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POLICY ISSUE
(Notation Vote)

SECY-94-127

May 12, 1994

FOR: The Commissioners
FROM: James M. Taylor
Executive Director for Operations
SUBJECT: OPTIONS FOR RESOLVING THE THERMO-LAG FIRE BARRIER ISSUES
PURPOSE:

To inform the Commission of the options and the U.S. Nuclear Regulatory Commission (NRC) staff plans for resolving the Thermo-Lag fire barrier technical issues.

SUMMARY:

To resolve the fire endurance issues associated with the Thermo-Lag fire barriers, the staff is developing the following four options (1) require compliance with existing NRC fire barrier requirements and grant limited exemptions where technically justified, (2) develop guidance for rating fire barriers on the basis of a range of combustible loadings for fire endurance tests, (3) work with a lead plant to develop a performance-based approach for resolving the issues, and (4) continue to develop a performance-based fire protection rule.

There are actions that licensees can implement to resolve inoperable Thermo-Lag fire barriers. These include (1) replacing Thermo-Lag fire barriers with qualified fire barriers, (2) upgrading existing Thermo-Lag fire barriers, (3) reevaluating circuits and components protected by Thermo-Lag fire barriers to determine if they are needed for safe shutdown, (4) rerouting cables or relocating components to eliminate the need for barriers, (5) reevaluating licensing commitments that may exceed regulatory requirements, (6) requesting exemptions, or (7) some combination of the preceding actions. The licensee costs to implement such corrective actions vary based upon amounts of Thermo-Lag fire barriers. For example, during a recent meeting Florida Power and Light (FPL) estimated that it would cost a total of \$10,000,000 to upgrade the Thermo-Lag fire barriers to meet the fire

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protection regulation at all four of its plants. The total number of operating units that have yet to resolve the Thermo-Lag issues has been reduced from 83 to 59. The staff is providing a detailed accounting and specific information on the completed and planned actions in a separate status paper.

Compensatory measure for degraded or inoperable fire barriers are specified in individual facility licenses and NRC-approved fire protection programs. Because these compensatory actions have been implemented for inoperable Thermo-Lag fire barriers, an adequate level of fire safety exists. The policy issue is not the current level of fire safety, rather it is the potentially long duration of compensatory measures which were not envisioned when such measures were approved. However, the staff does not believe a basis exists for immediately effective orders to require restoration of inoperable Thermo-Lag fire barriers. The staff will continue to monitor the resolution of the Thermo-Lag issues on a plant-by-plant basis to ensure that inoperable fire barriers are restored on a schedule that is consistent with the complexity of the plant-specific issues and the amounts of Thermo-Lag installed at the plant.

DISCUSSION:

In April 1992, the NRR review team concluded in its final report that Thermo-Lag fire barriers may not provide the levels of fire resistance required by NRC regulations. Since that time, the staff has (1) implemented an action plan to address the issues; (2) issued a number of generic communications (for example, Bulletin 92-01 and its supplement, which informed the licensees of failed Texas Utilities Electric Company (TU Electric) fire tests; Generic Letter (GL) 92-08 which identified specific concerns with Thermo-Lag fire barriers; and GL 86-10, Supplement 1, which provided fire endurance test acceptance criteria; (3) witnessed and reviewed industry fire tests (TU Electric, Tennessee Valley Authority, Nuclear Energy Institute); (4) conducted small-scale fire tests at the National Institute of Standards and Technology and full-scale tests at Underwriters Laboratories; (5) provided regulatory oversight of the industry test program and the development of application guidance; (6) issued (December 1993) a request for additional information in accordance with 10 CFR 50.54(f) to each licensee relying on the NEI test program to gain insights on the configurations and amounts of Thermo-Lag fire barriers installed and how licensees plan to resolve the technical issues; and (7) met with FPL and discussed its proposed performance-based approach for resolving the Thermo-Lag issues at the Turkey Point and St. Lucie facilities.

