatic fire suppression system shall be installed in the fire area.

Under fire conditions, the thermal degradation of fire barrier systems (e.g., walls, floors, equipment vaults, and electrical raceway enclosures), such as the Thermo-Lag system, could lead to both trains of safe shutdown systems being damaged by fire. This may significantly affect the plant's ability to achieve and maintain hot standby or shutdown conditions.

The NRC considered the apparent failures of the recent Thermo-Lag fire barrier fire endurance tests and determined that the 1- and 3-hour pre-formed assemblies installed on conduits, cable trays (of all sizes and configurations), and used to construct fire barrier walls and ceilings, and equipment enclosures do not provide the level of safety as required by NRC requirements. The tests sponsored by TU Electric raised concerns relating to joint and seam separation leading to cable damage. In addition, they raise concerns about the potential for burn through of the Thermo-Lag material itself. The tests sponsored by the NRC appear to confirm concerns relating to burn through of the Thermo-Lag material in certain configurations in the absence of joints and seams.

Requested Actions

All holders of operating licenses for nuclear power reactors, immediately upon receiving this bulletin supplement, are requested to take the following actions. These actions are essentially the same as those listed in Bulletin 92-01, but the scope has been expanded to include all sizes of conduits and trays and to include walls, ceilings, and equipment enclosures.

1. For those plants that use either 1- or 3-hour pre-formed Thermo-Lag 330 panels and conduit shapes, identify the areas of the plant which have

Thermo-Lag 330 fire barrier material installed and determine the plant areas which use this material for the protection and separation of the safe shutdown capability.

2. In those plant areas in which Thermo-Lag fire barriers are used in raceways, walls, ceilings, equipment enclosures, or other areas to protect cable trays, conduits, or separate redundant safe shutdown functions, the licensee should implement, in accordance with plant procedures, the appropriate compensatory measures, such as fire watches, consistent with those that would be implemented by either the plant technical specifications or the operating license for an inoperable fire barrier. These compensatory measures should remain in place until the licensee can declare the fire barriers operable on the basis of applicable tests which demonstrate successful 1- or 3-hour barrier performance.

Although the specific details of this supplement to Bulletin 92-01 may not apply to holders of construction permits for nuclear power reactors, it is requested that the general concerns of this bulletin supplement be reviewed for current or future applicability.

Required Report

Each licensee who has installed Thermo-Lag 330 fire barriers must inform the NRC in writing within 30 days of receiving this bulletin supplement, whether or not it has taken the above actions. Where fire barriers are declared inoperable, the licensee is required to describe the measures being taken to ensure or restore fire barrier operability. These measures should be consistent with actions taken in response to Bulletin 92-01.

Backfit Discussion

These types of fire barriers are installed at operating power reactor sites and are required to meet either a condition of a plant's operating license or the requirements of Section III.G of Appendix R to 10 CFR Part 50. The actions requested by this bulletin supplement do not represent a new staff position but are considered necessary to bring licensees into compliance with existing NRC rules and regulations where these test results are relevant. Therefore, the NRC is issuing this bulletin supplement as a compliance backfit under 10 CFR 50.109(a)(4).

Address the required written reports to the U. S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555, under oath or affirmation under the provisions of Section 182a, Atomic Energy Act of 1954, as amended and 10 CFR 50.54(f). In addition, submit a copy to the appropriate regional administrator.

This request is covered by Office of Management and Budget Clearance Number 3150-0012, which expires June 30, 1994. The estimated average number of burden hours is 120 person hours for each licensee response, including those needed to assess the new recommendations, search data sources, gather and

analyze the data, and prepare the required letters. This estimate of the average number of burden hours pertains only to the identified response-related matters and does not include the time needed to implement the requested action. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch, Division of Information Support Services, Office of Information Resources Management, U. S. Nuclear Regulatory Commission, Washington, D.C. 20555, and to the Paperwork Reduction Project (3150-0012), Office of Information and Regulatory Affairs, NEOB-3019, Office of Management and Budget, Washington, D.C. 20503.

