UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 25, 1994

MEMORANDUM FOR: Document Control Desk
Document Management Branch
Division of Information Support Services
Office of Information Resources Management

FROM: Andrew J. Kugler, Acting Chief
Generic Communications Branch
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

SUBJECT: DOCUMENT ASSOCIATED WITH SUPPLEMENT 1 TO GENERIC LETTER 86-10 TITLED "FIRE ENDURANCE TEST ACCEPTANCE CRITERIA FOR FIRE BARRIER SYSTEMS USED TO SEPARATE SAFE SHUTDOWN TRAINS WITHIN THE SAME FIRE AREA"

The Plant Systems Branch has prepared the subject generic letter supplement. The Committee to Review Generic Requirements (CRGR) has reviewed and endorsed this generic communication. This memorandum provides a compilation of the background material relevant to the subject generic communication that should be made available to the public. By copy of this memorandum we are providing the enclosed document to the Public Document Room. The enclosure is the resolution of public comments received on the proposed generic letter supplement, as endorsed by CRGR.

We request that you provide us with the Nuclear Documents System accession number for this memorandum. This information can be provided to the listed contact by telephone or by E-Mail.

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Enclosures: As Stated

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Original signed by Tea J. Kim for
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Division of Operating Reactor Support
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Enclosure 1

STAFF RESPONSES TO PUBLIC COMMENTS SUPPLEMENT 1 TO GENERIC LETTER 86-10 FIRE ENDURANCE TEST ACCEPTANCE CRITERIA FOR FIRE BARRIER SYSTEMS USED TO SEPARATE SAFE SHUTDOWN FUNCTIONS WITHIN THE SAME FIRE AREA

BACKGROUND

On November 18, 1992, the U.S. Nuclear Regulatory Commission (NRC) staff met with the Nuclear Management and Resources Council (NUMARC) to discuss fire barrier testing acceptance criteria for fire barrier systems used to separate safe shutdown functions within the same fire area. At this public meeting, the NRC staff provided its proposed position to NUMARC. In a letter of December 8, 1992, NUMARC provided its comments on the proposed staff position. In addition to the comments received from NUMARC, the NRC staff received comments from the Tennessee Valley Authority and fire barrier manufacturers. Before publishing the proposed criteria in the Federal Register the staff did not make changes to the proposed criteria based on these comments. However, the comments were considered as part of the public comments in this document.

On July 23, 1993, the NRC published proposed Supplement 1 to Generic Letter (GL) 86-10 in the Federal Register and invited comments. The comment period expired August 23, 1993. Comments were received anonymously and from Tennessee Valley Authority (TVA); Underwriters Laboratories, Incorporated (UL); Winston and Strawn; William A. Thue; Ohio Citizens for Responsible Energy, Incorporated (OCRE); American Nuclear Insurers (ANI); Consumers Power; Entergy Operations, Incorporated; Philadelphia Electric Company; NUMARC; Florida Power and Light Company; Arizona Public Service Company; Iowa Electric Light and Power Company; Southern Nuclear Operating Company; Georgia Power Company; Darchem Engineering Limited; and an alleger.

COMMENTS AND NRC STAFF RESPONSES

I. Anonymous Letter of November 30, 1992, to Chairman Selin (Attachment 1)

COMMENT 1 - Hose Stream Test Methods

"The acceptance of the fog nozzle appeared to be based around two facts; the fact that the standards allow you to burn for one hour and hose stream and if you fail you can then run for 30 minutes and hose stream again therefore the full hour can be the fog nozzle, the other is that the utilities will fight their fires with fog nozzles."

STAFF RESPONSE

Generic Letter 86-10, "Implementation of Fire Protection Requirements," established that Chapter 7 of National Fire Protection Association (NFPA) Standard 251, "Standard Methods of Fire Tests of Building Construction and Materials," provided the basis for the staff position for qualification testing of raceway fire barriers. This position is not changed by Supplement 1 to GL 86-10.

NFPA 251, Chapter 7, "Fire Test Acceptance Criteria for Nonbearing Partition Walls," allows the hose stream tests for a nonbearing wall to be performed on a duplicate test specimen after the specimen has been exposed to the standard test fire for a period equal to one-half of the fire resistance rating desired, but for not more than 1-hour (e.g., after a 30-minute fire exposure to qualify a 1-hour fire barrier and after a 1-hour fire exposure to qualify a 3-hour fire barrier). After the fire exposure, the test specimen is subjected to a solid hose stream test. The NRC staff position accepts this hose stream test method.

The staff also accepts the application of the hose stream test after the completion of the full fire endurance test period. If this method is used, one of the following hose stream test options can be applied:

- A solid hose stream applied at random to all exposed surfaces of the test specimen through a 2½-inch national standard playpipe with a 1⅛-inch orifice at a pressure of 30 psi at a distance of 20 feet from the specimen. The duration of the hose stream application is 1 minute for a 1-hour barrier and 2½ minutes for a 3-hour barrier; or

- A fog hose stream applied at random to all exposed surfaces of the test specimen through a 1½-inch fog nozzle set at a discharge angle of 30 degrees with a nozzle pressure of 75 psi and a minimum discharge of 75 gpm with the tip of the nozzle at a maximum of 5 feet from the test specimen. The duration of the hose stream application is 5 minutes for both 1-hour and 3-hour barriers); or

- A fog hose stream applied at random to all exposed surfaces of the test specimen through a 1½-inch fog nozzle set at a discharge angle of 15 degrees with a nozzle pressure of 75 psi and a minimum discharge of 75 gpm with the tip of the nozzle at a maximum of 10 feet from the test specimen. The duration of the hose stream application is 5 minutes for both 1-hour and 3-hour barriers.

NRC staff guidance in NUREG-0800, Standard Review Plan (SRP), Section 9.5.1, "Fire Protection For Nuclear Power Plants," specifies these hose stream methods for fire barrier penetration seal fire endurance tests. Therefore, the application to these hose stream test options to fire barriers systems used to separate safe shutdown functions within the same fire area is consistent with existing staff guidance. Furthermore, the staff believes that a fog hose stream test (after a full-duration fire test) satisfies the same fire safety objectives for fire barrier penetration tests as raceway fire barrier systems.

The staff accepts a fog hose stream test (after the full duration fire test) based on the following considerations:

(1) Nuclear power plant fire protection programs are based on the defense-in-depth concept, in which fires are prevented through administrative control of transient combustibles and ignition

sources. Installed plant fire protection features also provide fire separation between safe shutdown trains and enable the plant staff to rapidly detect, control, and suppress fires that occur despite the prevention efforts.

(2) The staff recognizes the fire-resistive construction of nuclear power facilities, the defense in depth of the fire protection program, and the low combustible fire loads in nuclear power plants. Thus, the staff does not expect significant fire-related structural challenges (e.g., collapse of cable trays) to the integrity of the raceway fire barriers before the fire is controlled and suppressed by either automatic fire suppression systems or the in-plant fire brigade.

(3) In-plant fire brigades apply water through fog streams to control fires in areas with energized electrical equipment (most areas with raceway fire barriers).

(4) The pressures and the discharge rates from fog stream hose streams provide sufficient cooling and eroding effects to evaluate the fragility of the barrier system after the full-duration fire exposure.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Hose Stream Test Criteria

"The standard was written for another purpose entirely when it addressed the hose stream, we now require no water to pass the barrier."

STAFF RESPONSE

The meaning of this comment is not clear. Supplement 1 to GL 86-10 is consistent with the acceptance criteria of NFPA 251, Chapter 7, in that it specifies that the fire barrier should remain intact and prevent the projection of water beyond the unexposed surface of the fire barrier during the hose stream test. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - ASTM Hose Stream Tests

"The new ASTM standard for envelopes still allows this second burn but requires both hose streams be solid."

STAFF RESPONSE

In responding to Comment I.1 the staff stated the bases for its position on hose stream testing. The current draft of the ASTM standard does not require a hose stream test for raceway fire barriers. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - UL Hose Stream Tests

"U.L.'s new envelope standard uses solid hose stream."

STAFF RESPONSE

In responding to Comment I.1, the staff stated the bases for its position on hose stream testing. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 5 - Penetration Seal Hose Stream Tests

"The penetration seal industry specifically has the authority under NUREG-0800 to use the fog nozzle however has always used the solid stream because the fog nozzle produced weak systems in the market place."

STAFF RESPONSE

The intent of the comment is not clear. The Standard Review Plan accepts the use of fog hose stream tests for penetration seals. In Supplement 1 to Generic Letter 86-10 the staff clarified and refined the fire barrier testing acceptance criteria previously specified in GL 86-10 for fire barriers used to separate redundant safe shutdown trains within the same fire area and does not apply to penetration seal fire tests. Therefore, the comment is not germane to the supplement. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 6 - ANI Hose Stream Tests

"The staff recognized that the NRC had no standard for envelope systems and recognized the ANI #5 standard along with NFPA 251, both solid stream but more than that the ANI which has been used until now wouldn't allow the second burn and wouldn't certainly allow the fog nozzle."

STAFF RESPONSE

In responding to Comment I.1, the staff stated the bases for its position on hose stream testing.

The staff endorses NFPA 251, but does not recognize ANI Bulletin 5(79), "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits," as an acceptable method for testing raceway fire barrier systems in its review guidance, such as the SRP. The staff reviewed ANI Bulletin 5(79), and found that it does accept the fog nozzle hose stream test. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 7 - Fog Nozzle Hose Stream Tests

"Until now there hasn't been any systems either in seals or envelopes accepted with the fog nozzle as the industry standard."

STAFF RESPONSE

In responding to Comment I.1, the staff stated the bases for its position on hose stream testing. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 8 - Use of Fog Nozzles for Fire Fighting

"Any fire fighting school teaches you to fog nozzle to cool and get closer to the fire for personnel protection but if you want to quench the burning embers and actually put out the fire turn the nozzle to solid stream."

STAFF RESPONSE

The staff agrees that fire fighting schools instruct trainees to use fog streams on fires involving energized electrical cables or equipment until the electrical hazard can be electrically isolated. If the redundant safe shutdown train is protected by a raceway fire barrier system and the other train is on fire, the fire would be cooled and controlled by either an automatic fire suppression system or the plant fire brigade. After the affected train has been electrically isolated and flaming combustion has been eliminated, the fire brigade can complete the final phase of fire extinguishment. This phase will require quenching burning embers by saturating deep seated smoldering fires, such as a cable fire, with water. By this phase of extinguishment, the room temperatures will be sufficiently cooled to the point that they will not affect the protected train of safe shutdown functions. The fire brigade under these conditions may use a narrow fog pattern or a straight stream to complete the final extinguishment.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

II. Tennessee Valley Authority Letter of December 3, 1992, to Conrad E. McCracken, Chief, Plant Systems Branch, NRR (Attachment 2)

COMMENT 1 - Use of Other Test Standards

"Since minor differences exist between the standard laboratory methods and the specific criteria in the draft NRC document, it is likely that confusion will occur at a later date regarding the acceptability of these different methods unless the issue is clearly addressed now."

"TVA recommends that the draft NRC document be revised to recognize UL Subject 1724, and other relevant laboratory standards, as an applicable method for performing the fire exposure tests. Tests conducted in accordance with laboratory standards should be required to meet all the acceptance criteria incorporated in those standards, as if the laboratory performed the tests. To avoid the need to produce an exhaustive list of relevant standards, TVA recommends that the NRC document be revised to state, "Fire exposure tests may also be performed in accordance with standard test methods of Nationally Recognized Testing Laboratories (such as UL Subject 1724)."

STAFF RESPONSE

The staff reviewed UL Subject 1724 and found that the standard does not specify acceptance criteria for internal temperature rise on the external surface of the raceway or within the fire barrier system during fire endurance test. In addition, the standard does not provide guidance for thermocouple averaging, assessing the effect of elevated internal temperatures on cable functionality, and thermocouple placement on junction boxes. Upon considering the differences between the staff position and UL Subject 1724, the staff decided not to endorse UL Subject 1724 (or any other test standards) in Supplement 1 to GL 86-10.

Supplement 1 to GL 86-10 states that licensees "may propose alternative test methods and acceptance criteria to demonstrate an equivalent level of protection; the staff will review such proposals on a case-by-case basis." Therefore, the staff concludes that licensees can use or adapt laboratory test standards for test programs criteria provided the standards meet the performance objectives established by the acceptance criteria in the Supplement 1 to GL 86-10.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Tests by Nationally Recognized Laboratories

"The draft criteria have been developed as part of addressing the acceptability of Thermolag fire barrier systems, which were not rated by a nationally recognized fire testing laboratory. Other barrier systems exist which were so rated. For example, Minnesota Mining & Manufacturing Co. (3M) electrical protective systems of various types have been rated/listed by Underwriters Laboratories, Inc. These ratings qualify these systems as rated fire barriers as required 10 CFR 50 Appendix R in exactly the same manner as similar ratings for fire doors, fire dampers, etc. Again TVA considers it important that the draft criteria explicitly state that such approved ratings are not invalidated. TVA recommends that the document include a statement such as "Raceway fire barrier systems which have been rated by a Nationally Recognized Testing Laboratory (e.g., Underwriters Laboratory or Factory Mutual) are acceptable for use without further testing or analysis."

STAFF RESPONSE

The staff disagrees with the recommendation. During its recent review of raceway fire barriers, the staff found that fire barrier systems listed by recognized testing laboratories may not meet existing NRC guidance without further testing or analysis. (The staff issued these findings to industry through information notices.) To demonstrate that a barrier system is acceptable, the licensee should determine that the in-plant cables have an equivalent level of thermal degradation resistance to those cables used to qualify the fire barrier system. To demonstrate this equivalence, a licensee may have to perform air oven functionality tests. In addition, the licensee must ensure that the listing (Underwriters Laboratory Listing) bounds the in-plant configurations. For example, a listing which supports the design and installation of a fire barrier system on a 24-inch wide cable tray may not bound the application of this fire barrier material on either a 36-inch wide tray or a 12-inch wide tray. The demonstration of structural and the thermal performance of fire barrier systems on various cable tray widths and conduit diameters by fire endurance testing is necessary to bound the various in-plant configurations.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Previous Appendix R Exemptions

"NRC has explicit reviewed and approved specific Appendix R deviations and exemptions for electrical fire barrier systems at many nuclear power plants. Imposition of additional, or changed, requirements to circumstances which have been reviewed and approved constitutes a backfit under 10 CFR 50.109. Such changes should be addressed on an individual basis, in accordance with backfit procedures. The draft criteria should explicitly state that they do not invalidate previous NRC-approved deviations or exemptions."

