August 30, 1995

Mr. Richard F. Phares
Director - Licensing
Clinton Power Station
P. O. Box 678
Mail Code V920
Clinton, IL 61727

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SUBJECT: RESPONSE TO THE FOLLOW-UP TO THE REQUEST FOR ADDITIONAL INFORMATION REGARDING GENERIC LETTER 92-08 AND LICENSEE SAFETY EVALUATIONS OF THERMO-LAG BARRIERS (TAC NOS. M85535 AND M91822)

Dear Mr. Phares:

The staff has reviewed your submittals of December 16, 1994 (U-602383) and March 28, 1995 (U-602435) regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers." These submittals were made in response to previous requests for additional information by the staff. In addition, the staff has reviewed your submittal of March 16, 1995 (U-602425) which included safety evaluations performed pursuant to 10 CFR 50.59. These evaluations were used in determining the acceptability of certain Thermo-Lag installations.

Based on our review, the staff has determined that insufficient technical justification has been provided to determine their acceptability. The results of the staff's review and the additional information necessary to complete our review are discussed in the attached. You are requested to submit this information within 60 days following receipt of this letter.

This request for information affects nine or fewer respondents and, therefore, is not subject to the Office of Management and Budget review under Public Law 96-511.

Sincerely,
ORIGINAL SIGNED BY:

Douglas V. Pickett, Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-461

Attachment: As stated

cc: See next page
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 30, 1995

Mr. Richard F. Phares
Director - Licensing
Clinton Power Station
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cc: See next page

Mr. Richard F. Phares
Illinois Power Company

Clinton Power Station
Unit No. 1

cc:

Mr. J. G. Cook
Vice President
Clinton Power Station
Post Office Box 678
Clinton, Illinois 61727

Mr. J. A. Miller
Manager Nuclear Station
Engineering Department
Clinton Power Station
Post Office Box 678
Clinton, Illinois 61727

Resident Inspector
U.S. Nuclear Regulatory Commission
RR#3, Box 229 A
Clinton, Illinois 61727

Mr. R. T. Hill
Licensing Services Manager
General Electric Company
175 Curtner Avenue, M/C 481
San Jose, California 95125

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, Illinois 60532-4351

Chairman of DeWitt County
c/o County Clerk's Office
DeWitt County Courthouse
Clinton, Illinois 61727

Mr. Robert Neumann
Office of Public Counsel
State of Illinois Center
100 W. Randolph, Suite 11-300
Chicago, Illinois 60601

Mr. J. W. Blattner
Project Manager
Sargent & Lundy Engineers
55 East Monroe Street
Chicago, Illinois 60603

Illinois Department
of Nuclear Safety
Office of Nuclear Facility Safety
1035 Outer Park Drive
Springfield, Illinois 62704

ATTACHMENT

CLINTON POWER STATION
DOCKET NO. 50-461
FOLLOWUP TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING GENERIC LETTER 92-08 "THERMO-LAG FIRE BARRIERS"
AND
LICENSEE SAFETY EVALUATIONS OF THERMO-LAG INSTALLATIONS

1.0 September 19, 1994, Request for Additional Information

In the response dated December 16, 1994, Illinois Power (IP), the licensee stated that the unknown parameters would not be evaluated for Thermo-Lag barriers that are eliminated or are determined to be acceptable as-is. Section II of the RAI, dated December 21, 1993, requested that the licensee provide information regarding the important parameters for each Thermo-Lag barrier installed in the plant, and the licensee's methodology for the evaluation of barriers whose important parameters are not known or have not been verified. Please provide the information requested in Section II of the RAI for Thermo-Lag barriers that were determined to be acceptable as-is.

The licensee's response to Section III. "Thermo-Lag Barriers Outside the Scope of the NUMARC Program" is acceptable.