Although no specific response is required for the following information, the following information would assist the NRC in evaluating the cost of complying with this bulletin supplement:

(1) the licensee staff's time and costs to perform requested inspections, corrective actions, and associated testing;

(2) the licensee staff's time and costs to prepare the requested reports and documentation;

(3) the additional short-term costs incurred to address the inspection findings such as the costs of the corrective actions or the costs of down time; and

(4) an estimate of the additional long-term costs that will be incurred as a result of implementing commitments such as the estimated costs of conducting future inspections or increased maintenance.

If you should have any questions about this matter, please contact one of the technical contacts listed below or the appropriate NRR project manager.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contacts: Ralph Architzel, NRR
(301) 504-2804

Patrick Madden, NRR
(301) 504-2854

Attachment:
List of Recently Issued NRC Bulletins

LIST OF RECENTLY ISSUED NRC BULLETINS

Bulletin No.	Subject	Date of Issuance	Issued to
92-02	Safety Concerns Relating to "End of Life" of Aging Theratronics Teletherapy Units	08/24/92	All Teletherapy Licensees.
92-01	Failure of Thermo-Lag 330 Fire Barrier System to Maintain Cabling in Wide Cable Trays and Small Conduits Free from Fire Damage	06/24/92	All holders of OLs or CPs for nuclear power reactors.
91-01	Reporting Loss of Criticality Safety Controls	10/18/91	All fuel cycle and uranium fuel research and development licensees.
89-01, Supp. 2	Failure of Westinghouse Steam Generator Tube Mechanical Plugs	06/28/91	All holders of OLs or CPs for PWRs.
89-01, Supp. 1	Failure of Westinghouse Steam Generator Tube Mechanical Plugs	11/14/90	All holders of OLs or CPs for PWRs.
90-02	Loss of Thermal Margin Caused by Channel Box Bow	03/20/90	All holders of OLs or CPs for BWRs.
90-01	Loss of Fill-Oil in Transmitters Manufactured by Rosemount	03/09/90	All holders of OLs or CPs for nuclear power reactors.
89-03	Potential Loss of Required Shutdown Margin During Refueling Operations	11/21/89	All holders of OLs or CPs for PWRs.
88-10, Supp. 1	Nonconforming Molded-Case Circuit Breakers	08/03/89	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

ENCLOSURE 5

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 17, 1992

TO: ALL HOLDERS OF OPERATING LICENSES OR CONSTRUCTION PERMITS FOR NUCLEAR POWER REACTORS

SUBJECT: THERMO-LAG 330-1 FIRE BARRIERS (GENERIC LETTER 92-08)

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter (GL) to obtain additional information needed from licensees to verify that Thermo-Lag 330-1 fire barrier systems manufactured by Thermal Science, Incorporated (TSI, the vendor), St. Louis, Missouri, comply with the NRC's requirements. Many licensees use Thermo-Lag 330-1 fire barriers to satisfy the NRC's fire protection requirements for safe shutdown capability. Some licensees also use Thermo-Lag 330-1 barriers to create physical independence between the circuits and electric equipment in and associated with the Class 1E power system, the protection system, systems actuated or controlled by the protection system, and auxiliary or supporting systems that must be operable for the protection system and the systems it actuates to perform their safety-related functions.

BACKGROUND

The NRC began a review of Thermo-Lag 330-1 fire barrier system fire endurance and ampacity derating test reports, installation procedures, and as-built configurations after receiving reports from Gulf States Utilities (GSU) about failed qualification fire tests and installation problems. The staff issued the results of the NRC's initial review in NRC Information Notice (IN) 92-46, "Thermo-Lag Fire Barrier Material Special Review Team Findings, Current Fire Endurance Tests, and Ampacity Calculation Errors," June 23, 1992. The special review team report enclosed with IN 92-46 included the technical bases for this generic letter. The NRC staff found the following regarding Thermo-Lag 330-1 barriers: incomplete or indeterminate fire test results, questionable ampacity derating test results and a wide range of documented ampacity derating factors, some barrier installations that are not constructed in accordance with the vendor recommended installation procedures, incomplete installation procedures, and as-built fire barrier configurations that may not be qualified by a valid fire endurance test or evaluated in accordance with the guidance previously provided by the staff in GL 86-10, "Implementation of Fire Protection Requirements," April 24, 1986.