On October 29, 1993, the NRC staff briefed the Commission on the status of the Thermo-Lag fire barrier issues. During the briefing, the Commission expressed concerns that industry efforts to resolve the issues through a test program

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might not lead to timely resolution of the issues. The Commission requested that the staff consider alternatives to the current program in the event the present course of action did not lead to a solution in a reasonable amount of time. The staff reassessed its course of action and, at that time, concluded that the current course was its most viable one. This called for the Nuclear Energy Institute (NEI, formerly the Nuclear Management and Resources Council) to complete the industry test program and guidance for applying the test results and for the licensees to implement plant-specific resolution plans for configurations particular to its plants.

The plan was based on the assumption that generic Thermo-Lag-based upgrades could be developed and applied to bring existing barriers into compliance with NRC fire protection requirements. However, on the basis of the results of the full-scale fire endurance tests conducted by the staff and industry, the staff has concluded that baseline 3-hour Thermo-Lag barriers provide only about 1 hour of fire resistance and cannot be reasonably upgraded using additional Thermo-Lag materials to achieve a 3-hour fire rating. Conversely, the staff has concluded that 1-hour Thermo-Lag fire barriers can be upgraded with additional Thermo-Lag materials to achieve a nominal 1-hour fire resistance rating. The staff also determined that some licensees were not sensitive to the importance of timely resolution of the concerns and appeared to be placing too much emphasis on the NEI program. These factors contributed to delays in achieving a final solution.

To focus attention on these weaknesses, the staff increased senior managerial involvement in resolving issues with NEI and issued a request for additional information (RAI) in accordance with 10 CFR 50.54(f) to each licensee that uses Thermo-Lag fire barriers. In the RAI, the staff requested information on (1) barrier configurations, (2) important parameters, (3) Thermo-Lag fire barriers outside the scope of the NEI program, (4) ampacity derating, (5) alternatives for resolving the issues and (6) schedules.

Provided in a separate Commission paper, "Status of Thermo-Lag Fire Barriers," are: the detailed status of staff and industry efforts to resolve the Thermo-Lag issues, including licensees that have resolved the issues; fire test results, staff assessments of the RAI responses; and the use of performance-oriented approaches. The staff has reassessed the Thermo-Lag Action Plan and the options available to resolve the outstanding issues. The four options considered by the staff are summarized below.

OPTION 1 REQUIRE COMPLIANCE WITH EXISTING NRC FIRE BARRIER REQUIREMENTS

The fundamental objective of the Thermo-Lag Action Plan is to return the plants with Thermo-Lag fire barriers to compliance with existing NRC fire protection requirements. With respect to these fire barriers, the NRC

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requirements can be summarized as follows: When redundant trains of systems needed to achieve and maintain shutdown conditions are located in the same fire area, the requirements can be met by separating the redundant trains by a fire barrier having a 3-hour fire rating or by enclosing one of the redundant trains in a fire barrier having a 1-hour rating and installing fire detectors and an automatic fire suppression system in that area.

On the basis of the results of fire endurance tests conducted by the staff and industry, the staff has concluded that 1-hour conduit and cable tray Thermo-Lag fire barriers can be upgraded by reinforcing the joints and seams with additional Thermo-Lag stress skin and trowel-grade fire barrier materials to achieve a nominal 1-hour fire resistance rating. The test results also suggest that baseline 3-hour conduit and cable tray fire barriers cannot be reasonably upgraded using additional Thermo-Lag materials to achieve a 3-hour fire rating. Baseline 3-hour conduit and cable tray Thermo-Lag barriers, however, provide only about 1 hour of fire resistance. Several conduit and cable tray fire barrier vendors are developing upgrades for these 3-hour Thermo-Lag barriers that will be tested to the standard-time temperature curve. Thermo-Lag configurations other than conduits and cable trays may require additional generic or plant-specific testing to assess performance and the need for upgrades.