2.0 December 28, 1994, Request for Additional Information

In the response dated March 28, 1995, IP stated that it does not consider it necessary to verify: (1) material thickness, (2) material weight and density, (3) the presence of voids cracks and delaminations, (4) fire endurance, (5) combustibility and flame spread, (6) mechanical properties, and (7) important installation parameters. This determination was based on the original purchase specifications for Thermo-Lag installed at the Clinton Power Station (CPS), the installation contractors quality assurance program, installation procedures, walkdown inspections, and the licensee's safety evaluations. In the December 28, 1994, RAI the staff stated licensees must have valid information on the specific Thermo-Lag materials installed at its plant and that some of the installation parameters cannot be verified by walkdowns or by comparing as built barriers with installation records or procedures. The licensee is requested to provide the information requested in the December 28, 1994 RAI.

The response concerning chemical testing of Thermo-Lag materials at CPS is acceptable.

3.0 Licensee Safety Evaluations

For five of the six fire zones analyzed by the licensee (Zone A-1a, Zone C-2, Zone CB-1e, Zone CB-1f and Zone D-8), the following six common justifications regarding the defense-in-depth features provided at the plant were specified: (1) Due to administrative controls and the physical design of the fire zone it is not credible to postulate a fire capable of affecting safe shutdown cables,

(2) Fire modeling has shown that fixed and transient combustibles present no credible risk of damage to safe shutdown cables, (3) Fire damage to both redundant trains is not credible due to the location of the cable trays, (4) Thermo-Lag will protect the safe shutdown cables until fire extinguishment is achieved by the plant fire brigade, (5) The probabilistic risk assessment did not identify any safety benefit, with regard to core damage, containment isolation, containment heat removal or containment hydrogen control, from the installed Thermo-Lag, and (6) In the event that both redundant trains of safe shutdown equipment are damaged by fire, operator training and the actuation of the plants emergency response organization will ensure plant safety. Please provide a response with a technical basis for each of the following staff comments and questions (3.1 through 3.15).

3.1 Administrative Controls

These justifications do not form an adequate basis for concluding that these six existing Thermo-Lag installations at CPS are acceptable as-is. Administrative controls, which are an important part of the plants overall fire protection program to minimize fire hazards, are not sufficient to ensure that a fire, that effects the plants ability to achieve and maintain safe shutdown, will not occur. Industry experience has demonstrated that a reportable fire occurs in most plant areas at a frequency of 10^{-3} to 10^{-2} per year. The licensee did not specify why the administrative controls and physical design of the fire zones at CPS are significantly superior to those at other nuclear power plants, to justify its conclusion. Therefore, the staff believes that it is credible to postulate a fire capable of affecting safe shutdown components at CPS.

3.2 Fire Modeling

The staff believes that the uncertainties associated with the use of fire modeling, due to the lack of experimental validation of the models for typical nuclear power plant compartments, and the lack of adequate data on the fire performance of components susceptible to fire damage typically present in a plant, make it unreasonable to conclude, based solely on the results of a fire model, that there is no credible risk of damage to redundant safe shutdown components at CPS. The staff specified the technical information to be addressed in engineering evaluations used to demonstrate that existing fire barriers are adequate to ensure safe shutdown capability in the letter to the licensee dated September 19, 1994. The licensee's evaluation does not fully address the specified variables and attributes to be included in a fire hazard analysis.

3.3 Separation Criteria

The separation criteria specified in Section III.G of Appendix R to 10 CFR Part 50, was based on industry fire experience and experimental data. Specific details on the origin of the separation criteria was provided by the staff in NUREG-0050, "Recommendations Related to Browns Ferry Fire," dated February 1976, and in the final rulemaking (45 FR 76602) regarding the fire protection program for operating nuclear power plants. The licensee's evaluations, that concluded that fire damage to both redundant trains is not

credible due to the location of cable trays, did not consider this information. An adequate technical basis for the licensee's conclusion that the location of the cable trays will prevent damage to cables of redundant divisions has not been provided.