Texas Utilities Electric Company (TU Electric) later conducted a series of full-scale fire endurance tests to qualify the Thermo-Lag 330-1 electrical raceway fire barrier configurations installed at its Comanche Peak Steam Electric Station. The NRC also conducted a series of small-scale fire tests of 1-hour and 3-hour Thermo-Lag prefabricated panels at the National Institute of Standards and Technology to assess the fire performance of the panels. The results of these fire tests raised additional concerns about the ability of

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Thermo-Lag 330-1 fire barriers to provide fire protection according to their specified fire-resistance ratings.

The staff issued the results of the TU Electric and NRC fire tests in Bulletins 92-01, "Failure of Thermo-Lag 330 Fire Barrier System to Maintain Cabling in Wide Cable Trays and Small Conduits Free from Fire Damage," June 24, 1992, and 92-01, Supplement 1, "Failure of Thermo-Lag 330-1 Fire Barrier System to Perform its Specified Fire Endurance Function," August 28, 1992. In the bulletin and its supplement, the NRC notified the licensees of apparent failures of Thermo-Lag 330-1 fire barriers and materials during fire endurance testing. The bulletin and its supplement requested that each licensee determine which plant areas use 1-hour or 3-hour prefabricated Thermo-Lag 330-1 panels or conduit shapes for raceway, wall, ceiling, or equipment enclosure fire barriers; determine the plant areas that use these materials to protect or separate safe shutdown capability; and implement, in accordance with plant procedures, compensatory measures until the fire barriers can be declared operable. The bulletin required that each licensee inform the NRC in writing whether or not the above requested actions were taken and describe the measures being taken to ensure or restore fire barrier operability.

AREAS OF CONCERN

The NRC has three principal areas of concern: the fire endurance capability of Thermo-Lag 330-1 barriers, the ampacity derating of cables enclosed in Thermo-Lag 330-1 barriers, and the evaluation and application of the results of tests conducted to determine the fire endurance ratings and the ampacity derating factors of Thermo-Lag 330-1 barriers.

The NRC is concerned that the Thermo-Lag 330-1 fire barrier systems may not provide the level of fire endurance intended by licensees and, therefore, that licensees that use Thermo-Lag 330-1 fire barriers may not be meeting the requirements of Section 50.48, "Fire protection," and General Design Criterion (GDC) 3, "Fire protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR Part 50).

Cables routed in electrical raceways are derated to ensure that systems have sufficient capacity and capability to perform their intended safety functions. Cables routed in raceways enclosed in fire barriers require additional derating because of the insulating effect of the fire barrier materials. Cable derating calculations that are based on inaccurate or nonconservative derating factors could result in installation of undersized cables or raceway overfilling. This could cause operating temperatures to exceed design limits within the raceways thereby reducing the expected design life of the cables. The NRC is concerned that because of the wide range of ampacity derating factors documented for Thermo-Lag 330-1 materials, some licensees may not have adequately accounted for the insulating effects of the Thermo-Lag material in their derating analyses and, therefore, may not be meeting the requirements of GDC 17, "Electric power systems." This concern applies where Thermo-Lag 330-1 barriers are used either to protect safe shutdown capability from fire or to achieve physical independence of electrical systems.

The NRC is also concerned that some licensees have 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.

The NRC is requiring information needed to verify compliance with 10 CFR 50.48, GDC 3, and GDC 17, and associated license conditions under the provisions of 10 CFR 50.54(f) where Thermo-Lag 330-1 barriers are used.

FIRE ENDURANCE CAPABILITY

The NRC's Qualification Requirements and Guidance for Fire Barriers

Section 50.48 of 10 CFR requires that each operating nuclear power plant have a fire protection plan that satisfies GDC 3. GDC 3 requires that structures, systems, and components important to safety be designed and located to minimize, in a manner consistent with other safety requirements, the probability and effects of fires. 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.[1] One means of complying with this requirement is to separate one safe shutdown train from its redundant train with fire-rated barriers. The level of fire resistance required of the barriers, 1 hour or 3 hours, depends on the other fire protection features provided in the fire area.