STAFF RESPONSE

Supplement 1 to GL 86-10 provides fire test acceptance criteria for future fire endurance qualification tests. The supplement does not address previous exemption requests and does not intended to invalidate previous NRC-approved deviations or exemptions. If the technical basis for an exemption or deviation relied on the installation of a fire barrier, Supplement 1 to GL 86-10 will not change the basis (the installation of a fire barrier) for approving the exemption or deviation. However, it remains the responsibility of the licensee to demonstrate that the fire barrier specified in the exemption or deviation request can perform its specified fire-resistive function.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - Insulation Resistance Testing

"The formula for determining minimum acceptable insulation resistance for cables (which appears on page 3 of the attachment to the draft criteria) is taken directly from IEEE 690-1984, section A.10.1. The Megger tests for which this formula is to be used to determine acceptance values include tests to be done during exposure to fire temperatures (for instrumentation cables) and immediately after such exposure. This IEEE standard establishes the acceptance criteria for new cables at room temperature immediately following installation. Applying this formula for determining the acceptance values for insulation resistance tests to be conducted at elevated temperatures has the affect of imposing more restrictive requirements than the cable had to meet when new, due to the recognized inverse relationship between insulation resistance and temperature. This would be a backfit which TVA considers technically inappropriate. NRC should apply the IEEE 690-1984 criteria for assessing minimum insulation resistance at room temperature, as intended."

STAFF RESPONSE

GL 86-10, Enclosure 1, "Interpretations of Appendix R," stated that

> In promulgating Appendix R, the Commission has provided methods acceptable for assuring that necessary structures, systems and components are free from fire damage. That is, the structure, system or component under consideration is capable of performing its intended function during and after the postulated fire, as needed.

The purpose of the acceptance tests recommended in IEEE 690-1984 is to verify that cable insulation was not damaged during installation. The formula for determining the minimum acceptable insulation resistance value for cable insulation (Megger) tests is a general criterion used by the industry (see Section 8.2.2 of IEEE 422-1986, "Guide for the Design and Installation of Cable Systems in Power Generating Stations") to assess the condition of cable systems. The utility of the formula is to ensure that the cable has a minimum insulation resistance (IR) value so that it will not fail when energized and will support the current carrying function of the cable. It is obvious that during a fire, the cables will be above room temperature when they will have to perform their intended safety function. Therefore, it makes sense to assess their functionality (i.e. measure IR) at these temperatures to assure that these cables will indeed function as intended. For instrument or special application cables in which circuit performance is sensitive to changes in insulation resistance, the staff recommends that insulation resistance measurements be taken during the fire endurance testing in order to demonstrate functionality during the fire exposure.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 5 - Instrumentation Cables

"The attachment to the criteria requires an evaluation of the impact of the minimum insulation resistance value on the functionality of instrumentation cables, in addition to the insulation testing. This implies the need to perform accuracy calculations. Such calculations are inherently application-specific, and would have to be performed for each specific instrument circuit in a power plant which is protected by a Thermolag fire barrier enclosure. This would be a major effort which would not materially add to the information obtained from the Megger and hi-pot testing. The NRC's insulation resistance acceptance criteria should be of a go/no go nature (e.g., IEEE 690-1984), and accuracy calculations should only be required for cables which do not pass these criteria. The paragraph immediately following the formula on page 3 of the attachment should be deleted."

STAFF RESPONSE

For instrument or special application cables in which circuit performance is sensitive to changes in insulation resistance, the staff recommends that insulation resistance measurements be taken during the fire endurance testing in order to demonstrate functionality during the fire exposure. Sandia National Laboratory (SNL) research studies have shown that Megger and hi-pot testing may not always discern whether cables protected by a possibly deficient fire barrier system (i.e., fire barrier deviation condition) have been exposed to temperatures which would affect the performance of an instrument circuit. An instrument circuit could be significantly degraded during fire exposure because the temperature of the insulation will dramatically affect its resistive capability. The staff concluded that post-test measurements are not sufficient alone because of this temperature-related effect and the failure of certain cables during testing which showed post-test insulation resistance values of greater than 10^8 ohms (NUREG/CR-4638/Volume 1 of 2, "*Transient Fire Environment Cable Damageability Test Results: Phase I*," September 1986). If a licensee proposes to justify a fire barrier deviation, it should evaluate cable functionality for the plant-specific application.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 6 - Thermal Exposure Threshold

"The concept of thermal exposure threshold (TET) is being applied inappropriately in section d. of the attachment to the draft criteria. TET limits are established to address concerns of potential degradation of cable insulation due to elevated temperatures associated with circuit faults. Exceeding TET limits does not imply an instantaneous failure of cable insulation, but rather establishes a need to evaluate long-term acceptability of the cables after it has experienced such temperatures. The visual inspections and megger and hipot tests called for by these draft criteria constitute an evaluation to determine whether the insulation has been damaged. TVA recommends that the concept of TET be deleted from these criteria."

STAFF RESPONSE

The thermal exposure threshold is the basis for mathematical analysis and correlation of past and related test data to be used in the engineering evaluation for demonstrating functionality for a specific fire barrier deviation condition. The subject section gives examples of where the maximum cable temperature or maximum short-circuit temperature with the normal operating temperature is used to set the appropriate temperature rise limits for the fire barrier system based on the specific cable application. The subject section is to be a conceptual framework for an engineering evaluation of fire barrier systems that deviate from the fire barrier acceptance criteria. This methodology is consistent with the staff's previous GL 86-10 position that an engineering evaluation can be used to demonstrate cable or component functionality for a fire barrier deviation condition.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

III. Nuclear Management and Resources Council Letter of December 8, 1992, to Conrad E. McCracken, Chief, Plant Systems Branch (Attachment 3)

COMMENT 1 - Application of Supplement 1 to GL 86-10

"In the case of TSI fire barriers, the NRC has formally declared, through Bulletin 92-01 and its supplement, that existing installations are indeterminate and subject to reverification. The draft acceptance criteria have been developed primarily for the purposes of application to future fire tests to address the TSI situation, and would apply as well to other fire barrier testing that may be performed in the future. The NRC document discussing the criteria should therefore clearly state that the test and acceptance criteria are forward looking and do not result in the need for retesting or analysis of fire barriers previously evaluated and found acceptable by licensees in accordance with NRC Generic Letter 86-10, unless they have been formally identified by the NRC as indeterminate."

STAFF RESPONSE

The staff clearly stated in Supplement 1 to GL 86-10 that it will use the supplement only to review future fire barrier testing programs. The staff will continue to use the acceptance criteria guidance specified in GL 86-10 to evaluate the adequacy of existing fire barrier system designs that have not been declared indeterminate. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Engineering Evaluations

"The NRC draft document discusses the need for an engineering evaluation to demonstrate functionality in the event that temperature limits are

exceeded, or visual damage is observed to the barrier or the cable. The draft document states that NRC review and approval of this engineering evaluation will be necessary. While we are hopeful that the NUMARC industry testing program will provide enclosure upgrades that will not require the use of these engineering evaluations, there is nonetheless a potential that forthcoming utility efforts to address installed Thermo-Lag configurations could result in submittal of large number of such evaluations, and corresponding delays in the NRC approval cycle. We therefore, believe the process for NRC review and approval, as outlined in the draft document, should provide that existing utility compensatory measures can be removed following completion of the engineering analysis and any associated modifications to the barrier system. NRC Generic Letter 86-10 provides that utilities could document these type of analysis for subsequent NRC review during inspections, and NRC has indicated in the November 13 Commission Briefing that inspections are planned for the 1994-1995 time frame. We believe there would be a benefit to developing a generic framework for these analysis, and providing guidelines that would allow for the removal of compensatory measures prior to completion of NRC review. Industry would be willing to work with NRC through NUMARC to develop such guidelines to the extent they are necessary beyond the explicit evaluation criteria that will be provided in the final form of the NRC document."

STAFF RESPONSE

If a fire barrier system covered by Supplement 1 to GL 86-10 does not meet the acceptance criteria of the supplement for barrier burnthrough, temperature rise limits, cable degradation, or barrier degradation by the hose stream test, the fire barrier systems does not satisfy the fire-resistive function specified by Section III.G of Appendix R to 10 CFR Part 50. The supplement allows a licensee to request a plant-specific deviation to a license condition or an exemption to the regulation based on an engineering evaluation which demonstrates cable functionality. Barrier degradation or cable damage conditions deviate from Appendix R fire barrier requirements. Deviations from a plant license or exemptions to the regulation require NRC approval. GL 86-10 guidance does not supersede a license condition or regulation; therefore, these engineering evaluations, which justify a deviation to a licensee condition or an exemption to a regulation, are not subject to the provisions of the generic letter. The number of exemption and deviation requests will depend on industry's ability to conduct a fire endurance testing program which demonstrates that these indeterminate fire barrier systems can provide an adequate level of fire-resistance and, when properly configured, can perform their specified fire barrier function. The purpose of the recommended functionality tests is to justify observed deviations in fire barrier performance. Engineering analyses justifying these deviations should not rely substantially upon the equipment (e.g., cable) qualification as the basis for acceptance.

Operability determinations are the responsibility of the individual licensees. If a licensee elects to request a deviation from its license or an exemption from the regulation upon completing its functionality

analysis and any fire barrier modifications needed to support the basis of the analysis, the licensee may remove its compensatory measures while its analysis is being reviewed by the NRC. However, if the staff finds the licensee's request and analysis unacceptable, they may be subject to enforcement actions.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Fire Tests of Empty Enclosures

"The criteria, and accompanying flow charts, should more clearly address the process for testing with empty enclosures and the use of air oven cable tests or other cable performance data, on the basis of measured temperature profiles from the fire tests."

STAFF RESPONSE

The staff agrees with the comment. In responding to Comment XII.1, the staff stated its position on testing empty enclosures.

COMMENT 4 - Thermocouple Placement

"Page 8 of the NRC draft document discusses thermocouple placement consideration. The discussion notes that "industry considers [placement of thermocouples on cables] the proper location for determining the temperature rise..." While industry considers that protection of the cables, rather than the enclosure, is the fundamental safety function, we agree that placement of thermocouples on the cables is not the best approach. We would note that the industry position paper on test criteria, provided to NRC on October 26, recommends that thermocouples be placed on copper conductors, and that testing be performed with empty enclosures. Furthermore, we believe that the copper conductors should provide for measurement of temperatures on surfaces of the enclosure that the cable may realistically come in contact with. With respect to cable trays, we do have a concern that the NRC draft document specifies use of a copper conductor underneath the cable tray rungs. We believe the appropriate placement for the copper conductor is on top of the cable tray rungs, as this will provide for measurement of temperatures that would be experienced by installed cables."

STAFF RESPONSE

The staff agrees that the protection of the cables within the raceway fire barrier system is the fundamental safety function. To properly protect these cables, the fire barrier system should maintain the cables free of fire damage, thereby ensuring functionality. The staff revised the acceptance criteria to include guidance on thermocouple placement when cables are not installed in the raceway during the fire endurance test. This guidance is provided on Page 10 of Enclosure 1 to Supplement 1 of GL 86-10.

COMMENT 5 - Circuit Integrity Monitoring

"The attachment to the NRC draft document discusses acceptable methods for determining cable functionality. Section b. discusses cable circuit integrity testing, and concludes that this is not a valid method for demonstrating that the protected shutdown circuits are capable of performing their required function. We agree with this statement, and believe the criteria should explicitly state that circuit integrity monitoring need not be performed. This will simplify the test procedure and provide for more timely performance of post exposure megger testing."

STAFF RESPONSE

The staff agrees with the comment and revised the acceptance criteria to state that circuit integrity monitoring during fire endurance tests is not needed to satisfy the acceptance criteria. However, circuit integrity testing at rated voltage continues to be needed during air oven tests. This additional guidance is provided on Page 1 of the attachment to Enclosure 1 to Supplement 1 of GL 86-10.

COMMENT 6 - Cable Functionality

"The second paragraph of page 4 of the attachment discusses cable normal operating temperature and its effect on the total temperature rise. We agree that cable normal operating temperature is a consideration in the engineering evaluation; however, we would note the following:

a. Initial operating temperature is only a consideration for power cables, of control and instrument cables that may be in the same enclosure with power cables. Elevated operating temperature need not be considered for instrument and control cables in separate enclosures.

b. Power cables will not be subjected to rated voltage and current prior to the fire exposure, and may only be intermittently energized, or not energized at all, prior to the exposure. The analysis should assume realistic conditions rather than rated voltage and current as stated. At the November 19 meeting, NRC stated that the analysis should assume operating voltage and normal current conditions.

c. The effect of initial temperature on endpoint is not a simple function of adding the difference between the initial temperature and the ambient air temperature to the measured temperature rise. Appendix V of NUMARC's draft criteria submittal of October 26 provides a heat transfer calculation relative to the effect of initial temperature on the endpoint temperature of 90 °C versus 23 °C. This calculation shows the effect to be minimal (12 °C) at one hour, and negligible at three hours. The attachment to the NRC draft document should allow the use of heat transfer calculations to determine the endpoint temperature rise."

STAFF RESPONSE

a. The staff agrees that the ambient temperature should be considered the normal operating temperature for instrument and control cables in separate enclosures.

b. The staff believes that any engineering evaluation to demonstrate functionality should be conservative to compensate for any age-related degradation over the life of cable systems installed in the plant.

c. The NUMARC analysis did not allow margin for loaded power cables subject to self-heating effects. NUMARC's does not have a correct basis for the effects of the initial cable elevated temperature on the cable thermal response. The Sandia National Laboratories analyzed the NUMARC heat transfer study and found that NUMARC did not consider that an energized cable would continue to generate thermal energy by self-heating throughout the fire exposure. A simple sample calculation of this effect indicates that the difference between the response of a non-energized cable and an energized cable to a step change in envelope temperature to 250 °C is not 12 °C as stated in NUMARC's submittal of October 26, 1992, but rather, at least 68 °C (excluding the effects of copper resistivity increasing with increased temperature). The staff believes that the acceptance criteria must provide sufficient margin to account for this effect and other uncertainties.

The staff does not agree that heat transfer calculations alone are sufficient to determine the endpoint of the rise in fire endurance temperature. Current models may not be capable of demonstrating the relationship and effects that the worst case cable operating temperature may have on the endpoint temperature rise.