Although industry has not submitted generic 1-hour upgrades for staff review, the staff believes, on the basis of the test results, that generic upgrades can be developed for conduit and cable tray barriers. Such upgrades would consist of additional thicknesses of Thermo-Lag material and joint reinforcements. Licensees could apply the generic upgrades to 1-hour barriers to achieve compliance with existing NRC fire protection requirements. Licensees could pursue the following actions to return the 3-hour barriers to compliance: (1) reevaluate components protected by 3-hour barriers to determine if they are truly needed to achieve shutdown—such analyses could reduce the population of barriers needed to meet NRC requirements—(2) relocate safe shutdown components to eliminate the need for barriers, (3) qualify 3-hour barriers as 1-hour barriers and install automatic suppression and detection systems in the areas, (4) replace 3-hour Thermo-Lag barriers with a qualified 3-hour fire barrier, (5) perform plant-specific fire endurance tests to develop plant-specific barrier upgrades, (6) expand the industry test program to develop generic upgrades, (7) request limited plant-specific exemptions to the current fire barrier regulation, or (8) some combination of these actions.

This option could be implemented through a bulletin or generic letter. The staff would consider limited plant-specific exemptions on a case-by-case basis provided the licensee submits a technical basis that demonstrates that the in-plant condition or configuration provides an adequate level of fire safety. This approach is allowed by the regulations and is consistent with past staff practice. For example, on the basis of recent fire test results, a licensee

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may choose to reclassify a 3-hour barrier to a 1-hour barrier and install fire detectors and a fire suppression system in the fire area. If the fire suppression system is an automatic system, the licensee will have achieved compliance with the fire protection regulation. However, if inadvertent actuation of an automatic system could have a negative safety impact, the staff may exempt the licensee from the requirement for an automatic system and approve the installation of a manually actuated system. If a number of licensees request similar exemptions, such as the use of manually actuated fixed suppression systems rather than automatic systems, the staff will consider revising the fire protection regulation to allow implementation of the common configuration. The staff will inform the Commission if any areas for a revision to the regulations become known.

On the basis of its experience with Comanche Peak, the staff believes that 1-hour barrier upgrades could be implemented across the board within two to three years, depending on the extent of the barriers per plant and refueling cycles. With respect to the 3-hour barriers, one or more of the eight aforementioned alternatives could be implemented in two to five years depending on the amount of Thermo-Lag material installed in a plant and the combination of alternative actions implemented.

Although the staff believes that compliance with the existing regulation is desirable, it recognizes that compliance will present challenges, specifically for 3-hour Thermo-Lag fire barriers. In addition, upgrading 1-hour barriers, upgrading or replacing 3-hour barriers, relocating shutdown components, and installing automatic fire suppression systems will be costly and could be difficult to achieve in some plant areas. The cost of such corrective actions are potentially large and would likely exceed the long-term cost of compensatory actions.

As documented in the Thermo-Lag Action Plan, NRC resources are planned to implement this option.

OPTION 2 DEVELOP GUIDANCE FOR RATING FIRE BARRIERS BASED UPON A RANGE OF COMBUSTIBLE LOADINGS FOR FIRE ENDURANCE TESTS

The severity of the standard time-temperature fire (American Society for Testing and Materials Standard E-119), which is used to qualify fire barriers, exceeds the severity of the fires that can be expected in some nuclear power plant (NPP) areas. Therefore, fire barriers tested in accordance with the ASTM E-119 time-temperature fire may, in some cases, be over qualified for postulated realistic (design basis) fires. One approach for resolving the Thermo-Lag fire endurance issues would be to develop an NRC Regulatory Guide for qualifying Thermo-Lag fire barriers on the basis of realistic fire hazards (plus margin) found in representative plant areas, e.g., high, medium, and low fire loadings and hazards. The staff expects that three standard NPP time-

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temperature fires will bound the range of fire hazards. This option has features in common with Option 3. The development of standard NPP fire severity curves that are tailored to representative plant hazards is performance-based. However, requiring the use of such curves instead of the ASTM curve is still prescriptive. Once approved, the NRC guidance could be applied to existing Thermo-Lag fire barriers in accordance with the Regulatory Guide without the need for rulemaking or exemptions.