The NRC issued guidance on acceptable methods of satisfying the regulatory requirements of GDC 3 in Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants;" Appendix A to BTP APCSB 9.5-1; BTP Chemical Engineering Branch (CMEB) 9.5-1, "Fire Protection For Nuclear Power Plants," July 1981; and GL 86-10. In the BTPs and in GL 86-10, the staff stated that the fire resistance ratings of fire barriers should be established in accordance with National Fire Protection Association (NFPA) Standard 251, "Standard Methods of Fire Tests of Building Construction and Materials," by subjecting a test specimen that represents the materials, workmanship, method of assembly, dimensions, and configuration for which a fire rating is desired to a "standard fire exposure" at a nationally recognized laboratory.[2] In GL 86-10, the staff included guidance on fire test acceptance criteria and for evaluating deviations from tested configurations.

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[1] See Appendix R to 10 CFR Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979."

[2] American Society for Testing and Materials (ASTM) Standard E119 was adopted by the National Fire Protection Association (NFPA) as NFPA Standard 251.

Fire Endurance Testing and the Evaluation and Application of Fire Test Results

On October 26, 1989, the Southwest Research Institute (SwRI) performed a 3-hour fire endurance test of a cable tray and support protected by a Thermo-Lag 330-1 fire barrier for GSU. SwRI found that temperatures within the test assembly exceeded the NRC's acceptance criteria within 60 minutes and that the test assembly collapsed in less than 90 minutes. These test results raised concerns about the adequacy of Thermo-Lag 330-1 cable tray enclosures. The staff informed the licensees of these test results in NRC IN 91-47, "Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test," August 6, 1991. NRC IN 92-46 contains the staff's evaluation of this fire test.

While conducting its review, the NRC staff found that many fire endurance tests have been conducted on electrical raceways protected with Thermo-Lag 330-1 fire barrier systems. The staff reviewed about forty 1-hour and 3-hour fire endurance test reports from various testing facilities and found that testing methods and procedures used during some of the qualification tests did not meet the NRC's guidance and deviated from good engineering practices. In NFPA 251, the NFPA advised that the test conditions should be evaluated carefully because variations from the construction of the test specimen or from the conditions in which it is tested may substantially change the performance characteristics of the assembly. The test reports reviewed did not contain sufficient details of the construction methods used for the test specimens, did not contain details of the materials used, and did not contain dimensioned drawings. Most of the test configurations were atypical of the as-built field configurations observed by the staff.

The NRC recognized that fire endurance testing of every as-built fire barrier configuration is not possible. In GL 86-10, the NRC issued guidance for reviewing deviations from tested fire barrier configurations. While reviewing the Thermo-Lag 330-1 fire barriers, the NRC staff found several instances in which licensees installed fire barrier configurations that may not have been qualified by fire endurance testing or may not have been reviewed in accordance with the guidance in GL 86-10. For example, when the NRC conducted its initial review, some licensees could not justify their practice of extrapolating test results from small barrier enclosures to significantly larger enclosures or installing barriers using procedures and materials that were different from those tested. The NRC visited five sites after issuing IN 91-47 and also found several licensees that had constructed fire walls, partitions, and vaults using Thermo-Lag 330-1 as a component. These licensees could not provide qualification test reports or justify deviations from tested configurations to demonstrate the acceptability of these fire barriers. The staff informed the licensees of these issues in IN 91-79, "Deficiencies in the Procedures for Installing Thermo-Lag Fire Barrier Materials," December 6, 1991.

The staff is concerned that some licensees have not adequately reviewed applicable fire endurance test results to determine if the tests are valid and if the test results apply to their plant designs.