The staff did not change its proposed review guidance or acceptance criteria in response to these comments.

COMMENT 7 - LOCA Temperature Profiles

"The attachment to the NRC draft document should state that comparison of fire test temperature profiles to existing EQ and LOCA test results, or air oven test results, is an acceptable approach to demonstrate cable functionality."

STAFF RESPONSE

The staff agrees with the comment provided the analysis incorporates the temperature rise caused by the self-heating effects of power cables. The staff revised the acceptance criteria contained in Section III of the attachment to the criteria (see Page 1 of the attachment to Enclosure 1 to Supplement 1 of GL 86-10).

COMMENT 8 - Thermal Exposure Threshold

"TVA submitted comments on the NRC draft document by letter to you of December 3, 1992. Item 6 of that letter questions the appropriateness of the cable thermal exposure threshold (TET) as a measure of short term cable operability. We concur with this comment."

STAFF RESPONSE

The staff addressed the cable thermal exposure threshold in its response to Comment II.6.

COMMENT 9 - Insulation Resistance Testing

"Item 4 of the TVA letter referenced above questions the use of the formula for determining minimum acceptable insulation resistance on page 3 of the attachment to the NRC draft document. We concur with this comment. The given formula is taken from IEEE 690-1984, section A.10.1, and is intended for use with new cables at room temperature. Testing of cables at elevated temperatures (i.e., immediately following the fire test) to this criteria represents a more restrictive requirement that the cable has to meet when new. The formula should only be used for cables tested at room temperature."

STAFF RESPONSE

The staff addressed insulation resistance testing in its response to Comment II.4.

IV. Nuclear Information and Resource Service Letter of December 15, 1992, to James Taylor, Executive Director of Operations (Attachment 4)

This letter was the basis of a 10 CFR 2.206 petition and reviewed the concerns regarding the acceptability of Thermo-Lag as a fire barrier. From this review the staff determined that the following comments were applicable to the staff's position on raceway fire barrier fire endurance testing acceptance criteria.

COMMENT 1 - Combustibility

"...Thermo-Lag is combustible, contrary to 10 CFR 50 Appendix A and R. The NRC's own testing (and dramatic color photographs) indicate that Thermo-Lag is indeed combustible. We understand, however, that the NRC is preparing an Information Notice acknowledging Thermo-Lag's combustibility. Further, we understand the NRC may require utilities to consider Thermo-Lag in its analysis of fire loads. It would indeed be ironic to have the fire protection material listed as part of the fire protection problem. Moreover, Thermo-Lag is often used in areas required to be free of combustible material. This is itself is evidence of an uncorrectable regulator violation and by itself should require removal of all Thermo-Lag material from use as fire barrier."

STAFF RESPONSE

NRC-sponsored tests indicated that Thermo-Lag exhibits combustible characteristics. The NRC issued the results of the tests in Information Notice 92-82, "Results of Thermo-Lag 330-1 Combustibility Testing," December 15, 1992.

The stated objective of Supplement 1 to GL 86-10 is to refine and clarify the fire barrier acceptance criteria specified in GL 86-10. As such, the focus of the supplement acceptance criteria is on fire endurance testing, not combustibility. NRC requirements and guidance do not specify that fire barrier systems be noncombustible. The NRC has issued guidance for the use and control of combustibles in nuclear power plants.

The NRC fire protection guidance documents include the following definitions for noncombustible material:

(a) Material which in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat; or

(b) Material having a structural base of noncombustible material, with a surfacing not over ¼-inch thick that has a flame spread rating of not higher than 50 when measured using ASTM E-84, "Surface Burning Characteristics of Building Materials."

The NRC has not changed these definitions. ASTM E-136 is one test method for obtaining data for assessing a combustibility hazard against these definitions.

NUMARC, as part of the industry effort to resolve the technical concerns with Thermo-Lag fire barriers, is evaluating issues associated with the combustibility of Thermo-Lag materials. These issues include the use of Thermo-Lag fire barriers to establish combustible free zones between redundant safe shutdown trains and to construct radiant energy heat shields inside containment. During a meeting of June 29, 1993, NUMARC informed the staff that it was conducting additional tests to assess the combustibility of Thermo-Lag and is developing a methodology for reviewing plant-specific Thermo-Lag applications in a manner that will be consistent with the NRC combustibility definitions. The NRC staff will review the NUMARC methodology. The staff will issue additional information on these issues, which are being addressed independently of the establishment of fire endurance test acceptance criteria, as appropriate.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Hose Stream Test Methods

"The NRC staff, in its proposed fire barrier criteria, incorrectly would allow the use of fog nozzle, rather than full-force hose stream test.

ASTM E-119, the standard fire test used by the NRC and passed by other products, requires a full-force hose stream test. We also note that the new, as-yet-unnumbered ASTM test for electrical raceways also would require a full hose stream test."

STAFF RESPONSE

In responding to Comment I.1, the staff stated its position on hose stream testing. The current draft of the ASTM standard does not require a hose stream test for raceway fire barriers. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

V. Minnesota Mining and Manufacturing Company (3M Company) Letter of December 18, 1992, to Ralph Architzel, Chief, Special Projects Section, Plant Systems Branch (Attachment 5)

COMMENT 1 - Operating Licenses

"3M has during the period 1981 to the present provided fire barrier product for 29 utility installations located throughout the country. These installations were all accepted for plant operation. Do the letters of acceptance and license to operate issued by the NRC covering these installations remain valid? If not, why not?"

STAFF RESPONSE

Supplement 1 to GL 86-10 does not affect the operating licenses for these facilities and does not affect invalidate letters from the NRC to applicants and licensees concerning NRC acceptance of a fire barrier system at a specific facility. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Testing Laboratories

"3M fire barrier product has over the years been continuously tested to American Nuclear Insurers (ANI) standards, as adopted by the NRC, and by test facilities, such as UL, Southwest Research Institute, CSTB in France, and Certified Testing Laboratories (CTL). Unlike the in-house testing practice and procedure of some manufacturers, 3M's product testing was conducted in its facilities under procedures correlated with UL and Factory Mutual Insurance standards, resulting in a 3M product classified and approved by these organizations. Does the NRC accept tests conducted under the above procedure and witnessed, approved and certified by Twin Cities Testing, a nationally recognized testing service, to be valid confirmation of the basic tests and criteria originally established for 3M product at UL and SWRI?"

STAFF RESPONSE

The staff does not recognize ANI Bulletin 5(79) as an acceptable method for testing raceway fire barrier systems in its review guidance, such as the SRP.

The NRC staff is not familiar with the qualifications or fire endurance testing expertise of Twin Cities Testing Service and, therefore, cannot respond directly to the question. Typically, the NRC staff evaluates fire test programs and fire test results individually for specific licensing applications. This was the case, for example, for the recent test programs carried out by Texas Utilities (TU) Electric Company for Comanche Peak Steam Electric Station (CPSES) and Tennessee Valley Authority (TVA) for Watts Bar Nuclear. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Previous Test Results

"3M has over the years accumulated a substantial body of data based upon use of a specified 12 inch spacing of thermocouples during fire tests, as directed by ANI. Current testing procedures now indicate a 6 inch spacing requirement. It is 3M's intent to conduct all future testing in accordance with this revised procedure. Does the NRC accept the validity of previously developed data generated at the manufacturers expense in accordance with the established 12 inch standard?"

STAFF RESPONSE

The staff clearly stated in Supplement 1 to GL 86-10 that it will use the supplement to review future fire barrier tests. The staff will continue to use the acceptance criteria and guidance specified in GL 86-10 to evaluate fire barrier test results and system designs. The staff will evaluate the acceptance criteria specified in the test reports for any such tests individually. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - Miscellaneous Issues

"Previously established test protocol and performance criteria placed emphasis on product capability with respect to specified areas of vital concern to public health and safety, including combustibility, toxicity, seismic performance, weight, and ampacity derating. Current efforts to re-evaluate test criteria are focused on product fire performance. Does the NRC intend to establish as part of the current test re-evaluation program an equal emphasis on all of the above areas of product performance relating to health and safety issues? How and when will these areas of concern be addressed in order to enable manufacturers to respond to customer demands for qualified product?"

STAFF RESPONSE

In responding to Comment IV.1, the NRC staff stated its position on combustibility of fire barriers. The staff stated its views on toxicity in its response to Comment XXIII.3. The staff has issued requirements and guidance on ampacity derating and seismic performance. The staff issued Supplement 1 to GL 86-10 to clarify existing acceptance criteria for conducting and evaluating future fire endurance tests. Ampacity derating and seismic analyses are outside the scope of the supplement.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 5 - Combustibility

"The original NRC test standard for noncombustibility was ASTM E84. In the current test re-evaluation process the NRC has indicated that ASTM E136 will now be applied. At the NRC public meeting on November 19, 1992, it was stated by NRC representatives that standard E136 would be interpreted to mean a product equivalent in noncombustibility to fire rated gypsum board. Will the E136 standard as defined in the November 19 meeting be applied against all existing installations regardless of manufacturer?"

STAFF RESPONSE

In responding to Comment IV.1, the NRC staff stated its position on combustibility. The staff recognizes ASTM E-84, "Surface Burning Characteristics of Building Materials," as an acceptable standard for determining flame spread ratings. However, flame spread alone does not allow a complete assessment of material combustibility. ASTM E-136 is one test method for obtaining data for assessing the combustibility hazard introduced by materials installed in nuclear power plants in accordance with existing NRC guidance.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 6 - Hose Stream Test Methods

"The hose stream requirements of NFPA 251, ASTM E119, and ASTM E814 have long been recognized as providing the mechanical means of determining fire barrier product performance with respect to thermal shock, effects of erosion and the ability to resist mechanical abuse. The new test protocol allows for fog nozzle testing in lieu of the solid stream test. What is the basis upon which the substitute fog nozzle test has been determined to provide equivalent test results regarding these critical product performance characteristics."

STAFF RESPONSE

In responding to Comment I.1, the staff stated the bases for its guidance on hose stream testing and as a result of this comment the staff did not change its proposed review guidance or acceptance criteria.

COMMENT 7 - Application of Test Acceptance Criteria

"At the present time there are fire barrier systems of either one or three hour performance duration at the various utility plant locations. These systems have been provided by one or the other of several manufacturers. Does the NRC intend that both systems are subject to the entire revised testing and specified performance criteria?"

STAFF RESPONSE

In Supplement 1 to GL 86-10, the staff states that the NRC will use the criteria to review the adequacy of the fire barrier systems being proposed by applicants and to evaluate future fire barrier testing conducted by licensees to demonstrate compliance with existing NRC rules and regulations. The staff will continue to use the acceptance criteria and guidance specified in GL 86-10 to evaluate previous fire barrier test results and system designs. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

VI. Minnesota Mining and Manufacturing Company (3M Company) letter of January 22, 1993, to Ashok C. Thadani, Director, Division of Systems Safety and Analysis (Attachment 6)

COMMENT 1 - Cable Functionality

"3M, working with Underwriters Laboratories, has tried various methods of testing cable and methods for evaluating cable functionality, including oven testing to establish failure points, Meggering before and after fire testing in both air and water, circuit integrity testing under low and high amperage loads during fire testing, and other means. 3M is willing to make this information available to the industry to help develop a functionality test method. The question still exists on proper selection of the cable to be tested should it be artificially aged before testing, as aged cables will function differently than new cables. Cables of the same design, labeled XLPE/PVC, can fail in an oven evaluation test at temperatures as low as 325 °F and as high as 750 °F, even though the cables are thought to be identical. The choice of cable will be crucial to testing cable functionality."

STAFF RESPONSE

The staff agrees that the proper selection of cables is critical for fire tests that use cables in the test specimens or for demonstrating cable functionality for barriers that deviate from the acceptance criteria (discussed below). The staff review guidance specifies that cables used

to demonstrate functionality represent the plant-specific cable configurations to be protected by the fire barrier system.

The Appendix R Rule does not specify functionality criteria for electrical equipment or cables. The intent of Appendix R is to protect the shutdown function from fire damage for a prescribed period of time. Appendix R can be met by separating redundant shutdown components with qualified fire barriers. The staff's view is that the selection of a qualified barrier can be selected independently of the design or nature of the components to be separated. Therefore it is not necessary to specify functionality parameters.

The fire barrier is qualified if the following conditions are met during the fire endurance test:

(1) The internal temperature of the fire barrier system, as measured on the exterior surface of the raceway or component, did not exceed 250 °F above its initial temperature.

(2) A visual inspection of the cables reveals no signs of degraded conditions.

(3) The fire barrier remained intact during the fire exposure and water hose stream tests without developing through barrier openings. Functionality is considered only if the tested fire barrier does not meet (1), (2), or (3) above. In this case a licensee may chose to declare the barrier as deviating from the acceptance criteria and demonstrate cable functionality. Supplement 1 to GL 86-10 specifies that licensees submit all deviations and functionality evaluations to the staff for review and approval.

The staff's position is that Appendix R requirements are satisfied if new cables are used in the fire endurance test specimens and in the event the fire barrier test specimen deviates from the acceptance criteria these cables can be used for performing functionality tests.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

VII. Darchem Engineering, Limited Letter of February 2, 1993, to Ralph Architzel, Chief, Special Projects Section, Plant Systems Branch (Attachment 7)

This letter covered a number of issues, some of which were not directly applicable to the generic letter supplement. From its review, the staff determined that the following were applicable to the staff's review guidance on raceway fire barrier fire endurance test acceptance criteria.

COMMENT 1 - CABLE FILL

"The fire test proposals at present do not indicate the number, size and types of cable to be used in the fire tests apart from the single cable loading."

STAFF RESPONSE

The staff revised Supplement 1 to GL 86-10 to specify that the preferred fire test method is to construct the test specimens without cables. For test specimens that include cables, cable types, and loading (fill) should represent plant-specific cables and loadings.

The staff also revised the proposed review guidance to specify that cable specimens used to demonstrate that functionality represent the installed plant-specific cables and configurations that will be enclosed in the fire barrier system. This additional guidance is provided on page 7 of Enclosure 1 to Supplement 1 of GL 86-10.

COMMENT 2 - Hose Stream Test Method

"The concern is that the new proposals allow for a relaxation in the hose stream criterion by including a Water fog as an option. We believe that the penetrating power that the impact of a solid hose stream imparts to the fire protection system around a raceway will not be reproduced by the water fog. This will mean that fire fighting teams will be restricted in their choice of equipment and methodology for tackling the blaze to penetrating through electrical circuit protection systems that have been qualified against the water fog criteria. It will also mean fire protection systems may not have the ability to withstand even small amounts of falling debris. We therefore recommend the existing solid hose stream test be used without alternative."