3.4 Barrier Worth

The determination that the existing Thermo-Lag will protect the required circuit until extinguishment can be achieved by the plant fire brigade has not been technically justified. The licensee has determined that the 1 hour Thermo-Lag barriers at CPS have a fire endurance rating of 28 or 46 minutes and the 3-hour Thermo-Lag barriers have a fire endurance rating of 85 minutes, based on the "NEI Application Guide for Evaluation of Thermo-Lag Barriers" and tests conducted by Sandia National Laboratories for the NRC. The staff position on the use of generic test data to qualify plant specific applications was provided to IP in a letter dated December 28, 1994. The staff also stated that based on its inspections of Thermo-Lag barriers and industry experience finding installation defects during destructive examinations, that some installation parameters cannot be verified by walkdowns or a review of installation records and procedures. In its response, dated March 28, 1995, the licensee stated that it does not intend to conduct any further verification of the installation parameters. To conclude that the 1- and 3-hour Thermo-Lag fire barriers installed at Clinton have a fire endurance rating of 28/46 and 85 minutes respectively, the licensee must have valid and verifiable information on each of the important material properties and installation parameters. Hose stream testing of Thermo-Lag barriers was not addressed in the licensee's evaluations

3.5 Fire Brigade

The assumption that the fire brigade responds within 12 minutes and is able to extinguish a fire within 28 minutes has not been justified by the licensee. Response times of the brigade recorded during fire drills may not be representative of the actual time for the fire brigade to achieve fire extinguishment. Industry experience, as documented in Licensee Event Reports, has demonstrated that actual time to achieve extinguishment of reportable fires significantly exceeds the recorded response times during drills.

3.6 Cable Damageability

The assumptions used by the licensee that IEEE 383 cables have a failure temperature of 700 °F and an ignition temperature greater than 900 °F is not technically supported. The temperature threshold for cable damage of IEEE 383 cables reported by Sandia National Laboratory in NUREG/CR-5546 ranged from 617 °F to 689 °F. Sandia also concluded that the temperature threshold for piloted ignition is less than the temperature threshold reported for cable damage.

3.7 Fire Initiating Event Frequency

The assumptions used by the licensee in calculating the fire initiating event frequencies used in the probabilistic risk assessment is not technically supported. No technical basis is provided for excluding cables, junction boxes and pumps of 5 horsepower or less as potential ignition sources.

3.8 Probabilistic Risk Assessment

The licensee's use of a probabilistic risk assessment to determine the benefit provided by the installed fire barrier to protect equipment required to achieve and maintain safe shutdown is not technically justified. The assessment assumes that fire damage causes a failure of all components regardless of fire barrier protection and the effect on core damage protection, containment isolation, containment heat removal and hydrogen control. The staff's position regarding the limiting safety consequences, required shutdown functions, performance goals, and equipment generally necessary for shutdown, are specified in Generic Letter 81-12, "Fire Protection Rule," dated February 20, 1981. If the Thermo-Lag installed in a fire area is not required to meet NRC requirements, the licensee should revise its analysis accordingly.

3.9 Operator Actions

Reliance solely on operator actions and the plants emergency response organization to ensure plant safety in the event that both divisions of redundant safe shutdown equipment is disabled is not in accordance with the defense-in-depth concept specified by the NRC for fire protection programs. The objectives of the fire protection program are: (1) prevent fires from starting, (2) rapidly detect, control and extinguish fires that do occur, and (3) provide protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished will not prevent the safe shutdown of the plant. In order to meet the third objective, one train of systems necessary to achieve and maintain safe shutdown conditions must be free of fire damage. The staff concludes that although operator training and the activation of the plants emergency response organization are important elements of the program to ensure plant safety, these elements are not unique to CPS, and are not considered adequate by themselves to meet this requirement.

3.10 Fire Zone A-1a

Several conclusions stated by the licensee in the detailed justification for the deviation in this area are not technically supported. For example, the licensee stated that since the cable trays are all located a minimum of 14 feet above the floor and there are no vertical floor to ceiling cable runs, it is not credible to postulate cable damage due to a fire originating at the floor. This conclusion is not correct. It appears that the analysis only considers flame impingement as a credible initiator of cable damage, the licensee has not considered the rapid rise in temperatures in the plume generated by a floor level fire, the high temperatures expected in the ceiling jet and descending hot gas layer and the radiant energy transfer from these

sources to the target cables, as sufficient to damage the cables. No basis has been provided to exclude these sources as potential initiators of cable damage.

The licensee also concluded that a hot gas layer cannot be formed due to the unvented construction of electrical panels, use of conduit for cables not in trays, large distances between ignition sources and targets, and the use of IEEE 383 qualified cable. These considerations have little effect on the potential for the formation of a hot gas layer. Typical factors that affect the formation of the hot gas layer are the heat release rate of the fuel, fuel surface area, the compartment geometry and the compartment ventilation. Provide an analysis that considers all relevant factors in the formation of a hot gas layer.