Deficiencies in the Fire Barrier Installation and Inspection Procedures

While conducting site visits after issuing IN 91-47, the NRC staff observed that the vendor had revised its recommended installation procedures without notifying the licensees, that the vendor installation procedures are 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. In IN 91-79, the NRC staff discussed installation problems resulting from incomplete TSI installation procedures, inadequate licensee installation procedures, installer errors, incomplete or incorrect design documents, and inadequate quality control oversight. In IN 91-79, the staff also listed the installation details in which it found differences between the field installations, the tested configurations, and the vendor installation procedures. These details are not repeated here.

AMPACITY DERATING

NRC Requirements and Guidance for Ampacity Derating

GDC 17 requires that onsite electric power systems be provided to permit the functioning of structures, systems, and components important to safety. The onsite electrical power system is required to have sufficient capacity and capability to ensure that vital functions are maintained. The Institute of Electrical and Electronics Engineers (IEEE) Standard 279, "Criteria for Protection Systems for Nuclear Power Generating Stations," includes guidance on acceptable methods of satisfying GDC 17. IEEE states that the quality of protection system components shall be achieved by specifying requirements known to promote high quality, such as the requirements for the derating of components, and that the quality shall be consistent with minimum maintenance requirements and low failure rates. Furthermore, IEEE 279 states that type test data or reasonable engineering extrapolation based on test data shall be made available to verify that protection system equipment continually meets the performance requirements determined to be necessary for achieving the system requirements.

In Regulatory Guide (RG) 1.75, "Physical Independence of Electric Systems," the NRC staff gave guidance for complying with IEEE Standard 279 and GDC 17 for the physical independence of the circuits and electric equipment comprising or associated with the Class 1E power system, the protection system, systems actuated or controlled by the protection systems, and auxiliary or supporting systems that must be operable for the protection system and the systems it actuates to perform their safety-related functions. Some licensees use Thermo-Lag 330-1 barriers to achieve physical independence of electrical systems in accordance with RG 1.75. The staff's concerns about ampacity derating apply to Thermo-Lag 330-1 barriers installed to achieve physical independence of electric systems and to those installed to protect safe shutdown capability from fire.

Ampacity Derating Tests and the Application of Ampacity Derating Test Results

Cables enclosed in electrical raceways protected with fire barrier materials are derated because of the insulating effect of the fire barrier material. Other factors that affect ampacity derating include cable fill, cable loading, cable type, raceway construction, and ambient temperature. The National Electrical Code, Insulated Cable Engineers Association (ICEA) publications, and other industry standards provide general ampacity derating factors for open air installations, but do not include derating factors for fire barrier systems. Although a national standard ampacity derating test method has not been established, ampacity derating factors for raceways enclosed with fire barrier material have been determined for specific installation configurations by testing.

The vendor has documented a wide range of ampacity derating factors that were determined by testing. For example, between 1981 and 1985, the vendor provided test reports to licensees that document ampacity derating factors for cable trays that range from 5.3 to 12.48 percent for 1-hour barriers and from 16.15 to 20.55 percent for 3-hour barriers. On October 2, 1986, TSI informed the NRC and its customers by Mailgram that, while conducting a special services investigation in September 1986 at the Underwriters Laboratories, Incorporated (UL), it found that the ampacity derating factors for Thermo-Lag 330-1 barriers were greater than previous tests indicated (28.04 percent for 1-hour barriers and 31.15 percent for 3-hour barriers). However, the cable fill and tray configuration for each test differed from those tested previously. The NRC learned that UL performed duplicate cable tray baseline tests using a longer stabilization period (4 hours instead of 15 minutes) after the final current adjustment and obtained a higher baseline current, which yielded higher derating factors (36.1 percent for 1-hour barriers and 38.9 percent for 3-hour barriers). UL gave these test results to the vendor, but they were not submitted to the NRC or to licensees. While reviewing tests which had been conducted at SwRI in 1986, the staff learned that the ampacity derating factor for the tested configuration was 37.4 percent for a 1-hour Thermo-Lag 330-1 barrier. The test procedures and test configurations differed for each of the aforementioned tests. Therefore, the results from these different ampacity tests may not be directly comparable to each other.