STAFF RESPONSE

In responding to Comment I.1, the staff stated the bases for its guidance on hose stream testing.

COMMENT 3 - Combustibility

"The ASTM E136 test method is traditionally used for indicating if a building material will either aid combustion or add appreciable heat to a ambient fire. It is also used for checking insulation materials, in particular calcium silicate which can have a high paper content.

We support the implementation of ASTM E 136 test method as we believe this test provides essential data in assessing the suitability of materials for use in fire protection systems. However the present ASTM E136 standard as it stands excludes coating materials. We would urge that a complete representative section of material including any coating is to be tested."

STAFF RESPONSE

Coatings are addressed by the Standard Review Plan and other NRC fire protection guidance documents which specify flame spread ratings (measured by ASTM E-84, "Surface Burning Characteristics of Building Materials") for materials used in nuclear power plants. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

VIII. Underwriters Laboratories, Inc., Letter of August 19, 1993 (Attachment 8)

COMMENT 1 - Hose Stream Test Methods

"It is our belief a fire test standard should clearly describe a singular reproducible method to measure a performance criteria for a product or system. It is also necessary that consistent results be obtained from the test method specified."

"It is our recommendation, the hose stream test be limited to the method requiring the playpipe nozzle which, as stated in the proposed generic letter, is specified in Standard NFPA 251."

"The elimination of the hose stream methods using a fog fire nozzle currently in proposed Generic Letter 86-10 will result in the Generic Letter containing a uniform, reproducible test method to measure impact resistance. This test method will provide a benchmark performance for impact resistance which has been demonstrated to be obtainable by currently available fire barrier systems."

STAFF RESPONSE

In responding to Comment I.1, the staff stated the bases for its guidance on hose stream testing.

COMMENT 2 - Combustibility

"It is our belief, the data generated from tests conducted in accordance with ASTM E136 and ASTM D1929 will not be sufficient to allow a complete hazard analysis of material and products used as a fire barrier. ....A test that provides both the temperature of the test specimen at ignition as well as the thermal inertia factor is ASTM E1321, Standard Test Method for Determining Material Ignition and Flame Spread Properties. Thus, ASTM E136 and ASTM D1929 should be replaced by ASTM E1321, to obtain a more complete ignitability profile of the test specimen."

"Further, it is our recommendation that ASTM E1354 (Standard Test Method for Heat and Visible Smoke Release Rates for Material and Products Using an Oxygen Consumption Calorimeter) be added to the list of tests to determine the heat release and smoke generation rates at specified heating flux (or fluxes). ....The combination of data from ASTM E1321 and ASTM E1354 tests will enable the quality of the hazard analysis to be greatly improved as compared to the analysis possible with the limited data presently being proposed."

STAFF RESPONSE

ASTM E-136 is one test method for obtaining data for assessing the combustibility hazard of materials installed in nuclear power plants in accordance with existing NRC guidance (see the staff's response to Comment IV.1). The staff agrees that additional tests may be appropriate to fully assess some materials and to allow a complete hazard analysis of material. However, the stated objective of Supplement 1 to GL 86-10 is to refine and clarify the fire barrier testing acceptance criteria specified by GL 86-10. The staff concluded that the existing guidance for combustibility is adequate and therefore did not change its proposed review guidance or acceptance criteria in response to the comments.

COMMENT 3 - Cable Functionality

Underwriters Laboratories stated the differences between the Cable Thermal Exposure Threshold Method expressed in the generic letter supplement and the cable functionality testing methods stated in its outline of investigation, "Fire Tests for Electrical Circuit Protective Systems." UL recommended that provisions for air oven functionality testing of cables be incorporated into the generic letter supplement.

STAFF RESPONSE

The staff agrees with the comment and revised Supplement 1 to GL 86-10 to include a modified air oven functionality test of cables. The staff also concluded that UL Subject 1724 has several points of technical merit as a testing methodology to simulate and monitor the temperature profile within the barrier system.

Appendix B to UL 1724 states that its requirements cover the adjunct investigation of specific electrical cable insulation types for use in... "protective systems..." Safety-related electrical cable systems in nuclear power plants are qualified under existing NRC regulations and industry standards for their unique environment. Although this procedure would provide for the detection of electrical faults and ignition of cables under high temperature conditions, it would not determine whether the insulation resistance of an instrumentation cable has degraded sufficiently to affect its safety related function during a fire. Therefore, Supplement 1 to GL 86-10 includes additional testing methods to evaluate cable insulation degradation and fully assess functionality.

IX. Winston and Strawn letter of August 20, 1993 (Attachment 9)

COMMENT 1 - Backfit

Winston and Strawn contended that Supplement 1 to GL 86-10 should go through the backfit process. They based this claim on the following:

"The NRC has indicated in previous issuances that the fire endurance tests on which many licensees relied to justify installations of Thermo-Lag in its plants may not be adequate. The language of the draft supplement suggests that tests conducted in the future (e.g., the NUMARC fire test program) will be evaluated against the new criteria. The results of such future tests apparently will be used, however, to assure the adequacy of installations and testing performed by numerus licensees in the past. The use of the proposed new criteria to validate existing installations and previous tests would appear to present a backfitting concerns and to require staff performance of a backfitting analysis per section 50.109(a)(3)."

STAFF RESPONSE

Supplement 1 to GL 86-10 clarifies existing fire endurance test guidance specified in GL 86-10. No generic or plant-specific backfitting is intended or approved at this time in connection with issuance of this review guidance. The staff may consider the need for further generic action in that regard, if the industry guidance currently under development for addressing the pertinent fire protection issues is substantively inconsistent with this staff review guidance; however, such action would be separately justified in accordance with the criteria of 10 CFR 50.109 and existing NRC backfit procedures. Similarly, if plant-specific backfits are proposed by the NRC staff consistent with this review guidance, the proposed backfits would be justified on a case basis in accordance with the criteria of 10 CFR 50.109 and existing NRC backfit procedures. Therefore, since the staff will use this review guidance to evaluate future fire barrier testing programs, this change in the staff position is not a backfit.

COMMENT 2 - Radiant Energy Heat Shields

"Both Branch Technical Position CMEB 9.5-1 and Generic Letter 86-10, indicate that a radiant energy shield that may not strictly meet the definition of noncombustible (see Section B.4 of CMEB 9.5-1) is acceptable if it has a fire rating of one-half hour."

STAFF RESPONSE

There is no technical basis for the contention that a radiant energy shield does not have to meet the definition of noncombustible if it has a fire rating of one-half hour.

The Standard Review Plan (Section 9.5.1, "Fire Protection Program," Section B.4) defines a noncombustible material as one which in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. SRP Section C.7.a(1)(b), specifies the separation of cables, equipment and associated nonsafety circuits of redundant trains by a noncombustible radiant energy shield having a minimum fire rating of one-half hour. GL 86-10 (Section 3.7, "Radiant Energy Shield," question 3.7.1, "Fire Rating") states

> "In some cases, where the penetrations were grouped by division, shields were placed between the divisions so that radiant energy from a fire involving the cables of one division would not degrade or ignite the cables of the other divisions. These shields also directed the convective energy from the fire away from the surviving division. These shields were usually constructed of ½-inch marinite board in a metal frame. Appendix R, Section III.G.f refers to these shields as "a noncombustible radiant energy shield. The guidelines in BTP CMEB 9.5-1, Section C.7.a(1)(b), indicate that these shields should have a fire rating of ½-hour. The staff concludes that any material with a ½-hour fire rating should be capable of performing the required function."

Since GL 86-10 listed several examples of noncombustible materials, the staff concluded that this response was focused on the need for the shield to have a fire resistive rating. The response also included the following performance criterion: radiant energy shields direct convective energy away from the object being protected. Clearly, a combustible material would not be capable of performing this function. Since radiant energy heat shields are not considered to be fire rated barrier assemblies, the staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Reference to Appendix R

Winston and Strawn requested deletion of the following quotation from the Appendix R final rule:

> If plant specific conditions preclude the installation of a 3-hour fire barrier to separate the redundant trains a 1-hour fire barrier and automatic fire suppression [and detection] system for each redundant train will be considered the equivalent of a 3-hour barrier.

Winston and Strawn contended that this quotation establishes a hierarchy of the options for protecting safe shutdown capability within the same fire area.

STAFF RESPONSE

In the staff's view, this statement substantiates the basis for establishing the equivalency of the fire protection options specified in Appendix R. However, to clarify the intent of this statement the staff added the following statement to Enclosure A, Section V, of Supplement 1 to GL 86-10:

> Appendix R to 10 CFR Part 50, Section III.G, Fire Protection of Safe Shutdown Capability, provides, what the NRC views as, equivalent means for ensuring that one safe shutdown train is free of fire damage.

X. Letter from William A. Thue, August 17, 1993 (Attachment 10)

COMMENT 1 - Cable Functionality Testing

"These tests must be conducted in a laboratory that has high temperature testing facilities - not a cable laboratory. Any attempt to do both temperature testing and electrical testing while the test is in progress is impractical, unsafe and will not prove nor disprove the validity of the cable condition."

STAFF RESPONSE

The staff's review guidance, as documented in Supplement 1 to GL 86-10 and in its responses to previous comments on cable functionality is that the tests and analyses specified in the supplement are valid for demonstrating cable functionality for deviating barrier conditions. The nuclear power industry and national testing laboratories performed numerous environmental qualification (EQ) tests of cables which involved simultaneous monitoring of electrical parameters (e.g., insulation resistance) under high temperature (e.g., LOCA temperature conditions). The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Use of Conductor Temperature

"For the past 100+ years, cable engineers have used the conductor temperature to predict performance - not the jacket temperature. Some temperature readings must be made with thermocouples on the conductor in the mass. This negates any electrical testing on those runs."

STAFF RESPONSE

Conductor temperature applies to cable qualification testing. However, cable qualification is not the intent of the fire barrier acceptance criteria. The purpose of the cable functionality tests specified in the criteria is to provide performance data to assess deviating conditions if the fire barrier acceptance criteria are not met. Supplement 1 to GL 86-10 does not replace or substitute for cable qualification tests. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Test Procedures

"Electrical tests must be made on cable that has two properly terminated ends. This means that both ends must be outside the fire barrier. The only way to assure their still being good after the fire is to make them as far away as practical from the heat source.

"Many laboratories do not look kindly on having guests in the vicinity of even the cold side during such tests. This forces one to put long enough ends on the cables to reach some satisfactory electrical test position. These long cable ends are now subject to mechanical damage that has nothing to do with the purpose of the test. Additionally the test instrument must be in a cool environment to produce accurate results. Long test leads also result in inaccurate readings."

"To do these electrical tests immediately after the end of the test (presumably just after the hose stream), requires the terminations be clean."

"Any attempt to terminate the cables after the test can lead to misleading results. Mechanical forces that may be needed for terminating procedures could easily mask out the successful passing of the test. This presumes that some degradation of the cable has been noticed that would make an electrical test necessary."

STAFF RESPONSE

The cable functionality tests specified in Supplement 1 to GL 86-10 are typical tests conducted for maintenance in nuclear power plants. Tests recently performed by TU Electric Company for Comanche Peak Steam Electric Station have demonstrated that cable lead length, cleanliness, location of test equipment, and potential for mechanical damage are not technical problems during fire tests conducted in accordance with good engineering and laboratory practices and the acceptance criteria specified in the supplement. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - Megger Tests

"Only modest megger tests should be used if any electrical tests are made after the fire test. High voltage dc tests are presently under careful scrutiny by the Electric Power Research Institute, the Insulated Conductors Committee of the IEEE... It is strongly suggested that dc tests are of a questionable value in meeting the stated objective to provide 'assurance that the cable will withstand the applied voltage during and after the fire..."

"The concern here is not that the cable will fail the test, but that the test will fail the good cable."

"This radical change in electrical monitoring the cable during and/or after these barrier fire tests should not be instigated until a workshop or other agreement of the cable engineering community has been reached. There is considerable personal concern that the cable engineers may not be remotely aware of these proposed changes."

STAFF RESPONSE

The staff's review guidance, as documented in Supplement 1 to GL 86-10 and in its responses to previous comments on cable functionality, is that the tests and analyses specified in the supplement are valid for demonstrating cable functionality for barrier deviations. The cable functionality tests specified in the supplement are typical tests conducted to ascertain the condition of potentially damaged cables in nuclear power plants. The staff does not believe that the tests are a radical change in electrical monitoring. Tests recently performed by TU Electric Company for CPSES Unit 2 demonstrated that the Megger test methods and the application of the test results specified in the supplement are valid for obtaining functionality data needed to assess barrier deviations.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

XI. Ohio Citizens for Responsible Energy, Inc. Letter of August 22, 1993 (Attachment 11)

COMMENT 1 - Combustibility

"The NRC should strictly prohibit the use of fire barrier materials which are combustible. A fire barrier is of little use if it itself burns."

STAFF RESPONSE

In responding to Comment IV.1, the NRC staff stated its position on combustibility relative to Supplement 1 to GL 86-10.

COMMENT 2 - Hose Stream Test Methods

"The proposed criteria would permit the use of fog nozzle test instead of solid hose stream test. This is unacceptable. The solid stream is more severe, and more likely to be used in fighting an actual fire. The fire barrier must withstand the most severe conditions which may be encountered."

"The NFPA 251 acceptance criteria for hose stream tests states that 'The assembly shall be considered to have failed the hose stream test if an opening develops and permits projection of water from the stream beyond the unexposed surface during the hose stream test...' The proposed Generic Letter Supplement appears to weaken this standard by defining failure as 'developing any opening through which the electrical conductor or raceway is visible.' It is plausible for an opening to develop which might not be large enough to permit the visual observation of conductors or the raceway. The proposed standard also replaces an objective test with a subjective one. The presence of water beyond the unexposed surface is easy to ascertain. Whether a conductor of raceway is visible through a small opening depends on the visual acuity of the inspector, whether the inspector uses any magnifying devices, and the inspector, patience, persistence, and attention to detail in detecting and inspecting all openings."

STAFF RESPONSE

In responding to Comment IV.1, the NRC stated the basis for its guidance on hose stream testing.