Under this option, the staff would provide guidance for the industry to use to develop and propose the new standard NPP fire severity curves as they apply to Thermo-Lag fire barriers. The staff believes that industry could develop the necessary time-temperature curves in about one year. The staff would closely monitor industry activities and independently verify the new fire severity curves proposed by industry. The schedule will be controlled by the processes and time needed to prepare generic communications, the time required to collect and assess plant-specific data, and the time needed to validate the new curves. Additional plant-specific and generic fire endurance tests of existing conduit and cable tray Thermo-Lag fire barrier designs may be needed to qualify them to the new standard NPP time-temperature fires. Furthermore, when evaluated against these curves Thermo-Lag fire barrier modifications may still be needed.

In view of the complexity of this option and the staff and industry resources that will be needed for its development and implementation, the staff will evaluate its technical feasibility and develop resource estimates and implementation schedules, before implementing this option. The staff will provide the results of its evaluation to the Commission within 6 months.

OPTION 3 DEVELOP A PERFORMANCE-BASED APPROACH

In response to the request for additional information issued in accordance with 10 CFR 50.54(f), the licensees for 21 plants stated that they intend to justify existing Thermo-Lag fire barriers by applying performance-based approaches. If approved by the Commission, the staff will work with a lead plant, rather than a number of plants, to develop a generic performance-based approach for resolving the Thermo-Lag issues. The staff would incorporate the generic approach into the new fire protection regulation (Option 4) for implementation by other plants. This will accommodate licensee proposals to use performance-based approaches and, with the exception of the lead plant, will eliminate the need for large numbers of exemptions.

Unlike the prescriptive barrier requirements specified in the NRC fire protection regulation (Option 1), performance-based approaches use fire modeling and probabilistic risk and safety assessment techniques to determine the fire protection features, such as fire barrier endurance, needed to protect the safe shutdown capability. On the basis of recent fire tests, the staff expects that most baseline 1-hour Thermo-Lag fire barriers will provide

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between 20 and 30 minutes of fire resistance and that most baseline 3-hour barriers will provide about 1 hour of fire resistance. Using a performance-oriented approach that is based on actual plant fire hazards (plus margin), the staff expects that these performance levels can be shown to be adequate for many existing plant configurations. In these cases, licensees could permanently reclassify the fire ratings of Thermo-Lag fire barriers below that required by the current regulation. For example, where a 1-hour rated barrier is installed, a 30-minute barrier may be adequate to satisfy the safety objective. Under the current regulation, the performance-based methodology and the results of its application would be the technical basis for exemptions. If the staff accepts a number of plant-specific performance based approaches or applies a generic approach without rulemaking, a large number of exemptions would be needed across industry. Note that performance-based approaches will also identify areas where existing Thermo-Lag barriers should be upgraded or other fire protection features should be provided, such as sprinklers, to ensure an adequate level of fire safety.

By letter of April 29, 1994, FPL submitted a plant-specific, performance-based approach that it proposes to use to resolve the Thermo-Lag fire barrier issue at the Turkey Point and St. Lucie facilities. This approach includes a traditional fire hazard evaluation based on combustible loading (the screening methodology), a fire growth assessment using a FPL-developed fire model, and a confirmatory risk assessment using a plant-specific PSA. FPL proposes to assess the adequacy of existing Thermo-Lag fire barriers by evaluating plant fire loads and their calculated fire severities and equating the severities against the ASTM E-119 standard time-temperature curve. Technically, the FPL submittal is not fully developed. In addition, during two meetings with the staff, FPL representatives stated that FPL does not want to assume the lead for developing a generic performance-based approach for resolving the Thermo-Lag issues.