The staff is concerned that the ampacity derating factors derived from the UL tests for similar Thermo-Lag 330-1 barrier designs are inconsistent with one another because of differing stabilization times, which calls into question the validity of the ampacity derating tests. While reviewing Industrial Testing Laboratories (ITL) test reports, the NRC staff noticed that ambient temperature and maximum cable temperature were allowed to vary widely for some tests (48 °C instead of 40 °C for ambient temperature and 94.4 °C instead of 90 °C for maximum cable temperature). ITL then used an ICEA procedure to calculate the ampacity derating factors by adjusting the tested current to 40 °C ambient and 90 °C cable temperature. Those tests may not be valid because the ambient and maximum cable temperatures were not maintained within specified limits in some tests. In IN 92-46, the NRC informed licensees that a licensee also discovered a mathematical error in the calculation of the ampacity derating factor as published in an ITL test report. A preliminary assessment of the use of lower-than-actual ampacity derating factors indicates

that Thermo-Lag 330-1 barrier installations may allow cables to reach temperatures that exceed their ratings, which could accelerate cable aging.

The staff is also concerned that some licensees have not adequately reviewed the results of ampacity derating tests to determine if the tests are valid and if the test results apply to their plant designs. The staff ampacity derating concerns apply to the use of Thermo-Lag 330-1 on electrical raceways both as fire barriers to protect the safe shutdown capability and as barriers to create physical independence between electrical systems.

ACTIONS REQUESTED

NRC regulations require that safe shutdown equipment be protected from fire, that onsite electric power systems have sufficient capacity and capability to ensure that vital functions are maintained, and that certain circuits and electric equipment be physically independent. The NRC has found test assemblies that failed qualification fire tests, fire test results that are incomplete and indeterminate, installation problems, questionable ampacity derating tests, and differences between reported ampacity derating factors. The NRC also found that some licensees have not adequately evaluated the results of tests for fire endurance and ampacity derating. Therefore, licensees are requested to confirm (1) that the Thermo-Lag 330-1 barrier systems have been qualified by representative fire endurance tests, (2) that the ampacity derating factors have been derived by valid tests, and (3) that these qualified barriers have been installed with appropriate procedures and quality controls to ensure that they comply with the NRC's requirements.

The staff is continuing to review technical issues associated with Thermo-Lag 330-1 barriers. The NRC staff will evaluate other fire barrier materials and systems used by the licensees to satisfy the NRC's requirements. If the staff finds concerns, it will address them through appropriate communications. This generic letter does not request actions for barrier materials and systems other than the Thermo-Lag 330-1 fire barrier system. However, the staff expects that the recipients of this generic letter will review the information to determine if it applies to other barrier materials and systems used at their facilities and consider actions, as appropriate, to avoid similar problems.

REPORTING REQUIREMENTS

All addressees are required, pursuant to Section 182(a) of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), to submit a written report within 120 days from the date of this generic letter. In this written report, the licensee shall address the following items. Where applicable, the written report can reference previous responses to Bulletin 92-01 and Supplement 1 to Bulletin 92-01 in its response to this generic letter.

1. State whether Thermo-Lag 330-1 barriers are relied upon (a) to meet 10 CFR 50.48, to achieve physical independence of electrical systems, (b) to meet a condition of a plant's operating license, or (c) to satisfy a licensing commitment. If applicable, state that Thermo-Lag 330-1 is not used at the facility. This generic letter applies to all 1-hour and all 3-hour Thermo-Lag 330-1 materials and

barrier systems assembled by any assembly method such as by assembling preformed panels and conduit shapes, as well as spray, trowel and brush-on applications.

2. If Thermo-Lag 330-1 barriers are used at the facility,

   (a) State whether or not the licensee has qualified the Thermo-Lag 330-1 fire barriers by conducting fire endurance tests in accordance with the NRC's requirements and guidance or licensing commitments.

   (b) State (1) whether or not the fire barrier configurations installed in the plant represent the materials, workmanship, methods of assembly, dimensions, and configurations of the qualification test assembly configurations; and (2) whether or not the licensee has evaluated any deviations from the tested configurations.