The staff views the hose stream testing acceptance criteria in its review guidance as having the same objective as the NFPA 251 criteria. Under the NFPA 251 criteria a projection of water has to breach the fire barrier assembly and be projected beyond the unexposed surface of the barrier. In the fire testing industry water weeping through surface cracks on the unexposed surface of the fire barrier assembly is not considered a projection of water beyond the unexposed surface and would not be classified as a failure. Experience with raceway fire barrier hose stream testing has shown that when water does project through the barrier it creates an opening. These barrier openings, when they do occur, have been large enough to allow an inspector to visually identify the raceway or the conductor.

The staff did not change its proposed review guidance or acceptance criteria in response to these comments on hose stream testing.

XII. Tennessee Valley Authority Letter of August 23, 1993 (Attachment 12)

COMMENT 1 - Fire Tests of Empty Enclosures

TVA recommended that the fire endurance testing criteria proposed by supplement to GL 86-10 be expanded to permit fire endurance testing

without cables in the raceway during the fire endurance test and that the internal cable tray or raceway temperature profile, as measured by a bare copper conductor, be used to evaluate the functionality of cables that are going to be enclosed within fire barriers in the plant.

STAFF RESPONSE

The staff agrees with the comment. Testing empty enclosures is conservative in that the fire barrier system is not influenced by the heat sink provided by cables. Therefore, the staff added a flow chart to the test acceptance criteria to address testing fire barrier systems using empty raceway enclosures. The staff also revised Supplement 1 of GL 86-10 to specify a methodology for fire testing raceway fire barrier systems without cables, for air oven cable functionality testing, and for performing engineering analysis using other cable thermal performance data to demonstrate that the cables can function in the temperature environment observed during the fire test if the temperature profile exceeds the fire test temperature rise criterion. The staff also agrees, for those fire barrier systems that exceed the cable tray or raceway barrier surface temperature acceptance criteria, that the internal temperature profile, as determined by the instrumented bare copper conductor, can be used in air oven testing when evaluating the functionality of plant-specific cable.

The staff has incorporated additional guidance into Section V of the fire endurance testing acceptance criteria.

COMMENT 2 - Cable Functionality

"UL Subject 1724, Appendix B, provides a methodology to use the temperature profile obtained from an instrumented bare copper wire to qualify the unique cable sizes and types intended for use in specific fire barrier enclosures. TVA considers that testing in accordance with UL Subject 1724, Appendix B, more accurately demonstrates cable functionality at elevated temperatures than intermittent electrical tests performed on selected cables during or after a fire endurance test. It is also more objective than reliance on a visual inspection for signs of degraded conditions. NRC's criteria should be expanded to permit acceptance of fire barrier enclosures for which internal temperatures rise greater than 139 °C on the basis of successful performance of tests in accordance with UL Subject 1724, Appendix B."

STAFF RESPONSE

The staff agrees with the comment. See the response to Comment VIII.3.

COMMENT 3 - Thermocouples on Cables

TVA commented on the placement of thermocouples on cables that are included in the fire barrier system during the fire test. TVA contends that the licensee should be free to place these thermocouples because the

proposed NRC fire endurance test acceptance criteria state that these thermocouples to be used only for "engineering purposes."

STAFF RESPONSE

The staff agrees with the comment and deleted from Supplement 1 to GL 86-10 the requirement to place thermocouples on test specimen cables.

COMMENT 4 - Construction of Bare Copper Conductor

TVA commented on the size of the bare copper conductor used for measuring internal temperatures of the fire barrier system and recommended that the criteria specify the construction of the bare copper conductor (i.e., solid or stranded).

STAFF RESPONSE

The staff agrees with the comment and revised Supplement 1 to GL 86-10 appropriately.

COMMENT 5 - Internal Raceway Temperature Measurement

TVA recommended that the bare copper conductor be used only for determining the internal raceway temperature profile during the fire endurance test. TVA also recommended that the temperature of the lower external surface of a cable tray be determined by attaching the thermocouples directly to the center of the underside of each cable tray rung.

STAFF RESPONSE

The staff agrees with the comment for test specimens that do not contain cables and revised Supplement 1 to GL 86-10 to incorporate provisions for the use of a bare copper conductor to determine the internal raceway temperature profiles during the fire exposure in such specimens. For those cable tray test specimens containing cables, the method specified in Supplement 1 to GL 86-10 for determining the lower external cable tray surface temperatures has not changed.

COMMENT 6

TVA recommended that the acceptance criteria specify the location of the thermocouples placed on the external surface of conduit.

STAFF RESPONSE

The staff agrees with this comment and revised Supplement 1 to GL 86-10 appropriately. See the staff response to Comment XII.1.

XIII. American Nuclear Insurers (ANI) letter of August 16, 1993 (Attachment 13)

COMMENT 1 - References to ANI Bulletin 5(79)

ANI requested that references to ANI Information Bulletin 5(79), "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits," state that the document is being issued for ANI/MAERP insurance purposes only.

STAFF RESPONSE

The staff agrees with the comment and revised Supplement 1 to GL 86-10 appropriately.

COMMENT 2 - Incorrect Date Reference

ANI found an incorrect ANI document date reference in the proposed supplement to GL 86-10.

STAFF RESPONSE

The staff agrees with the comment and corrected the date of the referenced ANI document.

XIV. Consumers Power Company letter of August 23, 1993 (Attachment 14)

COMMENT 1 - Use of the Term "Fire Barrier"

The proposed supplement interchangeably uses the terms fire barrier and raceway fire barrier throughout the document. This results in confusion as to what is actually being described and discussed. Good definitions are provided for these terms in the definitions section of the supplement. We believe that confusion can be reduced by using the terms consistently.

STAFF RESPONSE

The staff agrees with the comment and revised Supplement 1 to GL 86-10 appropriately.

COMMENT 2 - Thermocouple Placement

"The purpose of a raceway fire barrier is to protect the cables, to keep them free from fire damage, and to ensure its functionality. Thus, to have accurate and realistic data from the cables, thermocouples should be placed on the cables. Placing the thermocouples on the raceway surface is ultraconservative and would not provide accurate data on the exposure to the cables as the raceway itself provides protection to the cables."

STAFF RESPONSE

The staff agrees that the purpose of a raceway fire barrier is to protect the cables, to keep them free from fire damage, and to ensure their functionality. However, the staff concludes that fire barrier qualification is based on demonstrating by a standard fire endurance test that the fire barrier system is capable of limiting temperature rise on the unexposed side of the barrier. The staff stated this position in GL 86-10 which was not changed by Supplement 1 to GL 86-10.

Measuring cable temperatures is not considered a reliable means for determining excessive temperature conditions which may occur at any point along the length of the cable during the fire test. In lieu of measuring the unexposed surface temperature of the fire barrier test specimen, methods which will adequately measure the surface temperature of the raceway (e.g., exterior of the conduit, side rails of cable trays, bottom and top of cable tray surfaces, junction box external surfaces) can be considered as equivalent if the raceway components used to construct the fire test specimen represent plant specific components and configurations. The metal surfaces of the raceway, under fire test conditions, exhibit good thermal conductivity properties. Temperatures measured on these surfaces provide a representative indication of the actual temperature rise on the unexposed surface of the fire barrier material.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

XV. Entergy Operations, Inc. letter of August 20 ,1993 (Attachment 15)

COMMENT 1 - Temperature Conversions

Entergy Operations stated that the temperature conversions, Fahrenheit to Celsius, appear to be incorrect. For example, 250 °F should be 121 °C not 139 °C.

STAFF RESPONSE

The subject temperature conversions are correct because they expressed in terms of a temperature rise, not absolute temperatures. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Types of Barriers Covered by the Acceptance Criteria

Entergy Operations stated that the scope in the purpose section of the proposed supplement to GL 86-10 is unclear and that it encompasses all types of fire tests.

Entergy Operations also stated that the proposed supplement to GL 86-10 contains a discussion about the acceptability of fire doors and fire dampers which have been tested and listed by an approved fire testing laboratory. Entergy Operations recommended that this discussion be expanded to include penetration seal systems, structural steel systems, and fire wall assemblies.

STAFF RESPONSE

Supplement 1 to GL 86-10 does not cover all types of fire tests. The purpose of the supplement is to specify fire test methods and acceptance criteria for qualifying fire barrier systems used to separate safe shutdown components within the same fire area. Section IV of the acceptance criteria specifies fire endurance test methods and criteria for fire barrier walls, floors, ceilings, and equipment enclosures. Section V of the acceptance criteria specifies fire test methods and criteria for raceway fire barrier systems.

The staff discussed fire doors and dampers for purposes of clarification. Including penetration seals, structural steel and listed wall assemblies would not clarify or provide additional guidance to that which exists in current NRC fire protection program guidance documents.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Penetration Seals

"The last paragraph of Section IV should be revised to include ASTM E-814 as a guidance document to be consulted with regard to construction, materials, and thermocouple placement. This is appropriate due to the discussion in the preceding paragraph which references penetration seals."

STAFF RESPONSE

Responding to Comment XV.2, the staff stated that Supplement 1 to GL 86-10 does not address penetration seals. NUREG-0800, Standard Review Plan (SRP), Section 9.5.1, "Fire Protection for Nuclear Power Plants," specifies fire endurance testing acceptance criteria and guidance for penetration seals. (Nationally recognized testing standards, such as ASTM E-814, which establish a equivalent level of fire barrier penetration seal performance, would be reviewed by the staff for acceptability on a case-by-case basis.) The staff considers the SRP criteria for penetration seals adequate. Additional guidance is not needed. Therefore, the staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - Thermocouple Placement

Entergy Operations recommended that a tolerance of ±½ inch be allowed for the installation of thermocouples on test specimens. Entergy Operations also requested further clarification on the placement of the instrumented bare copper thermocouples on the cable trays.

STAFF RESPONSE

The staff included a thermocouple installation tolerance in Supplement 1 to GL 86-10. The staff reviewed the guidance for placement on the instrumented bare copper conductors and concluded that additional clarification was not warranted.

COMMENT 5 - Engineering Thermocouples

Entergy Operations stated that the placement of engineering thermocouples on the cables should be left to the discretion of the licensee or the testing laboratory.

STAFF RESPONSE

The staff agrees with this comment and revised Supplement 1 to GL 86-10 appropriately.

COMMENT 6 - Terminology

Entergy Operations noted that the terms fire barrier and raceway fire barriers are used synonymously. For clarity, Entergy Operations recommended that the term "raceway fire barrier" be used throughout the document.

STAFF RESPONSE

The staff revised Supplement 1 to GL 86-10 to clarify the term "fire barrier."

COMMENT 7 - Incorrect Metric Conversion

Entergy Operations found an improper metric conversion for the 1½-inch fog nozzle.

STAFF RESPONSE

The staff corrected the metric conversion.

COMMENT 8 - Penetration Seals

Entergy Operations recommended that Section VIII reference ASTM E814, "Standard Test Method for Fire Test of Through Penetration Fire Stops."

STAFF RESPONSE

The staff disagrees with the recommendation. See the staff response to Comment XV.2 and Comment XV.3.

COMMENT 9 - Use of Previous Test Results

Entergy Operations requested clarification for the following potential possible situations:

A. A previously approved fire barrier system is removed during a modification and then replaced without change, or with insignificant changes.

B. Although the fire barrier system added as part of a modification has not been previously used at that plant, previously approved tests (conducted before GL 86-10, Supp. 1) for the material and configuration can be obtained from another utility.

STAFF RESPONSE

A. The NRC staff will use fire endurance testing acceptance criteria specified in Supplement 1 to GL 86-10 to review future qualification fire tests for fire barriers used to separate redundant safe shutdown trains within the same fire area. Therefore, the criteria, in and of themselves, do not affect previous NRC approvals. The staff will review the adequacy of previous fire barrier qualification tests against either the conditions of a previous plant-specific NRC approval or the fire barrier guidance provided in GL 86-10. The staff will review specific future situations individually.

B. The licensee is responsible for determining whether or not existing fire barrier qualification tests (regardless of their source) can be used as the basis for installing a particular fire barrier system in a plant. The staff will review adequacy of previous fire barrier qualification tests against either the conditions of a previous plant-specific NRC approval or the fire barrier guidance provided in GL 86-10. The staff will review future situations individually.

VI. Philadelphia Electric Company letter of August 23, 1993 (Attachment 16)

COMMENT 1 - Measurement of Temperature Rise

Philadelphia Electric requested that the temperature rise acceptance criteria be clarified by adding "electrical" and "requiring protection" so that the temperature criteria reads as follows: "The internal temperature of the fire barrier system, as measured on the exterior surface of the electrical raceway or component requiring protection, does not rise more than 139 °C (250 °F) above its initial temperature."

STAFF RESPONSE

The staff's GL 86-10 position is that during the fire endurance qualification test, the transmission of heat through the barrier should be measured on the unexposed side of the fire barrier material. For raceway systems or components which have fire barrier materials directly applied to them, the temperature rise can be measured on the exterior surface of the raceway or component since the raceway or component is in close proximity to the unexposed side of the barrier material. Measurement of the temperature on the exterior surface of other components protected by free standing fire barrier enclosures may not be an acceptable means of assessing the temperature of the unexposed side of the barrier. Supplement 1 to GL 86-10 reflects this position. Therefore, the staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Cable Damage Definition

Philadelphia Electric recommended that "examples of cable degradation are: exposed, degraded, or discolored conductor insulation." Philadelphia Electric stated that cable jackets can sustain damage while the underlying conductor insulation remains damage free, therefore, not adversely affecting the function of the cable.

STAFF RESPONSE

The staff considers cable jacket discoloration to be fire damage. The function of the fire barrier is to maintain the protected component free of fire damage. Therefore, cable jackets that are discolored by heat are not free of fire damage. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Temperature Specification Convention

Philadelphia Electric recommended that the convention used to identify temperature rise be Δ 139 °C (Δ 250 °F) and end point temperature as 121 °C (250 °F).

STAFF RESPONSE

The staff reviewed Supplement 1 to GL 86-10 and found the specified temperatures properly qualified by the text. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - Thermocouple Placement

Philadelphia Electric recommended that the thermocouple placement criterion proposed by NUMARC for the industry test program be used instead of the criterion recommended by in the supplement to GL 86-10.

STAFF RESPONSE

The staff disagrees with the comment. The staff stated the bases for the thermocouple placement criteria in Supplement 1 to GL 86-10 and in the staff responses to Comments III.4, XII.1, XII.3, XII.5, XIV.2, and XVI.1 and Comment XVII.3.