In the staff's view, systematic and open consideration of the various elements of the performance-based approaches that depart from the current regulation—such as defining safety margins and developing fire modeling techniques—within the framework of the lead plant concept and rulemaking can ensure a technically sound approach that can be objectively implemented by all affected licensees. It could also be inspected and enforced against by the staff. Therefore, if approved by the Commission, the staff will identify a lead plant from the set of plants that proposed to use a performance-based approach and will work with the licensee of the lead plant to develop a generically-applicable performance-based approach for resolving the Thermo-Lag issues. The staff will develop the approach with the intention of incorporating the results of the work into the new performance-oriented, risk-based fire protection rule (Option 4).

The policy issues here are whether performance-based approaches can be used to identify solutions to the Thermo-Lag fire barrier issues and, if so, whether

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performance-based solutions should be approved for a number of plants under the exemption process or for the lead plant only with rulemaking for the other plants. By developing a generic approach with a lead plant and incorporating the approach into the new fire protection regulations, the need for exemptions will be eliminated. The approach described here will ensure public participation in a significant change in the methods used to determine the levels of nuclear power plant fire protection.

In view of the resources involved, the policy issue related to the use of performance-based approaches to resolve the Thermo-Lag issues through rulemaking, and the policy issue related to granting broad exemptions from the current regulation, the staff is requesting Commission guidance before proceeding further with this option. If the Commission approves, the staff will select a lead plant and will outline a plan for implementing this option, with milestones and resource estimates. If this option is approved, the staff will report back to the Commission 6 months after the selection of the lead plant.

OPTION 4 DEVELOP A PERFORMANCE-BASED FIRE PROTECTION RULE

In SECY-94-090, "Institutionalization of Continuing Program for Regulatory Improvement," of March 31, 1994, the staff provided the plan of action and framework for developing a performance-oriented and risk-based fire protection regulation through rule making. This rule making initiative, which is also identified in the Fire Protection Task Action Plan, stemmed from the periodic review of regulations and elimination of requirements marginal to safety (see SECY-92-263 of July 24, 1992). Although this rule making was not precipitated in any way by the Thermo-Lag issues, the rule making process would include reevaluation of the Appendix R fire barrier requirements. Therefore, the rule making could help resolve the Thermo-Lag issues. SECY-94-090 calls for the final rule to be issued by August 1996. Currently, the staff is awaiting industry's petition for rule making. The staff proposes to provide its technical evaluation of the NEI proposal 6 months after receipt of the petition.

STAFF-RECOMMENDED APPROACH:

1. The staff recommends continuation of Option 1 consistent with the Thermo-Lag Action Plan. If the Commission approves this option, the staff will advise the industry of the Commission position and request continued industry efforts to implement the option.
2. If acceptable to the Commission, the staff will evaluate the technical feasibility and resource estimates for Option 2 and will report back to the Commission in 6 months. If the staff determines that it is feasible to develop standard nuclear power plant time-temperature curves, the use

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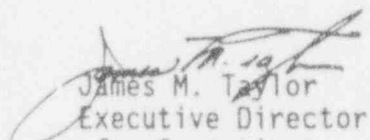
of such curves will provide the licensees with another method for achieving compliance under Option 1.

3. The staff will not proceed further with Option 3, unless the Commission approves the performance-based approach. If this option is selected, the Commission should indicate whether the staff should proceed with rulemaking or follow the existing exemption process.
4. The staff will continue to be receptive to the performance-oriented, risk-based rulemaking described in SECY-94-090. The staff will provide its comments on the technical merits of the NEI petition for rulemaking 6 months after receipt of the petition.

Options 2 and 3 are new work that was not planned in either the Thermo-Lag Action Plan or the Fire Protection Task Action Plan. This work will be resource intensive and, therefore, could impact other ongoing or planned activities. The staff will inform the Commission if resource limitations adversely impact work on the options discussed in this paper or any critical action plan activities.

COORDINATION:

The Office of the General Counsel reviewed these options and has no legal objection.


James M. Taylor
Executive Director
for Operations

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Friday, May 27, 1994.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Friday, May 20, 1994, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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