   (c) State (1) whether or not the as-built Thermo-Lag 330-1 barrier configurations are consistent with the barrier configurations used during the ampacity derating tests relied upon by the licensee for the ampacity derating factors used for all raceways protected by Thermo-Lag 330-1 (for fire protection of safe shutdown capability or to achieve physical independence of electrical systems) and (2) whether or not the ampacity derating test results relied upon by the licensee are correct and applicable to the plant design.

3. With respect to any answer to items 2(a), 2(b), or 2(c) above in the negative, (a) describe all corrective actions needed and include a schedule by which such actions shall be completed and (b) describe all compensatory measures taken in accordance with the technical specifications or administrative controls. When corrective actions have been completed, confirm in writing their completion.

4. List all Thermo-Lag 330-1 barriers for which answers to item 2 cannot be provided in the response due within 120 days from the date of this generic letter, and include a schedule by which such answers shall be provided.

The licensee should retain all documentation of any reviews performed to satisfy the reporting requirements for future NRC audits or inspections.

If the addressee cannot submit the information required or meet the reporting deadline, it shall include in the response due within 120 days from the date of this generic letter, a justification, a description of any proposed alternative approaches, and a schedule under which responses and proposed actions will be completed. The NRC encourages licensees to work together to develop acceptable generic solutions to the problems addressed in this generic letter.

The written reports required shall be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555 under oath or affirmation. A copy of the report shall also be submitted to the appropriate regional administrator.

BACKFIT DISCUSSION

The types of barriers addressed in this generic letter are currently installed at many operating power reactor sites and are required to meet either a condition of a plant's operating license or NRC requirements such as Section III.G of Appendix R to 10 CFR Part 50. The information required by this generic letter is necessary to verify licensees' compliance with their current licensing bases. There is no new staff position reflected in this generic letter. Therefore, any actions taken by licensees concomitant with responding to this generic letter are necessary to bring licensees into compliance with existing NRC rules and regulations, and are not the result of any new staff requirement or position. Accordingly, this generic letter is being issued as a compliance backfit under the terms of 10 CFR Section 50.109(a)(4).

The staff evaluated this generic letter in accordance with the charter of Committee to Review Generic Requirements (CRGR) and will place that evaluation in the NRC's public document room with the minutes of the October 6, 1992, meeting of the CRGR.

REQUEST FOR VOLUNTARY SUBMITTAL OF IMPACT DATA

This request is covered by Office of Management and Budget Clearance Number 3150-0011, which expires June 30, 1994. The estimated average number of burden hours is 300 person-hours for each addressee's response, including the time required to assess the requirements for information, search data sources, gather and analyze the data, and prepare the required letters. This estimated average number of burden hours pertains only to the identified response-related matters and does not include the time to implement the actions required to comply with the applicable regulations, license conditions, or commitments. Comments on the accuracy of this estimate and suggestions to reduce the burden may be directed to Ronald Minsk, Office of Information and Regulatory Affairs (3150-0011), NEOB-3019, Office of Management and Budget, Washington, D.C. 20503, and to the U.S. Nuclear Regulatory Commission, Information and Records Management Branch, Division of Information Support Services, Office of Information and Resources Management, Washington, D.C. 20555.

Although not required, the following information would assist the NRC in evaluating the cost of complying with this generic letter:

1. The licensee staff time and costs to perform requested inspections, corrective actions, and associated testing;

2. the licensee staff time and costs to prepare the required reports and documentation;

3. the additional short-term costs incurred as a result of the inspection findings such as the costs of the corrective actions or the costs of down time; and

4. an estimate of the additional long-term costs that will be incurred in the future to implement commitments such as the estimated costs of conducting future inspections or increased maintenance.

If you have any questions about this matter, please contact the technical contact or the lead project manager listed below.

Sincerely,

James G. Partlow
Associate Director for Projects
Office of Nuclear Reactor Regulation

Enclosure:
List of Recently Issued Generic Letters

TECHNICAL CONTACT: Steven West, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Mail Stop 9 A2, Washington, D.C. 20555, telephone (301) 504-1220

LEAD PROJECT MANAGER: Armando Masciantonio, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Mail Stop 13 D18, Washington, D.C. 20555, telephone (301) 504-1337