COMMENT 5 - Review of In-Plant Barriers

Philadelphia Electric stated the need for guidance on how the NRC will review installed assemblies not exactly matching tested configurations.

STAFF RESPONSE

The staff issued Supplement 1 to GL 86-10 to guidance for performing future fire test programs. The objective of a fire test program is to prepare and test specimens that bound the sizes and types of raceway configurations installed in the plant. In conducting, the test program the licensee should use fire barrier installation techniques that will be used to construct the in-plant fire barrier systems. Since all possible in-plant fire barrier configurations cannot be tested, the licensee should conduct an engineering evaluation for field conditions that effect the installation of a fire barrier. This engineering evaluation should confirm that the configuration under consideration is within the bounds of the test program. GL 86-10 includes guidance for assessing variations between tested fire barrier configurations and installed configurations.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 6 - Combustibility

Philadelphia Electric requested that the NRC requirements that fire barrier materials used as radiant energy heat shields and to establish combustible free zones be revised to allow deterministic fire modeling to determine whether the material will function as designed.

STAFF RESPONSE

In Supplement 1 to GL 86-10, the staff did not discuss NRC requirements for the radiant energy heat shield, the licensee's practice of enclosing combustibles to create combustible-free zones, and deterministic fire modeling. Therefore, the staff did not change its proposed review guidance or acceptance criteria in response to this comment. For more information on fire barrier combustibility see the staff response to Comment IV.1.

XVII. NUMARC letter of August 23, 1993 (Attachment 17)

COMMENT 1 - Comparison of Supplemental Guidance to Original Guidance

NUMARC stated that the criteria proposed for fire test and cable functionality in the supplement to GL 86-10 are more conservative than those currently specified in GL 86-10. Examples include the following:

"1. The requirements for evaluation of tested configurations with respect to installed configurations; Generic Letter 86-10 required only that continuity of the fire barrier, thickness of the barrier, nature of the support assembly, and end use application be considered. The proposed supplement would require evaluation of materials, workmanship, and details such as dimensions of parts. This will result in the need for many more tests to qualify a given number of diverse configurations than would be the case under the original Generic Letter 86-10 requirements."

"2. The requirements for cable functionality verification would be changed from simple low-voltage continuity testing to much more rigorous testing, including Megger, and hi-pot testing, and consideration of initial cable operating temperature in the cable evaluation process. This process is not only resource intensive in performing the tests, but could also result in disqualification of cable type previously found acceptable for a given time temperature exposure."

STAFF RESPONSE

1. In GL 86-10, the NRC essentially incorporated the National Fire Protection Association (NFPA) Standard 251, "Standard Methods of Fire Tests of Building Construction and Materials," for the staff position for qualification testing of raceway fire barriers. NFPA 251 specifies the evaluation of the workmanship and details such as dimensions of parts. In proposed Supplement 1 to GL 86-10 the staff did not change this position or its guidance in GL 86-10 for evaluating tested configurations with respect to installed configurations to consider the continuity of the fire barrier, the thickness of the barrier, the nature of the support assembly, and the end use application.

2. GL 86-10 did not specify criteria for evaluating cable functionality. In proposed Supplement 1 to GL 86-10, the general fire barrier acceptance criteria guidance established by GL 86-10, were adapted for fire barrier systems used to separate safe shutdown trains within the same fire area. In Supplement 1 to GL 86-10, the staff establishes fire-resistive performance acceptance criteria for raceway fire barrier systems that are equivalent to that required by Chapter 7 of NFPA 251 for non-bearing fire barrier partitions or walls. The need to assess cable functionality is only necessary when the fire barrier system has not adequately performed its

fire-resistive function during the fire endurance test and the licensee proposes to justify the deviating condition. The purpose of the recommended functionality tests is to justify the observed deviations in fire barrier performance.

No generic or plant-specific backfitting is intended or approved at this time in connection with issuance of this review guidance. The staff may consider the need for further generic action in that regard, if the industry guidance currently under development for addressing the pertinent fire protection issues is substantively inconsistent with this staff review guidance; however, such action would be separately justified in accordance with the criteria of 10 CFR 50.109 and existing NRC backfit procedures. Similarly, if plant-specific backfits are proposed by the NRC staff consistent with this review guidance, the proposed backfits would be justified on a case basis in accordance with the criteria of 10 CFR 50.109 and existing NRC backfit procedures. Therefore, since the staff will utilize this review guidance to evaluate future fire barrier testing programs, this change in the staff's position is not a backfit.

COMMENT 2 - Backfit Analysis

NUMARC stated that a backfit analysis should be performed to the requirements of 10 CFR 50.109, to demonstrate that the conservatisms inherent in the other aspects of Appendix R, as they relate to the proposed augmented requirements for fire barrier testing and acceptance. NUMARC requests that this analysis be performed as part of the process of finishing the proposed generic letter supplement, and should not be deferred to later plant-specific applications.

STAFF RESPONSE

The staff addressed backfit analysis in its response to Comment IX.1.

COMMENT 3 - Temperature Criterion

NUMARC believes that the basic premise for the temperature acceptance criteria should relate to cable temperatures, as measured by bare copper conductors in contact with the cables, or on the raceway surfaces in direct contact with the cables, rather than cold side barrier temperatures. NUMARC further contends that the cold side temperature, as originally specified in GL 86-10, is used because the ASTM E-119 Standard is applied to cable raceway testing. Accordingly, NUMARC contends that this standard was not intended for application to cable raceways, but was intended for non-load-bearing walls that may be in direct contact with combustible material.

NUMARC stated that the industry has not reached a consensus on a fire test standard for protecting cable tray raceways. ASTM Subcommittee E5.11 has devoted considerable effort in the past year to write such a standard. NUMARC stated that draft 8 of this proposed standard, provides for the use of the bare conductor to temperatures in cable tray systems

and is consistent with NRC's approach in many respects. This proposed draft of the ASTM standard provides for placement of the lower central copper conductor above the cable tray rungs, consistent with the NUMARC position.

STAFF RESPONSE

The staff agrees that the draft standard proposed by ASTM Subcommittee E5.11, "Standard Test Methods for Fire Tests of Fire Resistive Barrier Systems for Electrical System Components," Draft 13, August 27, 1993, establishes a sound technical basis for assessing the thermal performance of raceway fire barrier systems. This proposed ASTM standard specifies that fire tests of raceway fire barrier systems be performed on test specimens that do not contain cables. This standard calls for an instrumented bare copper conductor inside the raceway to determine the internal temperature rise within the fire barrier system during the fire exposure. (This instrumented bare copper conductor is in addition to the thermocouples on the cable tray side rail surface.) The instrumented copper conductor is installed down the longitudinal center of the cable tray and is attached to the top of the cable tray rungs. Thus, since the test specimen does not include thermal mass (cable fill) to influence the thermal performance of the fire barrier system, the temperature profile measured by the bare copper conductor more accurately reflects the thermal performance of the fire barrier system during the fire test. The staff revised Supplement 1 to GL 86-10 to incorporate a similar test method.

The NRC staff considers this as the preferred test method for qualifying fire barriers to be used for protecting various cable insulation material types. Under this test method, if a fire barrier system without a cable fill passed the thermal and barrier condition criteria, the fire barrier configuration could be applied to similarly designed raceway systems containing any of the various cable types used in the nuclear industry.

COMMENT 4 - Cable Thermocouples

NUMARC stated that the inclusion of cable thermocouples for "engineering information" is not justified.

STAFF RESPONSE

The staff agrees with the comment and revised Supplement 1 to GL 86-10 appropriately.

COMMENT 5 - Combustibility

"The ASTM E-136 method for determining material combustibility is but one method available in defining a material as a "combustible material." In the same vein, the ASTM E-84 test for flame spread is but one method available in defining a material as a flame spread hazard. Both these methods are "pass/fail" standards with the definition of "pass/fail" having only "standard" rather than "specific" relationship to actual

plant conditions. These standards do not allow the licensee the opportunity to evaluate plant-specific situations to determine if there is any actual impact on safe plant shutdown. Consideration of the form in which the material is used and the conditions anticipated in the plant, as provided for in the definition of noncombustible materials contained in Section III, Definitions, of Enclosure 1 to the proposed generic letter supplement, cannot be accomplished with the use of these standards. These issues are better addressed by testing to ASTM E-1321 and E-1354."

STAFF RESPONSE

The NRC staff stated its position on combustibility in its response to Comment IV.1.

COMMENT 6 - Cable Functionality

"....The methods discussed in the NRC proposed approach relate to testing of cables during and after actual fire tests of the specific cables. Given the broad diversity of cable types, sizes, brands, etc., it is impractical to assume that fire tests would be conducted encompassing the cable types in use. A more practical approach is to generate time-temperature (T-t) data from generic testing of protected raceway configurations, and then to apply these results to installed cable types (to the extent that the temperatures are in excess of the 325 °F criterion). The NRC position should allow for this optional approach. There are two ways this approach can be accomplished:

1. Cable air ovens using the T-t curves from the fire test. Underwriters Laboratories (UL) Subject 1724 discusses one method for air oven testing.

2. Comparison of the fire test T-t curve to existing cable performance data, such as data from equipment qualification (EQ) testing. EQ testing is typically performed to rigorous conditions, including rated voltage and current. By correlating the EQ test T-t curve to the fire test T-t curve, the EQ test data would provide a viable mechanism to ensure cable functionality. A large body of EQ test data for many cable types exists today. Use of EQ data thus represents a cost-effective approach to address cable functionality for fire testing for those cases where the 325 °F limit is exceeded."

STAFF RESPONSE

The staff agrees with the comment provided the comparison of fire test temperature profiles to existing EQ and loss-of-coolant accident (LOCA) test results considers the temperature rise due to self heating effects of in-plant power cables. See the staff response to Comment XII.1, and Section III of the attachment to the acceptance criteria.

COMMENT 7 - Initial Cable Operating Temperature

NUMARC repeated its comment on initial cable operating temperature and its effect on the total temperature rise from the NUMARC letter of December 8, 1992.

STAFF RESPONSE

The staff addressed the effects of initial cable operating temperature on cable functionality in its response to Comment III.6.

COMMENT 8 - Insulation Resistance Testing

"The formula for determining minimum acceptable insulation resistance is taken from IEEE 690-1984, section A.10.1, and is intended for use with new cables at room temperature. Testing of cable at elevated temperatures (i.e., immediately following the fire test) to this criteria represents a more restrictive requirement than the cable has to meet when new. The formula should be adjusted to accommodate the elevated cable temperature at the time of testing."

STAFF RESPONSE

Except for the last statement, this comment is identical to Comment 9 of the NUMARC letter of December 8, 1992. The staff stated its response for Comment III.9.

XVIII. Florida Power and Light (FPL) letter of August 23, 1993 (Attachment 18)

COMMENT 1 - Evaluations of Fire Barrier Adequacy

FPL proposed that licensees be allowed to test for cable functionality, and to perform evaluations, in accordance with Interpretation 4 of Generic Letter 86-10, of the adequacy of the fire barrier to protect the redundant safe shutdown equipment and components (cable) from a design basis fire in a particular plant area. The evaluation would then be retained by the licensee for subsequent NRC audits.

STAFF RESPONSE

Unless the licensee has demonstrated by fire test that the fire-resistive performance of a particular cable tray or raceway fire barrier system is acceptable (see GL 86-10, Question 3.2.1, "Acceptance Criteria"), there is no basis for evaluating the adequacy of the fire barrier system against a design basis fire by fire modeling plant-specific conditions. An NRC-approved exemption or deviation is required for fire barriers used to separate safe shutdown functions within the same fire area, where the performance of the barrier system, as determined by an acceptable test meeting the acceptance criteria of GL 86-10 does not meet either the 1-hour or 3-hour fire barrier requirement of Appendix R.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Insulation Resistance Testing

"The proposed supplement discusses cable insulation testing as it relates to engineering analyses that would be performed by the licensee to demonstrate functionality of the protected cable should the cable under test not meet the acceptance criteria under existing regulations. Paragraph C ... states in part that "Insulation resistance (Megger) testing provides an indication of the cable insulation resistance, whe eas the high-potential (Hi-Pot) test provides assurance that the cable has sufficient dielectric strength to withstand the applied rated voltage..."

"The insulation resistance test...does not give an indication of the total dielectric strength of the cable insulation. It may also reveal contamination present on the cable in the form of moisture, dirt or carbonization. (Note, that after the proposed testing the presence of dirt or other contaminations, particularly on the terminations, caused by testing could cause the cable to fail electrical tests leading to an erroneous conclusion that the cable would not have been operable in an actual installation). The applied voltage during insulation resistance testing is generally low (e.g., 500 to 2500 V dc depending on the equipment being tested). Therefore, it has historically been a practice to proof-test medium voltage shielded power cable using high-potential testing."

"It is FPL's position that of the two tests described, only insulation resistance testing would be applicable to testing the functionality of a cable that has not met the acceptance criteria after a test of a fire barrier. (This assumes that the test setup allows for proper and safe performance....) High-potential testing, even at reduced voltage levels, would more than likely fail a cable that would have otherwise passed the test had it been subjected to only operating voltage during the test. Additionally, when examining a fire barrier or the performance of a cable during a test of the fire barrier, it is assumed that the cable will be subject to only the maximum operating voltage."

STAFF RESPONSE

Insulation resistance testing is one of the simplest and least potentially damaging test methods available for assessing cable functionality. It also reveals the least about the state of the insulation. The Megger test is a preliminary "pass-fail" test to confirm the gross insulation condition and the absence of short circuits as a result of fire exposure. The performance of Megger tests before and after the fire test permits a quick assessment whether cable degradation has occurred during the fire test. The subsequent performance of a successful high-potential test provides a more definitive confirmation of insulation soundness. It should be noted that the dc voltage stress is not as rigorous as the ac voltage case. Since the hi-pot tests are done with dc voltage, the recommended industry practice is to perform these tests at a higher voltage than the cable operating voltage. Therefore, FPL argument that the dc test voltage is higher than the cable maximum operating voltage (ac voltage) is not valid as explained above. The staff would consider Hi-Pot tests which are conducted with ac voltage given that the licensee provides sufficient engineering justification. These functionality tests as recommended are only one approach to justify observed deviations to the fire barrier criteria and were not intended to substitute for cable qualification tests. The tests recommended are typical industry tests conducted to ascertain the condition of potentially damaged cables in nuclear power plants. Alternate methods to assess degradation of cable functionality are permissible under Supplement 1 to GL 86-10 and will be individually evaluated by the staff.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - High-Potential Testing

"High-potential (both ac and dc) testing is generally used to detect gross imperfections in the cable insulation, perforations of the insulation, or improper practices/materials used in splicing/terminating the cable. High-potential testing of cables is only recommended for shielded power cables (these are generally cables rated $\geq$ 5000 V); however, based upon tests currently being performed by EPRI on aged cables, it appears that dc high-potential testing may significantly accelerate aging of the cable such that it may no longer be recommended as a test method."