3.11 Fire Zone C-2

In this fire zone the licensee has improperly applied the guidance contained in Appendix A to the Branch Technical Position Section F.10. Section F.10 relates to the separation of diesel fuel oil storage buildings from buildings containing safety related equipment. Fire zone C-2 is the containment building outside of the drywell. This section of the BTP is not applicable to this Thermo-Lag configuration. The separation criteria for fire areas inside containment outside of the drywell is specified in Section III.G.2 of Appendix R to 10 CFR 50. Provide an analysis that properly applies the criteria contained in Appendix R.

The licensee has improperly classified the Thermo-Lag in this fire zone as a noncombustible material. In Information Notice 95-27, "NRC Review of Nuclear Energy Institute, Thermo-Lag 330-1 Combustibility Evaluation Methodology Plant Screening Guide," May 31, 1995, the staff informed industry that the NEI methodology for evaluating Thermo-Lag combustibility does not provide a level of safety equivalent to that specified by existing NRC requirements and that the NRC staff would not accept the use of the NEI guide to justify the use of Thermo-Lag where noncombustible materials are specified by existing NRC fire protection requirements or to assess the combustibility of Thermo-Lag materials. The methodology used by IP in their safety evaluation is similar to the NEI guidance. In addition Information Notice 92-82, "Results of Thermo-Lag 330-1 Combustibility Testing," the staff provided the results of combustibility testing performed by the National Institute of Standards and Technology, which determined that Thermo-Lag 330-1 is a combustible material.

3.12 Fire Zone CB-1e

Conclusions stated by the licensee in the detailed justification for the deviation in this area are not technically supported. For example, the licensee stated that cable trays are all located high in this fire zone, therefore it is not credible to postulate cable damage from a fire at the floor level. This conclusion is not correct. It appears that the analysis only considers flame impingement as a credible initiator of cable damage, the licensee has not considered the rapid rise in temperatures in the plume generated by a floor level fire, the high temperatures expected in the descending hot gas layer and the radiant energy transfer from these sources to

the target cables, as sufficient to damage the cables. No basis has been provided to exclude these sources as potential initiators of cable damage. Provide the technical basis for excluding these sources for cable damage.

The licensee also concluded that a hot gas layer cannot be formed due to the use of conduit for cables not in trays, large distances between ignition sources and targets, and the use of IEEE 383 qualified cable. These considerations have little if any effect on the potential for the formation of a hot gas layer. The factors that affect the formation of the hot gas layer are the heat release rate of the fuel, fuel surface area, the compartment geometry and the compartment ventilation. Provide an analysis that considers all relevant factors in the formation of a hot gas layer.

3.13 Fire Zone CB-1f

In this fire zone the licensee concluded that based on fire modeling there is no credible risk to safe shutdown equipment from either fixed or transient combustibles. The staff believes that the uncertainties associated with the use of fire modeling, due to the lack of experimental validation of the models for typical nuclear power plant compartments, and the lack of adequate data on the fire performance of components susceptible to fire damage typically present in a plant, make it unreasonable to conclude, based solely on the results of a fire model, that there is no credible risk of damage to redundant safe shutdown components from fixed and transient combustibles. Provide the detailed validation and verification of the fire model used in this analysis.

The licensee has concluded that based on the NEI Application Guide for Thermo-Lag Fire Barrier Systems that the Thermo-Lag installed in this area has a fire endurance of 85 minutes. Provide the detailed analysis that the Thermo-Lag barriers installed in this are qualified to an equivalent fire rating of 85 minutes including hose stream testing.

3.14 Fire Zone D-8

The licensee has concluded that based on the NEI Application Guide for Thermo-Lag Fire Barrier Systems that the Thermo-Lag installed in this area has a fire endurance of 46 minutes. Provide the detailed analysis that the Thermo-Lag barriers installed in this are qualified to an equivalent fire rating of 46 minutes including hose stream testing.

3.15 Fire Zone F-1p

No comments.