"The proposed supplement....states:

> "In addition, AC or DC high-potential (Hi-Pot) test for power cables greater than 100 volts shall be performed after the post-fire Megger tests to assess the dielectric strength. This test provides assurance that the cable will withstand the applied voltage during and after a fire...."

The high-potential test is inappropriate for this purpose as previously stated under Comment 2. In general, the thickness of insulation on a

power cable is far in excess of that necessary for the normal operating voltage applied to the cable. Mechanical strength of the insulation (e.g., that necessary to withstand handling during installation and termination) is the overriding consideration for determining the thickness."

"For example, based upon Table B1 in AEIC Stds CS6-87 and CS5-87, the minimum average insulation thickness for an 8 kV rated cable, 1000 kcmil or less would be 115-140 mils for ethylene propylene rubber (EPR), thermoplastic, or crosslinked polyethylene (XLPE). Each of these insulating materials has a dielectric strength of at least 400 V/mil (based upon ASTM Std D 149). Using these numbers, the dielectric strength of the cable insulation based solely upon its minimum average thickness would range from 46- to 56-kV. It is this level of insulation that the high-potential test is designed to detect failure in, rather than whether the cable would withstand its operating voltage (i.e., the intent of the testing to be conducted under the proposed supplement).

STAFF RESPONSE

As noted by FPL, "it has historically been a practice to proof-test medium voltage shielded power cable using high-potential testing." In the case of medium power cables only, the staff believes that a Megger test which is subsequently followed by a Hi-Pot test would both detect any circuit degradation and confirm the current carrying capability of the cable to ensure that the fire exposure did not cause a loss of function. The statement made for conducting Hi-Pot test for power cables greater than 1000 volts is intended for cable system rated at 5 KV and above, such as 4.16 KV, 6.9 KV, etc. In nuclear power plants, the electrical insulation systems above 600 V, usually comprise of 5 KV and above. The proposed tests for assessing cable damage are only recommended for those cables used in the fire endurance test (i.e. test specimens) and not for testing installed cables in nuclear power plants. Therefore accelerated aging of installed cables in nuclear power plants due to Hi-Pot testing is not a relevant concern. The functionality tests recommended represent but one approach to justify observed deviations to the fire barrier criteria and are not intended to substitute for cable qualification tests. The tests recommended are also typical tests conducted to ascertain the condition of potentially damaged cables in nuclear power plants. Alternate methods to assess degradation of cable functionality are permissible under Supplement 1 to GL 86-10 and will be evaluated individually by the staff.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 4 - Cable Functionality Testing

"The proposed supplement in paragraph c. presents a table of cable type, operating voltage and tests (including test voltages). ....The proposed supplement states 'The table below summarizes the Megger and Hi-Pot test

voltages which, when applied to power, control and instrumentation cables, would constitute an acceptable cable functionality test.'"

"FPL disagrees with both the table and statement. For the reasons discussed in other comments, high-potential testing of the cables should not be performed. In addition, recommending such tests for non-shielded power cable (i.e., <1000 V ac) is contrary to all industry standards, even for newly installed cable. The use of a high-potential test for cables that have already sustained some damage during the fire barrier test to evaluate whether or not they would have been functional would be inappropriate."

"Additionally, the test voltage for the insulation resistance measurements are too high. For example, the three industry standards that describe this testing for newly installed cable at generating stations and substations are IEEE Std. 422-1986, IEEE Std. 690-1984 and IEEE 525-1992. Each of these standards recommend that insulation resistance tests for low-voltage power and control cable be at a minimum of 500 V dc. Recommendations vary on the need for insulation resistance test instrumentation. For example, IEEE 690-1984, Appendix A, clause A10.1 (4) states 'Insulation resistance measurements should be performed on instrumentation cables if circuit performance is dependent upon level of insulation resistance. Cable manufacturers' recommendations should always be considered.' If manufacturing standards are considered, both NEMA Std WC 7-1988 (ICEA S-66-524), and NEMA Std WC 8-1988 (ICEA S-68-516) recommend a test voltage of 100 to 500 V dc for insulation resistance testing of new cable at the factory."

"FPL proposes the following test voltages for insulation resistance testing for various cables tested (additionally, it is proposed that no testing be performed during the fire test unless it can be demonstrated that this testing can be done safely):

Cable Type	Operating Voltage	Megger test Voltage
Power Cable	≥1000 V ac	2500 V dc
	1000 V ac	1000 V dc
	600 V ac	500 V dc
	≤ 300 V dc	500 V dc
Control Cable	≤ 240 V ac	500 V dc
	≤ 300 V dc	500 V dc
Instrumentation* Cable		300 V dc

* If the instrumentation cable's circuit performance is not dependent upon the level of insulation resistance, the ANS circuit integrity shall be used as the acceptance criteria."

STAFF RESPONSE

The staff disagrees with the comment and the proposed test voltages for insulation resistance testing for various cables. The proposed cable functionality test is based on the industry practice of performing installation and in situ maintenance insulation resistance tests for power cables. For example, the 600 V class cable is insulated for 600 V RMS or a peak voltage value of 852 V (1.42 x 600 V). Further, it should be recognized that the dc voltage is not as stressful as the ac voltage stress. In order to simulate an equivalent level of dc voltage stress as the ac voltage would impose on the cable insulation in normal service, the industry standards and manufacturers recommend that dc test voltages should be at least 2 to 3 times the nominal operating voltage. The purpose of these functionality tests is to search out for potential damage in the cable that could prevent it from performing its function during and after a fire exposure. The test voltage values used for assessing cable functionality have to be sufficiently high to reveal the damage in the cable that may have occurred from the fire exposure which is not apparent with lower test voltages. For high-voltage power cables (i.e. above 1000v) test voltages used for insulation resistance are not high enough to reveal cable degradation. Therefore, a high-voltage potential test is recommended for high-voltage power cables. The intent of this test is to establish that the fire exposure did not result in a significant degradation of the cable insulation.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 5 - Test Procedures

"The high temperatures in the vicinity of the fire test chamber requires that the ends of the cables under test be long enough to enable them to be in a satisfactory location for electrical testing (i.e., an area cool enough for the test instruments and the test personnel). These longer cable ends may be subjected to mechanical damage, e.g., as the cable under test is moved about, which may alter test results due to damage unrelated to the specific purpose of the test. Additionally the use of test instrument in a high ambient temperature environment will affect the accuracy of the measurements taken as will the alternate of using long test leads..."

"Ideally, all terminations for the cable under test should be made before the fire test, however, due to the specific configuration of the test assembly this may not be possible. If the cable terminations are made after the test, this may lead to misleading results. Movement of the tested cable to enable proper termination can subject it to mechanical forces that could damage the cable, causing it to fail."

STAFF RESPONSE

The NRC staff addressed these issues for Comment X.3.

COMMENT 6 - Sequence of Tests

"In paragraph c, the fourth paragraph discusses the need to 'immediately' Megger test all cables. Performance of the Megger test takes time, thus adding to the 1 or 3 hour testing time since the test assembly would remain in the oven at or near test temperature (the assembly and cable would see 1+ or 3+ hours of elevated temperatures). The additional time, at temperature, could cause a test failure. If high-potential testing as described in the proposed supplement, is also performed in the 'oven' then the time of temperature exposure of the test assembly would be further increased. If the electrical cable testing is to be performed, it is more logical to complete the fire test, perform the hose stream test, then, if necessary, perform any electrical cable testing."

STAFF RESPONSE

With the exception of instrumentation or special application cables where circuit performance is sensitive to changes in insulation resistance, the test sequence recommended by the commenter (fire test, hose stream test, electrical cable testing), is essentially the same as that currently specified in Supplement 1 to GL 86-10. Recent fire endurance tests performed by TU Electric for CPSES validated this approach. In responding to Comment II.5, the staff stated the bases for its guidance on testing instrumentation or special application cables.

COMMENT 7 - Proposed Electrical Tests

"The proposed electrical tests used to determine functionality if the test cable fails to meet acceptance criteria are new to the industry and should be reviewed for feasibility and personal safety implications. This process should include appropriate industry review (e.g., cable manufactures, IEEE, AEIC, ICEA, etc.).

RESPONSE

The tests specified in Supplement 1 to GL 86-10 are typical tests conducted to ascertain the condition of potentially damaged cables in nuclear power plants. The tests are only new as a test methodology to enable applicants to provide engineering justification that observed deviations from the fire barrier acceptance criteria will not affect the functionality of planned cable applications. The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

XIX. Arizona Public Service Company (APS) letter of August 23, 1993 (Attachment 19)

COMMENT 1 - Application of Test Acceptance Criteria

APS requested that the supplement state that the acceptance criteria are forward looking and do not result in the need for retesting or analysis of fire barriers previously evaluated and found acceptable by licensees

in accordance with GL 86-10, unless they have been formally identified by the NRC as indeterminate.

STAFF RESPONSE

The staff addressed the application of the acceptance criteria in its response to Comment V.7.

COMMENT 2 - Acceptance Criteria Conservatism

APS stated that conservatism should not be added to standard fire endurance test acceptance criteria for fire barrier systems that are traditionally used in industrial applications. When considering the defense-in-depth approach used in the nuclear power fire protection program compliance, additional conservatism beyond that already inherent in fire barrier qualification would have a compounding effect and is not necessary.

STAFF RESPONSE

The staff agrees that conservatism should not be added to standard fire endurance test acceptance criteria for fire barrier systems that are traditionally used in industrial applications. For this reason, the staff, in GL 86-10, specified the acceptance criteria of NFPA 251, "Standard Methods of Fire Tests of Building Construction and Materials," as being applicable to cable wrap fire barrier systems. This position is not changed by Supplement 1 to GL 86-10.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Cable Discoloration

APS contends that cable discoloration is appropriate as a specific example of thermal cable degradation.

STAFF RESPONSE

In responding to Comment XVI.2, the staff stated the bases for its position on cable discoloration.

COMMENT 4 - Thermocouple Placement

APS stated that the overall purpose of the raceway fire protection is to ensure functionality of the protected cables during (and after) the fire exposure. In addition, they stated that the copper conductor should be routed above the rungs of the cable tray where the cables are routed.

STAFF RESPONSE

The staff agrees that the thermocouple instrumented bare copper conductor should be routed above the rungs of a cable tray when it is tested without cables (empty).

Testing empty enclosures is conservative in that the fire barrier system is not influenced by the heat sink provided by cables. The staff also revised Supplement 1 of GL 86-10 to specify a methodology for fire testing raceway fire barrier systems without cables, for air oven cable functionality testing, and for performing engineering analysis using other cable thermal performance data to demonstrate that the cables can function in the temperature environment observed during the fire test if the temperature profile exceeds the fire test temperature rise criterion. The staff also agrees, for those fire barrier systems that exceed the cable tray or raceway barrier surface temperature acceptance criteria, that the internal temperature profile, as determined by the instrumented bare copper conductor, can be used in air oven testing when evaluating the functionality of plant-specific cable.

The bases for the thermocouple placement criteria specified in Supplement 1 to GL 86-10 are found in the staff responses to Comments III.4, XII.1, XII.3, XII.5, XIV.2, and XVI.1 and XVII.3.

COMMENT 5 - Thermocouples on Cables

APS stated that the installation of thermocouples on test specimen cables is not justified and that individual cable temperature measurements should be optional.

STAFF RESPONSE

The staff agrees with this comment and revised Supplement 1 to GL 86-10 appropriately.

COMMENT 6 - Removal of Compensatory Measures

Section V of the proposed generic letter discusses the need for an engineering evaluation to demonstrate functionality in the event that temperature limits are exceeded, or visual damage is observed to the cables. This evaluation will require NRC approval. APS stated that the utilities forthcoming efforts to address installed Thermo-Lag configurations could result in submittal of large numbers of such evaluations and corresponding delays in the NRC approval cycle. APS believes the process for NRC review and approval, as outlined in the proposed supplement to GL 86-10, should allow for the removal of existing utility compensatory measures following completion of the engineering analysis and any associated modifications to the barrier system. APS also states that the guidance of GL 86-10 provides that utilities could document these types of analyses for subsequent NRC review during inspections.

STAFF RESPONSE

The purpose of these fire barrier systems is to provide assurance that the protected safe shutdown function is free of fire damage. Cable functionality is dependent on the chemical composition of the cable insulation and the jacket, and its function. The staff concluded that the placement of thermocouples as specified in Supplement 1 to GL 86-10, the temperature data obtained from these thermocouples during the test fire exposure, and observations of barrier condition following the fire exposure and hose stream tests, will provide sufficient data to allow judgments to be made regarding fire barrier performance and the condition of the cables during the fire exposure. Cables installed in these barrier systems that exhibit signs of damage are not free of fire damage and therefore, the fire barrier system did not perform its required fire-resistive function. An engineering evaluation which demonstrates the functionality of fire damaged cables is considered to be a technical basis for establishing the equivalency in fire safety of the tested configuration to the level of fire safety which is provided by a qualified fire barrier system. The staff considers these conditions to deviate from NRC fire protection requirements and therefore, require NRC approval. The purpose of the recommended functionality tests is to justify observed deviations in fire barrier performance. Engineering analyses justifying these deviations should not rely substantially upon the equipment (e.g., cable) qualification as the basis for acceptance.

The licensee is responsible to make operability determinations. Therefore, before receiving NRC approval, a licensee can declare the barriers operable and remove the compensatory measures. Operability determinations should be based on the engineering evaluations that demonstrate that the barriers are operable and that any needed barrier modifications, have been completed. However, if the staff finds the licensee's operability evaluation unacceptable, they may be subject to enforcement actions.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 7 - Configurations to be Tested

APS noted that several test specimens will be required to qualify various sizes and runs of cable trays and conduits, junctions boxes, and other components. The APS position is that the construction techniques and methods should be consistent with the tested configuration. The critical parameters of the physical characteristics of installation should be the basis for accepting and qualifying various configurations, and not necessarily the exact size of raceway that was fire tested. APS contends that the tests performed by TU and TVA showed the failure mode for a fire barrier configuration larger than an enclosure for small diameter conduits is structural. Therefore, the use of critical parameters of the physical characteristics of the installation should govern the acceptance, regardless of raceway size.

STAFF RESPONSE

Full-scale fire endurance tests observed by the staff indicate that the conditions of fire barrier failure are linked to the size of the raceway and the structural ability of the fire barrier system. Small cable tray and raceway fire barrier systems have the tendency to exceed the thermal performance criterion, while wide cable trays fail structurally. Therefore, raceway size is a critical test specimen parameter. The staff included additional information on bounding configurations in its response to Comment XVI.5.

COMMENT 8 - Combustibility

APS recommends that the generic letter allow fire modeling techniques to determine if fire barrier materials are combustible in the form which they are used and under the conditions anticipated.

STAFF RESPONSE

In responding to Comment IV.1, the NRC staff stated its position on combustibility. NUMARC, as part of the industry effort to resolve the technical concerns with Thermo-Lag fire barriers, is evaluating issues associated with the combustibility of Thermo-Lag materials. These issues include the use of Thermo-Lag fire barriers to establish combustible free zones between redundant safe shutdown trains and to construct radiant energy heat shields inside containment. NUMARC informed the staff that it was conducting additional tests to assess the combustibility of Thermo-Lag and is developing a methodology for reviewing plant-specific Thermo-Lag applications in a manner that will be consistent with the NRC combustibility definitions. The NRC staff will review the NUMARC methodology. The staff will issue additional information on these issues, which are being addressed independently of the establishment of fire endurance test acceptance criteria, as appropriate.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 9 - Initial Cable Operating Temperature

APS agrees that cable normal operating temperature is a consideration in the engineering evaluation. However, initial operating temperature is only a consideration for power cables, or control and instrument cables that may be in the same enclosure with power cables. Power cables will not be subjected to rated voltage and current before the fire exposure, and may only be intermittently energized, if at all, before the fire exposure. The effect of initial temperature on endpoint temperature is not a simple function of adding the difference between the initial temperature and ambient air temperature to the measured temperature rise.

STAFF RESPONSE

The staff addressed the effects of initial cable operating temperature on cable functionality in its response to Comment III.6.

COMMENT 10 - Cable Functionality

APS recommends that the proposed NRC criteria be revised to state that comparison of fire test temperature profiles to existing emergency qualification (EQ) and LOCA test results, or air oven test results, is an acceptable approach to demonstrate cable functionality.

STAFF RESPONSE

The staff agrees with the comment. The staff addressed the use of EQ and LOCA test data in its response to Comment III.1.

XX. Iowa Electric Light and Power Company letter of August 27, 1993 (Attachment 20)

COMMENT 1 - Appendix R Deviations

"We believe that the staff should provide additional review guidance that specifies the margin of safety or acceptance criteria that is required for determining the adequacy or acceptability of deviations from the requirements of Appendix R, i.e., if the fire barrier will only meet the required acceptance criteria (1) and (3) for a period of time less than that the required 1- or 3-hour barrier ratings. This guidance should specifically address barrier protection in relation to combustible loading and, as an alternative, in terms of its affect on core damage frequency."

STAFF RESPONSE

The objective of Supplement 1 to GL 86-10 is to provide acceptance criteria for conducting and evaluating fire endurance tests. Except for cable functionality evaluations, guidance for assessing fire barriers that deviate from the requirements of Appendix R is outside the scope of the supplement.

Without a fire test which demonstrates the fire-resistive performance of a particular cable tray or raceway fire barrier system (see GL 86-10, Question 3.2.1, "Acceptance Criteria"), there is no valid technical basis for evaluating the performance of the fire barrier against plant-specific conditions or fire hazards. An exemption or deviation is required for those fire barriers used to separate safe shutdown functions within the same fire area, where the performance of the barrier system has been established by a valid fire endurance test (meeting the acceptance criteria of GL 86-10), but it does not meet either the 1-hour or 3-hour fire-resistive requirement of Appendix R. The staff would base its approval of exemptions and deviations requests on technical evaluations

that demonstrate that the level of fire safety provided for the area of concern is equivalent in performance to that required by either the regulations or a plant-specific license condition.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

XXI. Southern Nuclear Operating Company letter of August 23, 1993 (Attachment 21)

COMMENT 1 - Fire Barrier Evaluations

"We recommend the following changes to the acceptance criteria:

"... For those barriers which are not capable of performing their intended function, a deviation based on demonstrating that the functionality of thermally degraded cable was maintained and that these cables would have adequately performed its intended function during and after a postulated fire exposure may be granted..."

to read "... For those barriers which are not capable of performing its intended function, an engineering evaluation which demonstrates that the functionality of the thermally degraded cables was maintained and that these cables would have adequately performed its intended function during and after a postulated fire exposure shall be performed by the licensee and maintained for inspection with the plant records for review..."

STAFF RESPONSE

The staff disagrees with the comment. The staff addressed evaluations of in-plant fire barriers and the need for NRC approval of deviations and exemptions in its responses to Comments III.2, XVIII.1, and XX.2.

COMMENT 2 - Hose Stream Test

"the basis for the requirement for hose stream testing ... appears to be more applicable to the testing of penetration seals and fire zone barriers rather than one hour or three hour cable tray wrap. Since the integrity of the barrier is not required to protect the cable from the effects of a fire hose stream, and the barrier has already served its delaying function at a time when a hose stream might be applied in combatting the fire, it is recommended that the criteria for cable wrap fire barrier testing be revised to delete references to hose stream testing."

STAFF RESPONSE

The staff disagrees with the comment. Hose stream testing is important because fire fighting activities could cause limited structural challenges to the fire barrier. The rational for performing the hose stream test at the end of the fire exposure is that if a barrier can withstand the forces imposed by the hose stream at the fire exposure end

point, then it would be structurally resistant to fire-fighting activities at any time before the end of the fire exposure.

In responding to Comment I.1 on Page 1, the NRC staff stated the bases for its guidance on hose stream testing. The staff did not change its proposed review guidance or acceptance criteria in response to the comment.

XXII. Georgia Power Company letter of August 23, 1993 (Attachment 22)

The comments submitted by Georgia Power Company were the same as those submitted by Southern Nuclear Operating Company (see comment Section XXI).

XXIII. Darchem Engineering, Ltd letter of September 13, 1993 (Attachment 23)

COMMENT 1 - Hose Stream Test Methods

Darchem restated its comments on hose stream testing from its letter of February 2, 1993 (see Section VII).

STAFF RESPONSE

In responding to Comment I.1, the NRC staff stated the bases for its guidance on hose stream testing.

COMMENT 2 - Combustibility

"The language used to identify ASTM E-136 as a method for determination of combustibility merely indicates the possible use of this test method rather than proscribing its use. Again, the reference to ASTM D-3286 or NFPA 259 merely suggests its potential use as one means of determining heat release of the fire protection materials."

"Put alongside the mandatory requirements of ASTM D1929 and ASTM E84, it would appear not only that the specific combustibility and heat release tests referenced, but also the test categories themselves, are not mandatory. We would suggest a change to indicate a requirement for such testing, referencing ASTM E136 and ASTM D3286 or NFPA 259, or equivalents as necessary requirements."

STAFF RESPONSE

The test methods and criteria specified in Supplement 1 to GL 86-10 are guidance, not NRC requirements. The staff considers the guidance as an approach for demonstrating compliance with NRC fire protection requirements. In Supplement 1 to GL 86-10 the staff recommends ASTM E-136 as a test method for demonstrating if a material is combustible. Licensees may use this test method or propose alternatives to the staff which they consider equivalent.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Toxicity

"We also request consideration of maximum allowable levels of toxic substances such as cyanide, CFCs, etc."

STAFF RESPONSE

Nuclear power plants contain numerous materials that can burn and, therefore, release combustion products (e.g., cable insulations, charcoal filters, plastics, paper, wood, lube and transformer oils). The staff recognizes that all combustion products are toxic to varying degrees. In-plant fire brigades are trained and equipped to fight fires in the hazardous environments created during fires and to control and mitigate smoke during fire fighting. However, NRC requirements do not place limits on the toxicity of the combustion products of in-plant materials. The establishment of such limits is outside the scope of Supplement 1 to GL 86-10, which is intended to refine and clarify NRC staff guidance and acceptance criteria for fire endurance tests. Moreover, any toxicity criteria would have to be applied to all in-plant materials since fire barriers are not unique in having combustion products that are toxic.

XXIV. Alleger letter of April 16, 1993

COMMENT 1 - Hose Stream Test Methods

"You claim the fog gives you more water 375 gallons verses the solid stream 210 gallons. What a misconception-The old "Industry Standard" ANI 1979 called for 2½ minutes of solid stream and 2½ minutes of fog - solid stream being preferred. This is 187.5 gallons for fog and 525 gallons of water (solid stream) for virtually all tests as a safety margin"

STAFF RESPONSE

The supplement need not specify that a specific quantity of water be delivered to the test specimen. The staff does not consider the quantity of water applied as a basis for the hose stream test. In responding to Comment I.1, the NRC staff stated the bases for its position on hose stream testing.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

XXV. Alleger letter of June 24, 1993

COMMENT 1 - Cold Side Temperature Criterion

"The reason the NRC proposed fire endurance criteria is that the Industry used primarily the ANI bulletin #5(79) and the ANI criteria allowed the internal temperature of the envelope to exceed 325 F required by the NRC

on the cold side of the system. The NRC requirement now is determined to be on the cold side of the barrier ASTM E-119, yet prior to 1992 there was no definition of this as you allowed and accepted the ANI "Not to Exceed 325 F on the cables inside the envelope." Now your staff is changing the cold side to the tray side similar to ANI."

STAFF RESPONSE

In GL 86-10 of April 24, 1986, the staff reaffirmed that its acceptance criteria for raceway fire barriers was based on NFPA 251, "Standard Methods of Fire Tests of Building Construction and Materials." A fundamental NFPA criterion, and therefore, a staff criterion, for qualifying a fire barrier is that the unexposed side temperature of the fire barrier did not rise more than 250 °F above the ambient temperature at the start of the fire endurance test. (The end point temperature limit is commonly referred to as 325 °F, based an initial ambient air temperature of 75 °F.) Although additional guidance for empty cable trays and raceway has been included in the proposed review guidance, the temperature rise criterion has not changed by Supplement 1 to GL 86-10.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Barrier Condition Following the Test

"You state 'the ANI method does not require the barrier to remain intact during the fire and hose stream test. Yet the ANI bulletin you reference to specifically states acceptance criteria to ASTM E-119 which your proposed definition states the barrier remains intact and does not allow projection of water beyond the unexposed surface."

STAFF RESPONSE

The staff reviewed ANI Bulletin 5(79) and found that it does not reference NFPA 251 and that its only reference to ASTM E-119 is "the protective envelope shall be exposed to the standard temperature-time curve found in ASTM E-119-76." ANI Bulletin 5(79) does not invoke or rely on any other part of ASTM E-119, including the ASTM E-119 acceptance criteria. The staff also found that ANI Bulletin 5(79) does not require that the fire barrier remain intact during the fire and hose stream tests. The staff criteria of Supplement 1 to GL 86-10 do specify that the fire barrier remain intact during the fire and hose stream tests.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Cable Degradation

"ANI allowed the degradation of the cables yet the ANI required the same 325 F maximum temperature on the cables every foot. It would seem to me that the criteria assumed that any maintaining of the 325 F wouldn't degrade the cables."

STAFF RESPONSE

The staff reviewed ANI Bulletin 5(79) and did not find an acceptance criterion based on cable temperatures. It appears that ANI did allow cable degradation since the ANI acceptance criteria are based on maintaining cable circuit integrity at low voltage. The staff did not change its proposed staff position or acceptance criteria in response to this comment.

XXVI. Alleger letter of June 25, 1993

COMMENT 1 - Cable Temperature Versus Fire Barrier Temperature

"The difference is ANI measured temperature on the cables not the barrier material, your staff proposes to now measure on the external surface of the raceway. ANI's method which has been used by all manufactures for years measures the temperature the cables will actually see-you want to measure the raceway. This change appears that it has been done wrong in the past but your making it appear that the raceway verses the past is a great deal better-not so. If cable on a curve touches the barrier material the cable could be much hotter than the raceway if those cables are 16 gauge polyethylene and could fail before the raceway temperature reaches it's maximum."

STAFF RESPONSE

The staff agrees that cables in intimate contact with the unexposed side of a fire barrier are most vulnerable to damage during a fire. To minimize this vulnerability, while maintaining previously established GL 86-10 temperature rise criteria, the acceptance criteria are based on the temperatures of the unexposed side of the fire barrier material itself. The purpose of protecting cables within a fire barrier system is to minimize the maximum temperature the cables will experience. Under the conditions of acceptance specified in Supplement 1 to GL 86-10, the thermal performance of a fire barrier is judged by measuring the temperature on the unexposed side of the fire barrier material itself. If the average temperature of the unexposed side of the fire barrier is maintained below the limit established by the criteria (250 °F above the initial temperatures at the start of the test) the cables within the fire barrier system will be exposed to temperatures less than that of the unexposed fire barrier surface. If the acceptance criteria were based on measuring the temperatures of the cables instead of the unexposed side of the fire barrier, the likelihood of thermally damaging cables in contact with the fire barrier material is greatly increased.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 2 - Hose Stream Test Damage

"What you neglect to say in your proposed criteria is that the previous criteria always had "no passage of water through the barrier" which

obviously would ensure against the "no visible signs of conductor or raceway."

STAFF RESPONSE

The staff agrees that the acceptance criteria in GL 86-10 for hose stream testing are the same as those specified in Supplement 1 to GL 86-10. The staff added the performance criterion of "no visible signs of conductor or raceway" was added to clarify previous GL 86-10 acceptance criteria.

The staff did not change its proposed review guidance or acceptance criteria in response to this comment.

COMMENT 3 - Combustibility

"The product was supposed to have a non-combustible feature as the others have. ANI.... required non-combustible-you found the product to have the combustibility of "treated pine boards" you now say there isn't a requirement for non-combustible they only need to include in the "combustible loading factor"

STAFF RESPONSE

In responding to Comment IV.1, the NRC staff stated its position on combustibility of fire barriers.

The staff reviewed ANI Bulletin 5(79) and found that it specifies that fire barriers should be noncombustible. ANI gave an example of noncombustible as having a flame spread of 25 or less. The staff's opinion is that flame spread is only one property of combustibility.

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